Relationship between entrepreneurial finance and success of High Tech Young Entrepreneurial Firms: the role of funding structure and governance characteristics

The Claude Littner Business School

Relationship between Entrepreneurial Finance and Success of High Tech Young Entrepreneurial Firms: The Role of Funding Structure and Governance Characteristics

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Abstract

High Tech Young Entrepreneurial Firms (HTYEFs) are widely recognised as critical drivers of economic growth and technological advancement. They rely substantially on external equity financing, yet there are gaps in the understanding of how to structure such funding to optimise value creation and innovation outcomes. This thesis presents a quantitative empirical investigation of how external equity funding patterns and resulting governance structures have influenced performance and innovation outcomes in HTYEFs in the UK. Integrating agency theory and signalling theory, this study asks two research questions, using a bespoke governance architecture framework to explore how governance dimensions driven by funding choices—investor heterogeneity, insider ownership, and ownership concentration—impact firm performance and innovation. Drawing on panel data from 400 UK HTYEF for the period 2018 to 2023, the quantitative analysis employs longitudinal regression models to analyse performance outcomes (financial assets and employment growth) and cross-sectional models to interrogate innovation outcomes (patents and IP activity scores). Six hypotheses test competing theoretical mechanisms to determine whether (negative) horizontal agency costs or (positive) credibility signalling benefits dominate in explaining governance-outcome relationships. Findings reveal that investor diversity, lower insider ownership, and dispersed blockholder structures consistently enhance both performance and innovation through complementary resources, knowledge networks, and credibility signals for stakeholders. These governance characteristics support superior employment growth, asset accumulation, and innovation outcomes. Conversely, concentrated ownership structures constrain both performance and innovation through coordination costs and founder entrenchment. The same governance dimensions are consistently associated with superior outcomes across both performance and innovation, suggesting that governance architecture acts as a broad enabler of firm capabilities, even though the underlying mechanisms differ by context. The research advances entrepreneurial finance theory by providing empirical evidence on competing agency and signalling mechanisms, clarifying when agency costs or credibility signalling mechanisms dominate in outcomes for HTYEFs. The findings offer entrepreneurs strategic guidance on governance design and inform investors and policymakers about how governance characteristics influence both growth and innovation capacity. These insights from this research represent an essential contribution to the development of innovative high-tech ventures as they compete for both financial performance and technological advancement within innovation-driven economies.

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List of Abbreviations

3Fs	Friends, Family and Fools
AI	Artificial Intelligence
BA	Business Angel
BREXIT	UK leaving the European Union
CEO	Chief Executive Officer
CV	Control Variable
CVC	Corporate Venture Capital
DPIA	Data Protection Impact Assessment
DV	Dependent Variable
ESG	Environmental, Social and Governance
EUIPO	European Union Intellectual Property Office
FCA	Financial Conduct Authority
FE	Fixed Effects
FinTech	Financial Technology
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
HHI	Herfindahl–Hirschman Index
HTYEF	High Technology Young Entrepreneurial Firms
ICO	Initial Coin Offering
IP	Intellectual Property
IPO	Initial Public Offering
IPSCORE	IP Activity Score
IV	Independent Variable
MVP	Minimum Viable Product
NTBF	New Technology-Based Firms
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
ONS	Office for National Statistics
PE	Private Equity
R&D	Research and Development
RE	Random Effects
ROA	Return on Assets

ROE	Return on Equity
SME	Small and Medium Enterprise
STO	Security Token Offering
UK	United Kingdom
UWL	University of West London
VC	Venture Capital

1. Introduction

“An investment in knowledge pays the best interest.”

Benjamin Franklin[1]

The relationship between entrepreneurial finance and firm success represents one of the most consequential yet complex questions facing high-tech startups and growth ventures (Pantea and Tkacik, 2024). While securing capital remains essential for entrepreneurial firms seeking to scale operations and pursue innovation, the governance implications arising from different funding sources and investor types introduce dynamics that may fundamentally shape the course of these firms (Mönkemeyer *et al*., 2026). For High Tech Young Entrepreneurial Firms (HTYEFs) operating in technology-intensive sectors, external equity funding decisions create governance structures that influence both financial performance and innovation outcomes (Eshraghi, 2025). This thesis investigates how these funding patterns and resulting governance characteristics relate to firm success in a UK context. Understanding these mechanisms holds significance for entrepreneurs navigating funding decisions, investors seeking to maximise portfolio value, and policymakers designing interventions to support entrepreneurial ecosystems.

1.1 Background

High-tech entrepreneurial ventures have emerged as central drivers of economic growth and technological innovation, particularly since the rise of Silicon Valley and knowledge-based economies in the late 20th century (Colombo and Grilli, 2010). Understanding the financial ecosystems supporting these ventures requires examining their historical evolution, defining characteristics, and contemporary challenges within the context of external equity financing and governance structures (Bruton *et al*., 2010).

Since the post-war era, entrepreneurial activity has shifted from having primarily societal and political significance to being recognised as a central mechanism for economic growth (Bosma *et al*., 2018). Schumpeter's foundational work (1934, 1976) established entrepreneurship and innovation as engines of economic development, a perspective validated by substantial empirical evidence linking entrepreneurial activity to economic growth, job creation, and technological advancement (OECD, 2014; NESTA, 2006). Building on Schumpeter,

[1] Benjamin Franklin, *Poor Richard Improved, Being an Almanack and Ephemeris … for the Year of our Lord 1758* (Philadelphia: Printed and Sold by B. Franklin and D. Hall, 1758)

contemporary economic theories continue to emphasise technological change as a critical driver of growth (Schilirò, 2019; Popa, 2016).

HTYEFs are nascent companies, typically less than 25 years old, operating in sectors characterised by rapid technological innovation and development (Tarillon, 2022; Bertoni *et al.*, 2011; Colombo and Grilli, 2005). These firms distinguish themselves by leveraging cutting-edge technologies to offer novel solutions, often disrupting established markets and industries, and pursuing the transformation of technological advances into marketable goods or services (Bertoni *et al.*, 2011). Due to these novel technological innovations and unestablished markets and customer bases, HTYEFs are characterised by significant uncertainties, requiring substantial external risk capital for growth financing (Subrahmanya, 2022).

HTYEFs exist as a response to rapid technological advancements in the late 20th and early 21st centuries, especially in information technology, biotechnology, and renewable energy. Early examples, companies like Apple and Google, emerged from Silicon Valley, which became symbolic of and synonymous with high-tech entrepreneurial startups. As technology became increasingly accessible, high-tech entrepreneurial ecosystems emerged globally, with vibrant hubs developing in places such as London, Bangalore, and Berlin (Brown and Mawson, 2019).

High-tech entrepreneurial ventures play a disproportionate role in innovation diffusion, employment generation, and technological advancement (Martínez-Fierro *et al.*, 2019; Saty Kouame and Ivanaj, 2017), explaining why their financing and growth prospects are policy priorities for governments globally. However, HTYEFs face significant financial constraints, particularly during initial stages of operation (Colombo *et al.*, 2014), materially impeding their growth and adding to challenges caused by deficiencies in commercial and managerial skills (Bertoni *et al.*, 2011; Carpenter and Petersen, 2002). The financial crisis of 2008-9 exacerbated these funding challenges, creating funding gaps that particularly affected young entrepreneurial firms dependent on external finance (Fraser *et al.*, 2015; Wilson *et al.*, 2018). The emergence of alternative sources such as crowdfunding, accelerators, and family offices has expanded entrepreneurial finance options (Drover *et al.*, 2017; Block *et al.*, 2017), yet also increased complexity in understanding optimal funding structures (Block *et al.*, 2017). These developments have intensified the need for a deeper understanding of how different funding sources interact and their implications for firm growth and innovation outcomes.

Entrepreneurial finance differs fundamentally from traditional corporate finance. Where corporate finance involvement in a company was typically limited to capital provision, entrepreneurial finance investors remain actively involved, providing not only capital but also networks, expertise, and strategic guidance essential for venture success (Cumming, 2008). Young entrepreneurial firms often lack the necessary resources, experience, and networks to progress rapidly (Bonini *et al.*, 2019), making investor involvement critical for accessing missing intangible and tangible resources (Bushee, 1998). This active engagement creates questions around investor heterogeneity and ownership structure and the implications of these governance choices for firm outcomes—the central focus of this research.

UK government policy since the 1980s has promoted enterprise culture by supporting entrepreneurial and technology firms (Dodd and Anderson, 2001). Financial deregulation, US cultural alignment, and language advantages have made the UK a leading global entrepreneurial finance centre (Sanders *et al.*, 2020). This positioning proved resilient during the financial crisis, with business angel investment outperforming traditional venture capital (Mason and Harrison, 2015).

Given the significance of entrepreneurial ventures for economic growth (Hessels and Stel, 2009) and the complexity of their funding landscapes (Ewens and Farre-Mensa, 2022), it is essential to understand more precisely how various sources of financing interact and the implications for firm success (Eshraghi, 2025). These issues are the focus of this research, as detailed below.

1.2 Research Context

The UK entrepreneurial finance landscape has undergone substantial transformation in recent decades (Bank of England, 2025). From a relatively constrained environment dominated by traditional venture capital, it has evolved into a diverse ecosystem encompassing multiple funding sources, including business angels, corporate venture capital, private equity, crowdfunding platforms, and family offices (Block *et al.*, 2017; Sanders *et al.*, 2020). This diversification, accelerated by the 2008-9 financial crisis and subsequent regulatory changes, has created a complex financing environment where HTYEFs increasingly access capital from heterogeneous investor populations with varied objectives, time horizons, and strategic priorities (Fraser *et al.*, 2015). Understanding how this diversity affects firm outcomes requires more than the traditional research paradigms that consider individual funding sources in isolation. Recent evidence indicates that the increasing heterogeneity of investor types and the proliferation of syndicated and cross-border investment relationships have further intensified coordination challenges and horizontal agency frictions in the entrepreneurial finance ecosystems funding HTYEFs (Kang *et al.*, 2022; Gang *et al.*, 2025; Pantea and Tkáčik, 2024).

Existing entrepreneurial finance research predominantly examines individual funding sources separately (Nguyen *et al.*, 2020). There are studies available focusing, in isolation, on business angels (Capizzi *et al.*, 2021; Annamalaisami, 2021; Bonini *et al.*, 2019), venture capital (Bertoni *et al.*, 2011; Chemmanur *et al.*, 2011; Kaplan and Schoar, 2005), private equity (Lerner *et al.*, 2011; Bruton *et al.*, 2010; Farah and Sönmezer, 2022), and crowdfunding (Stevenson *et al.*, 2021; Hornuf and Schwienbacher, 2018; Moritz and Block, 2016). This segmentation reflects historical constraints regarding data, as investment datasets traditionally concentrate on single investor types (Cosh *et al.*, 2009). However, this approach no longer closely tracks with reality, as entrepreneurial firms increasingly use multiple external equity sources, creating complex governance structures through heterogeneous investor participation (Cumming *et al.*, 2019). Even the traditional "finance escalator" conceptualisation (North *et al.*, 2013) of different funding sources sequentially at different stages of a firm's lifecycle oversimplifies contemporary dynamics. Now, multiple investor types may co-invest across multiple lifecycle stages, creating an entrepreneurial landscape characterised by dynamic interactions among diverse funding sources (Cumming *et al.*, 2019).

This multiplicity of funding sources introduces governance complexities absent from single-source scenarios. When firms secure external equity from multiple investor types, each bringing distinct objectives, expertise networks, and strategic priorities, the resulting ownership structure creates potential for horizontal agency conflicts (Connelly *et al.*, 2010; Ward and Filatotchev, 2010). Unlike traditional vertical agency conflicts between dispersed shareholders and professional managers, horizontal agency conflicts arise from principal-principal disagreements among heterogeneous investors with divergent interests regarding firm strategy, growth pace, innovation investment, and exit timing (Young *et al.*, 2008). These coordination challenges may be expected to constrain firm performance and innovation by diverting attention and resources toward managing stakeholder disagreements (Chen and Lambrecht, 2025), yet existing research provides limited analysis of, or empirical evidence on, how investor diversity and the resulting governance characteristics affect outcomes for entrepreneurial firms.

The UK context proves particularly relevant for examining these dynamics (Bank of England, 2025). Since the early 1980s, UK government policy has prioritised the development of "enterprise culture" as an economic development model, reallocating resources from traditional industries toward entrepreneurial and smaller high-technology firms (Dodd and Anderson, 2001; Westhead and Cowling, 1995). Over this period, the UK has nurtured an entrepreneurial ecosystem that has benefitted from financial market deregulation, cultural affinity with US entrepreneurial traditions, and a common language that facilitates cross-border investment and has positioned itself as a leading global entrepreneurial finance centre (Sanders *et al.*, 2020). Additionally, UK regulations require private companies to report finances and ownership structures annually through Companies House[2]. The availability of this data enables systematic research on funding and governance structures in privately held entrepreneurial firms, where such research is challenging in jurisdictions lacking comprehensive private company disclosure requirements (Beuselinck *et al.*, 2021). Nevertheless, the recent research contributions highlight that mature entrepreneurial ecosystems, such as the UK's, are characterised by increasingly complex multi-actor configurations in which public agencies, universities, incubators, and private investors co-shape entrepreneurial opportunities and governance arrangements (Fernandes and Ferreira, 2021; Mikhailov *et al.*, 2024; Hruskova, 2024).

Within the innovation context, a critical tension emerges between innovation dynamics and investor expectations. Innovation inherently involves patient, cumulative knowledge development over extended timeframes with uncertain outcomes (Pyka and Burghof, 2013; Alvi and Ulrich, 2023). Conversely, financial investors often prioritise shorter-term performance metrics and returns. There is thus a misalignment in the time horizon between innovation requirements and investor preferences. This tension manifests intensely in HTYEFs, where sustained R&D investment proves essential for competitive positioning, yet diverse external investors may disagree regarding optimal innovation investment levels. The tension creates governance conflicts that, in turn, affect innovation rates (Hall and Lerner, 2010). Understanding

[2] Companies House is the executive agency responsible for maintaining the UK company register (gov.uk).

how funding diversity and governance structures affect innovation rates holds particular significance for policymakers seeking to foster innovation-driven economic growth (OECD, 2024).

Despite extensive research on individual funding sources, critical gaps remain. First, there is limited research examining how combinations of external equity sources and the resulting governance architectures collectively influence entrepreneurial firm outcomes (Denis, 2004; Cumming and Vismara, 2016). Existing studies that concentrate on one or, at most, two funding sources provide insufficient understanding of the governance complexities arising from heterogeneous investor participation (Chemmanur and Fulghieri, 2014). Second, the broader governance implications of funding diversity remain underdeveloped as a research topic, with limited empirical evidence on or analysis of how investor heterogeneity, ownership concentration, and insider ownership affect firm performance and innovation (Colombo *et al*., 2013). Third, most entrepreneurial finance research focuses on performance outcomes, with innovation outcomes receiving substantially less empirical attention despite their centrality to the success of high-tech ventures (Block *et al*., 2017).

This research addresses these gaps by investigating how external equity funding patterns and the resulting governance characteristics influence two critical outcomes for UK HTYEFs: (1) firm performance measured through financial assets and employment growth; and (2) rate of innovation measured through patent intensity and innovation scores. The research employs a governance architecture framework that integrates both agency theory and signalling theory perspectives, examining three governance dimensions arising from funding decisions: investor heterogeneity, insider ownership, and ownership concentration. Through panel data analysis of 400 firms over the period 2018-2023, this study provides empirical evidence on governance mechanisms connecting funding structures to performance and innovation outcomes, thereby contributing both theoretical insights and practical guidance for entrepreneurs, investors, and policymakers navigating entrepreneurial finance decisions.

In the UK, potential high-growth and innovation-intensive ventures are significantly more likely to rely on external equity than the wider SME population, reflecting both their strong growth opportunities and their limited access to bank lending due to intangible, R&D-intensive assets (Enterprise Research Centre, 2024; Copenhagen Economics, 2021). This disproportionate dependence on equity funding makes the structure of equity investors and the resulting governance arrangements especially consequential for the performance and innovation outcomes of UK HTYEFs, reinforcing the practical relevance of the present study.

1.3 Statement of the Problem

The central problem this research addresses is the inadequate theoretical and empirical understanding of how external equity funding patterns shape the governance architectures of entrepreneurial firms, despite these architectures materially influencing multiple dimensions of firm success. More specifically, existing research provides a limited understanding of:

(1) whether governance structures arising from heterogeneous investor participation generate net positive effects through resource complementarity and credibility signalling or net negative effects through coordination costs and strategic conflicts;

(2) how governance mechanisms operate differently for performance versus innovation outcomes, given the distinct strategic priorities and time horizons of heterogeneous investors;

(3) whether theoretical predictions from agency theory (emphasising governance costs) or signalling theory (emphasising governance benefits) better explain the observed relationships between funding structure, governance characteristics, and firm outcomes in entrepreneurial contexts; and

(4) how these relationships manifest in the specific institutional context of UK HTYEFs operating under the conditions of high technological uncertainty, information asymmetry, and resource constraints characteristic of technology-intensive sectors.

Questions regarding governance architecture for HTYEFs require systematic empirical investigation because the answers have direct implications for entrepreneurial finance theory development, entrepreneur funding strategy decisions, investor portfolio management practices, and policy interventions designed to foster innovation-driven economic growth.

1.4 Research Aims and Objectives

The primary aim of this research is to advance understanding of how external equity funding patterns shape the governance architectures that simultaneously influence firm performance and innovation outcomes in HTYEFs operating in the UK. Specifically, this study investigates how two critical dimensions of HTYEF success—firm performance and rate of innovation—are impacted by three key, related governance dimensions that arise from funding decisions. These are: investor heterogeneity (diversity of external equity sources), insider ownership (managerial equity control), and ownership concentration (distribution of equity among blockholders).

By examining these relationships against an integrated theoretical framework that brings together agency theory and signalling theory, this research investigates whether governance structures generated by diverse sources of external funding primarily constrain firm outcomes through horizontal agency coordination costs or enhance them—that is, whether the costs of horizontal agency coordination outweigh benefits from resource complementarity and credibility signalling. The investigation employs panel data from 400 HTYEFs over the period 2018-2023, providing empirical evidence on governance mechanisms to connect external funding structures to firm outcomes in a specific single market context (the UK).

Research Objectives:

- Research Objectives Relating to Firm Performance (Research Question 1)

- Objective 1.1: To examine how investor heterogeneity—the diversity of external equity sources participating in firm financing—influences firm performance in HTYEFs and specifically whether access to multiple investor types with complementary expertise and networks on balance generates performance benefits through resource provision and signalling or performance constraints through increased coordination costs and governance complexity.
- Objective 1.2: To investigate how insider ownership—the proportion of equity controlled by managers actively involved in firm operations—affects firm performance, examining whether managerial alignment incentives and founder motivation improve performance (as agency theory predicts for aligned ownership) or whether excessive insider control generates entrenchment effects that constrain performance at higher ownership levels.
- Objective 1.3: To consider how ownership concentration among blockholders—the distribution of equity stakes among significant shareholders—influences firm performance, examining whether concentrated ownership provides close monitoring and strategic coherence that improves performance or whether excessive concentration enables dominant shareholders to extract private benefits at the expense of minority shareholders where dispersed ownership produces superior performance through improved credibility signalling.

- Research Objectives Relating to Innovation (Research Question 2)
  - Objective 2.1: To examine how investor heterogeneity influences innovation outcomes in HTYEFs, investigating whether diverse investor participation provides complementary resources and specialised expertise that supports sustained R&D investment and innovation outcomes or whether conflict among heterogeneous investors with divergent time horizons and risk preferences constrains innovation, diverting attention and generating strategic conflicts.
  - Objective 2.2: To investigate how insider ownership affects innovation rates, examining whether high insider ownership enables sustained long-term focus on innovation free from external performance pressure or whether domination by insiders constrains innovation through lack of funding and restricted access to external networks and the expertise necessary for scaling innovation.
  - Objective 2.3: To determine how ownership concentration influences innovation outcomes, examining whether concentrated ownership enables coherent focus on R&D strategy or whether dispersed blockholder ownership produces superior innovation through governance checks that prevent entrenchment by dominant shareholders in technology innovations that are not proving effective and by attracting essential additional resources for innovation through signalling.

These objectives underpin the governance architecture framework described later in this chapter, mapping how external equity funding decisions create governance characteristics across the three interconnected dimensions of investor heterogeneity, insider ownership, and ownership concentration. The theoretical foundation for this research is the prediction that these resulting governance structures influence firm outcomes in competing directions. Where agency cost mechanisms predominate, governance complexity can be expected to increase coordination challenges, monitoring costs, and conflicts among heterogeneous stakeholders; where signalling benefit mechanisms are ascendant, the governance architecture can be expected to convey confidence in firm quality through credibility signals from investor endorsement and the reassurance of diverse stakeholder involvement. Six hypotheses are applied to test whether agency costs or signalling benefits dominate in specific governance contexts and whether these mechanisms operate differently in relation to performance versus innovation outcomes.

The results of the research will yield benefits for multiple stakeholder groups in entrepreneurial ecosystems. For entrepreneurs, understanding how funding decisions shape governance architecture enables strategic capital structure decisions that balance immediate financing needs against long-term governance consequences affecting both growth and innovation capabilities. For investors, clarifying how governance characteristics influence outcomes improves portfolio construction decisions, due diligence practices, and post-investment engagement strategies that maximise value creation while managing horizontal agency coordination costs in syndicated investments. For policymakers, evidence shows how funding diversity and governance structure affect both performance and innovation rates, informing the design of entrepreneurial finance policies, tax incentives for specific investor types, and regulatory frameworks governing equity crowdfunding and alternative finance channels that support innovation-driven economic growth. For academic scholarship, this research contributes to theoretical understanding by providing empirical evidence on whether agency theory or signalling theory better predicts the impact of varying governance structures in entrepreneurial contexts and whether impacts differ for performance and innovation outcomes.

1.5 Research Questions

This research investigates how heterogeneous external equity funding sources and the associated governance impact outcomes for HTYEDs. It considers two research questions:

- Research Question 1 (RQ1): To what extent do heterogeneous external equity funding sources and resulting governance characteristics affect HTYEF firm performance?
- Research Question 2 (RQ2): To what extent do external equity funding structures and associated governance characteristics affect the rate of innovation in HTYEFs?

1.6 Overview of the Research Approach

This study employs a quantitative research approach to examine the complex relationships between entrepreneurial finance structures and HTYEF performance and innovation success outcomes. The methodology is designed to address theoretical propositions derived from agency theory and signalling theory while accounting for the dynamic nature of entrepreneurial financing decisions.

Philosophical Foundation and Overall Strategy

This research adopts an empirical, quantitative paradigm grounded in objectivist ontology and positivist epistemology, reflecting the nature of financial data as observable, measurable phenomena existing independently of researcher interpretation. The empirical investigation employs a deductive research approach, commencing with established theoretical frameworks (agency theory and signalling theory) and testing their applicability in the novel context of HTYEFs. The quantitative methodology emphasises empirical validation through statistical hypothesis testing, aligning with a positivist commitment to factual knowledge generated through systematic observation and measurement. This philosophical positioning proves particularly appropriate given that entrepreneurial finance encompasses objective phenomena, investment amounts, ownership structures, patent counts, and employment growth that can be reliably quantified and tested.

Dual Research Design Rationale

This empirical investigation employs a dual research design tailored to address the distinct characteristics of the two research questions.

RQ1, which examines how funding and governance characteristics affect firm performance, utilises a longitudinal panel research design spanning six consecutive years (2018–2023). This structure enables the investigation of within-firm changes in governance characteristics and their effects on financial assets and employment growth over the time period, while controlling for unobserved firm-specific heterogeneity through advanced panel regression methods. Panel analysis proves essential for RQ1 because performance metrics are flows that can change year-on-year, while the causal mechanisms linking governance changes to variation in performance operate and are observed over sustained periods of time.

RQ2, conversely, employs a cross-sectional research design with observations measured in 2023 to examine how funding and governance characteristics affect firm innovation. Innovation outputs (patent stocks, innovation scores) represent cumulative measures that do not decline over time, making year-on-year panel estimation inappropriate. The cross-sectional design pairs governance characteristics measured at minimum values across the period 2018-2023 with cumulative innovation outcomes in 2023, reflecting a theoretical understanding that innovation accumulation depends on governance constraints experienced during development phases.

This dual design represents an optimal alignment between research questions, data characteristics, and analytical requirements and is a methodological approach well-established in entrepreneurial finance research. The consistent conceptualisation across both research questions ensures that the same underlying governance mechanisms are tested for both outcome domains while accounting for the distinct analytical requirements of each.

Data Sources and Sample Construction

The empirical analysis integrates multiple data sources to construct a comprehensive dataset on funding, governance, and firm outcomes. The method uses information from multiple sources, checking in a variety of ways to ensure the data is reliable while also taking advantage of the UK's detailed rules on private company reporting that support governance research.

Financial performance data drawn from regulatory filings at Companies House are supplemented by commercially available data via the FAME database that holds standardised company financial information across UK firms. Ownership and governance data are taken from the detailed ownership registers and shareholder registers mandated by UK company law. Innovation outcomes are measured through patent databases, including the UK Patent Office and IPqwery, cross-referenced with patent citation indices to construct innovation intensity measures. The final sample comprises 400 HTYEFs with around 1,800 balanced firm-year panel observations (2018-2023) for RQ1 analysis and cross-sectional observations for RQ2 analysis, providing substantial statistical power while maintaining focus on the target population.

Analytical Methods and Hypothesis Testing

For RQ1 (panel performance analysis), the investigation employs pooled Ordinary Least Squares (OLS), Fixed Effects (FE) and Random Effects (RE) regression models to test hypotheses regarding the influence of governance on performance while controlling for time-invariant firm characteristics and time-varying environmental factors. Model selection tests (Hausman tests) determine whether FE or RE specifications provide appropriate estimation, with specification choices varying across outcome measures and model stages. For RQ2 (cross-sectional innovation analysis), the study uses OLS regression with robust standard error estimation to test how governance characteristics predict cumulative innovation outcomes.

Both analyses incorporate comprehensive diagnostic procedures, multicollinearity assessments, heteroscedasticity testing, and model fit evaluations to ensure the findings are robust to specification violations and do not arise from data irregularities. Robustness testing employs alternative model specifications, application of alternative governance variables, and alternative outcome measures to validate core findings and assess specification sensitivity.

1.7 Significance of the Study

The primary significance of this study is not merely closing a gap in the available theory but also ensuring its findings address practical decision-making needs that exist in entrepreneurial ecosystems. The ultimate value of these research findings is that they enable stakeholders from all parts of that ecosystem—entrepreneurs, investors, policymakers, and scholars—to make better informed decisions regarding funding sources, governance structures, and entrepreneurial strategy.

Recent data from the UK highlight the practical importance for innovative firms and high-growth ventures of understanding equity finance dynamics. Potential high-growth companies in knowledge-intensive and technology-based sectors are far more likely to seek and obtain external equity finance than the broader SME population, reflecting both their high growth potential and their limited access to traditional bank lending due to intangible, R&D-intensive asset bases (British Business Bank, 2025; Copenhagen Economics, 2021). Survey data show that early-stage innovative firms frequently combine multiple equity investors and instruments over time, creating complex ownership and control structures that differ markedly from debt-financed SMEs (Enterprise Research Centre, 2024; British Business Bank, 2025). For UK policy, investors, and entrepreneurs, these patterns underscore a critical practical question: How do different configurations of external equity funding and their associated governance arrangements affect the performance and innovation outcomes of HTYEFs (Santos *et al.*, 2024)? This is the central focus of this thesis.

The following section expands on how findings from this research translate into practical benefits across the entrepreneurial ecosystem:

For Entrepreneurs: Strategic Capital Structure and Governance Decisions

Entrepreneurs face critical decisions regarding capital structure: Is it better to seek multiple investor types or concentrate on a single investor type? Is it better to retain majority ownership or accept external investment and dilute that position? How should governance architecture be structured to provide the best support for both performance and innovation? These topics have profound implications for long-term governance. Current entrepreneurial practice relies heavily on intuition, peer experience, or investor preferences rather than empirical evidence. This research will allow entrepreneurs to make such strategic capital structure decisions better informed by empirical evidence on how governance architectures affect both performance and innovation outcomes. Findings regarding investor heterogeneity can help entrepreneurs optimise investor portfolios. Evidence on insider ownership levels can guide decisions on dilution versus preservation of control. Understanding ownership concentration effects also informs equity structure design. Most importantly, the findings improve strategic decision-making by allowing entrepreneurial decisions to be grounded in evidence rather than subjective beliefs.

For Investors: Portfolio Construction and Post-Investment Value Creation

Investors construct portfolios and make investment decisions that are intended to maximise returns while managing risk, but they possess a limited systematic understanding of how governance characteristics may affect expected returns or how a syndication structure affects outcomes. They need to consider whether to syndicate their investment with diverse co-investors or maintain concentrated ownership and to understand how different investor types may complement each other in generating returns. This research contributes to investor decision-making by providing evidence on how governance characteristics affect firm performance and innovation. Findings on the effects of investor heterogeneity can inform syndication decisions. Understanding how insider ownership and ownership concentration affect outcomes is essential for guiding control negotiations and making equity allocation decisions. Post-investment, findings on governance mechanisms will help investors identify which governance interventions best support portfolio company outcomes. Most critically, evidence on innovation effects helps investors distinguish between portfolio companies pursuing high-growth strategies versus those employing operational excellence strategies, enabling them to apply differentiated forms of oversight.

For Policymakers: Entrepreneurial Ecosystem Support and Innovation Policy

Policymakers seek to foster entrepreneurial ecosystems that support innovation-driven economic growth. They do this through policy levers including tax incentives for specific investor types, regulatory frameworks governing alternative finance, government venture funds, and innovation support mechanisms. Current policy design reflects limits to the understanding of how different funding sources and governance structures affect entrepreneurial firm outcomes. This can lead to counterproductive policies that constrain beneficial governance configurations in attempting to protect the ecosystem from failures that are rare in practice. This research enables better informed policy design by providing evidence on how funding diversity and governance characteristics affect both firm performance and innovation rates. Evidence on governance-performance relationships enables the formulation of policies that support founder retention and long-term involvement. Understanding the innovation effects of different ownership structures will inform crowdfunding and regulation of alternative finance, enabling policymakers to distinguish between regulations that offer genuine protection for investors and those that merely constrain beneficial configurations.

For Academic Scholarship: Theory Testing and Future Research Opportunities

This research contributes to entrepreneurial finance scholarship in multiple ways. Empirically, it provides novel evidence on governance architecture effects across a large, diverse sample of UK HTYEFs with statistical power enabling rigorous theory testing. Theoretically, it simultaneously tests competing predictions from agency theory and signalling theory, contributing to understanding how far each theory accurately predicts relationships and outcomes when mechanisms interact in complex ways. Methodologically, this research demonstrates that comprehensive governance research is feasible in contexts with public reporting requirements, indicating how opportunities for similar research can be fostered across other jurisdictions. Most importantly, this research identifies future research opportunities. These include the investigation of contingent relationships where governance effects depend on firm characteristics or competitive environments, longitudinal investigation of how governance evolution affects long-term outcomes, and investigation of mechanisms through which governance influences strategic decisions.

This research generates practical value to entrepreneurial ecosystems by translating theoretical understanding of governance architecture into actionable insights for strategic decision-making by stakeholders in these ecosystems. By providing empirical evidence on how funding decisions create governance structures that affect firm success, this research supports better informed entrepreneurial decision-making, investor strategies that are more beneficial, and public policy approaches that are more effective in stimulating innovation-driven economic growth.

1.8 Thesis Structure/Outline

This thesis has been organised to offer a logical flow of arguments and evidence, carefully designed to address RQ1 and RQ2 in a comprehensive manner.

The thesis begins with an introductory chapter, Chapter 1, that sets the stage by introducing the research problem and its significance. It also presents the research objectives that the study aims to address and the two research questions that frame the work.

Chapter 2 contains concise scene-setting on the entrepreneurial finance landscape and the venture life cycle, clarifying the financing instruments available and the frictions that shape funding choices and outcomes for HTYEFs. This chapter establishes the institutional and practical context into which the study's questions are situated, bridging the general background in Chapter 1 and the literature review and theoretical framework developed in Chapters 3 and 4.

Chapter 3 provides a comprehensive review of existing literature related to the research topic. This chapter focuses on specific topics and theories that are relevant to the study, serving as both a theoretical foundation and a context within which the research questions can be examined.

Chapter 4 is dedicated to the theoretical framework underpinning this investigation. It explores how investor heterogeneity and ownership structures are conceptualised within established economic and organisational theories, looking specifically at agency theory, with a focus on horizontal agency costs in conjunction with information asymmetry and signalling theories.

Chapter 5 sets out the research methodology, including the philosophical positioning, research design, and method. The chapter specifies data sources and analytical approaches to ensure transparency and replicability, offering a complete account of how the study was conducted.

Chapter 6 translates the theory into an operational research model. It restates the research questions and introduces the hypotheses to be tested. It also defines independent, dependent and control variables and details the empirical specifications alongside key diagnostic considerations, survivorship, exit, sample construction, period choices and multicollinearity so that the modelling strategy and its assumptions are explicit.

Following on from the chapters on methodology and research model, Chapter 7 presents the data analysis. After documenting data preparation and descriptive statistics, it reports correlations and estimates the core models that link funding and ownership structures to firm performance and innovation, providing the empirical basis for interpretation.

In Chapter 8, the discussion further explores the implications of these findings. It considers the evidence in relation to specific frameworks and applications, aiming to provide a broader understanding of the research topic.

Finally, in Chapter 9, the thesis concludes with a summary of the research, a discussion of its limitations, and suggestions for future work in this field. This serves as both a recap and a final reflection on the research undertaken.

To complement the main chapters, a bibliography and detailed appendices of data are included at the end of the thesis. These provide supplemental information and offer full citations for all the sources referenced, ensuring academic rigour.

2. Entrepreneurial Finance Landscape and Study Context

This chapter provides the contextual foundation for analysing the relationship between entrepreneurial finance and the success of High Tech Young Entrepreneurial Firms (HTYEFs). It maps the main equity funding sources, investment mechanisms, and lifecycle patterns that shape the governance environment in which HTYEFs operate, thereby positioning the focus of this research on funding structure and governance characteristics.

Situating the study within the broader entrepreneurial finance landscape serves three purposes. First, this positioning clarifies why external equity finance is central to high-tech venture formation and growth, justifying the motivation for the research objectives and questions detailed in Chapter 1. Second, highlighting the increasing heterogeneity of equity investors and funding instruments illuminates the emphasis on investor heterogeneity, insider ownership and ownership concentration as key governance dimensions. Third, outlining how financing patterns evolve over the venture lifecycle explains why the combining of heterogeneous funding sources and the varied associated governance architectures matters both theoretically and practically for understanding HTYEF performance and innovation.

Chapter 2 therefore acts as a bridge between the general background presented in Chapter 1 and the detailed theoretical and empirical analyses in the chapters that follow. The chapter begins with an overview and background, then summarises the main sources of equity finance and the investment mechanisms available to entrepreneurial firms. It concludes by describing how these funding options interact over the venture life cycle in the UK context.

2.1 Overview and Background

Current economic growth theories highlight the importance of technological change for economic growth (Schilirò, 2019; Popa, 2016), picking up Schumpeter's (1934, 1976) emphasis on innovation as the key factor for economic development. Schumpeter (1934, 1976) views resource allocation to innovation as having three characteristics. The first is that investment of resources is *required* for innovation; the second is that innovation generally happens in new ventures formed for that specific purpose; and the third is that innovation is generally driven by entrepreneurs who were new to the activity. Entrepreneurs are therefore likely to be high on energy and enthusiasm but potentially short on track record credentials, which results in problems attracting external investment at the very beginning of their entrepreneurial initiative (Denis, 2004). The success of a new enterprise hinges on the ability of entrepreneurs to create and leverage financial resources. However, what it takes to start an entrepreneurial business often conflicts with what investors prefer, which are solid plans, well-defined markets, and track records (Mercer, 2004; Myers and Majluf, 1984).

In consequence, specialist funding has emerged as part of the entrepreneurial ecosystem, as distinct and separate from conventional corporate finance. However, the definition of such 'entrepreneurial finance' varies across the literature, and there is no consensus on its exact meaning (Clement and Silvernagel, 2019; Rita and Muharam, 2018). In this research, external equity finance in the context of entrepreneurial ventures means capital raised from investors external to the founding team in exchange for ownership stakes in the firm (Attig *et al*., 2008). Dedicated entrepreneurial finance is a crucial aspect of the entrepreneurship process, touching all the financial aspects of initiating, operating, and expanding a business (Tenca *et al*., 2021). Entrepreneurial finance activity can encompass generating and evaluating innovative ideas, financing firm-level activities, and guiding the direction and governance of a firm's growth (Kor *et al*., 2007). Entrepreneurial finance fundamentally diverges from conventional corporate finance by prioritising both capital provision *and* active investor engagement. External equity investors in entrepreneurial initiatives provide financial resources, as well as the networks, knowledge, strategic assistance, and connections vital for venture success (Cumming, 2008).

Access to finance is a critical element for the start-up and subsequent performance of any enterprise (Marlow and Patton, 2005). However, access to finance is also a key constraint for business-led innovation that is inherently risky and may require a long-term horizon. Financial constraints are especially high for new entrants, since they have no history of success, and their assets may be difficult to value. Seed capital and external financing play a key role in enabling entrepreneurial individuals to turn new ideas into new products. These external actors—encompassing a range of investors from venture capitalists to angel investors—significantly influence the strategic direction and operational aspects of entrepreneurial firms through the governance mechanisms embedded in their ownership structures (Ward *et al*., 2009).

There are two main categories of external funding available to enterprises seeking finance: debt financing—from banks, individuals, and government agencies—and equity financing—from venture capitalists, business angels, Initial Public Offerings (IPOs), and individuals. However, many start-ups are unable to access debt finance, as they do not have the necessary collateral or track record to secure a loan (Chemmanur and Fulghieri, 2014).

The landscape of available entrepreneurial equity funding has undergone substantial transformation over recent decades (Kraemer-Eis *et al*., 2016). Historically, institutional equity sources for entrepreneurial finance came from venture capital (VC) and private equity (PE) sources, with angel investment and financing from family and friends supplementing gaps in VC and PE funding (Drover *et al*., 2017). Contemporary entrepreneurial ventures access capital from increasingly heterogeneous sources. Traditional VC and angel investment sit alongside emerging players, including the capital arms of corporate ventures, family offices, and accelerator sponsors and funding via digitally-enabled platforms, including equity crowdfunding, peer-to-peer lending, and security token offerings (Schückes and Gutmann, 2020; Colombo *et al*., 2022; Lambert *et al*., 2021).

The emergence of these new players and instruments (Love, 2020) can be attributed to the challenges encountered by entrepreneurs and early-stage ventures in obtaining funding after the financial crisis of 2008/09 (Block *et al*., 2017). However, this diversification, while expanding financing opportunities, generates complexity in understanding optimal funding structures or the resulting governance implications for firm success.

Recent entrepreneurial ecosystem research emphasises that this diversification of funding sources is embedded within evolving regional ecosystems, where institutional quality, knowledge flows and network structures shape how heterogeneous investors interact with each other and co-govern ventures (Stam and van de Ven, 2021; Wurth *et al.*, 2021; Fernandes and Ferreira, 2021).

The proliferation of entrepreneurial finance sources and types of investor involvement drives the focus on governance architecture in this research which examines how investor heterogeneity, insider ownership, and ownership concentration shape HTYEF performance and innovation.

2.2 Equity Finance Sources and Investment Mechanisms

This section of Chapter 2 describes the various equity finance sources available to HTYEFs, detailing their investment approaches and non-financial support mechanisms:

Seed Funding and Early-Stage Sources

Seed funding represents the earliest stage of external equity finance, being made available while ventures remain largely conceptual with minimal operational history or validated market traction. Seed investors are often successful entrepreneurs or experienced angel investors and frequently provide mentorship, industry insights, and assistance building initial teams and developing prototypes alongside capital (Davis *et al.*, 2020; Annamalaisami, 2021). Seed-stage financing is particularly important for bridging the gap between a founder's vision and market validation, enabling entrepreneurs to develop Minimum Viable Products (MVPs) and gather preliminary customer evidence, reducing risk for subsequent larger institutional investors.

Friends, Family, and Fools

Friends, family, and informal investors (often grouped together as the '3Fs') are traditionally the most common source of entrepreneurial finance, with surveys indicating that substantial majorities of new ventures receive initial funding from personal networks before accessing institutional capital (Basu and Parker, 2001). These investors typically take a passive approach, not engaging directly in venture management but extending emotional support, initial credibility validation, and potentially lenient funding terms compared to professional investors (Belka, 2019; Sieger and Minola, 2016). While 3Fs financing enables ventures to reach initial milestones without surrendering governance control to external investors, reliance on personal networks creates distinctive challenges. The informal nature of personal investment commitments can generate complexity at the point ventures need to access formal institutional investment.

Business Angel Investors

Business angels (BAs) tend to be high-net-worth individuals investing personal capital in early-stage ventures, typically between a few tens of thousands and a few hundred thousand pounds, thus filling a critical financing gap between founder/friends-and-family capital and institutional venture capital (Mitteness *et al*., 2012; Bonini *et al*., 2019). BAs bring distinctive value beyond capital, which might include domain expertise accumulated through careers in relevant industries, operational experience that allows them to offer practical business mentoring, and established networks providing customer introductions, partnership opportunities, and recruitment channels (Capizzi *et al*., 2021). BAs typically invest in the early stage of high-technology sectors, adopt active investment approaches, engage directly in strategic decision-making, serve on advisory boards or boards of directors, and maintain regular communication regarding business progress (Mitteness *et al*., 2012). Angel groups are increasingly organising BA individuals to pool their investment funds to achieve economies of scale (Tenca *et al*., 2021).

Venture Capital Firms

VC firms invest pooled capital from pension funds, endowments, corporations, and wealthy individuals in high-growth-potential ventures in exchange for equity stakes, typically in tranches of between £250,000 and £5 million per investment, with the expectation of 5-7 year investment horizons culminating in exit events (IPO or acquisition) to generate portfolio returns (Gompers and Lerner, 2001; Gantenbein *et al*., 2019). VC firms adopt highly active investment approaches, providing hands-on strategic guidance, operational improvement initiatives, assistance recruiting management talent, and coordination of subsequent funding rounds essential for scaling (Lerner and Nanda, 2020). Professional venture capitalists employ sophisticated due diligence processes and contractual mechanisms, including liquidation preferences, anti-dilution protections, and board control provisions to protect investments while maintaining founder incentive alignment. VC involvement generates substantial benefits that enable VC portfolio companies to scale more rapidly than comparable unfunded ventures by drawing on access to the VC ecosystem, strategic networks, and operational expertise (Hellmann and Puri, 2002; Lerner, 2022). However, VC participation also imposes governance restrictions, including requirements for board representation, quarterly reporting, annual budgeting, and investor approval for material transactions, thus creating organisational discipline and external oversight that constrain founder autonomy (Chemmanur and Fulghieri, 2014).

Corporate Venture Capital

Corporate venture capital (CVC) is funding from established companies for external ventures, typically to pursue strategic objectives including market exploration, technology acquisition, capability development, or ecosystem participation (Hill and Birkinshaw, 2014; Chen *et al*., 2022). Depending on their corporate objectives, CVC investors can vary from being passive financial investors to being highly active strategic partners. Involvement ranges from arm's-length capital provision to deep operational integration, providing access to parent corporation resources, distribution channels, technical capabilities, and commercialisation pathways (Zu Knyphausen–Aufseß, 2005). CVC investors offer unique advantages, such as access to existing distribution and customer connections, manufacturing and operational skills, and credibility thanks to the corporate ties, which can boost confidence among suppliers and customers. However, CVC participation can also complicate governance by introducing divergent objectives between venture-maximising financial returns and corporate parents pursuing strategic objectives, who potentially prefer to accept lower financial returns to secure strategic value according to their corporate objectives (Park *et al.,* 2019).

Family Offices

Family offices are private wealth management vehicles operated by and for wealthy families and typically managing £50+ million in assets. They increasingly participate in venture investing as a family diversification strategy and sometimes as a mechanism for younger family members to become involved in wealth management (Welsh *et al*., 2013). Family offices may provide capital with lenient governance terms that reflect longer-term investment horizons and lower return requirements than professional investors. The passive-to-active spectrum of family office involvement varies dramatically. Some operate as purely financial investors, providing capital but no operational involvement, while others engage deeply with portfolio companies, providing strategic guidance, network access, and board participation. Family office participation creates particular implications for governance. On the one hand, availability of patient capital with potentially flexible exit timelines can allow the pursuit of longer-term innovation strategies without pressure for near-term profitability; on the other hand, family governance structures and dynamics introduce complexity if family members involved in portfolio company decision-making have divergent preferences and the hierarchy of authority is unclear (Wilson, 2012).

Private Equity Firms

PE firms invest pooled capital from institutional sources typically in later-stage companies (growth and mature stages) or in turnaround situations, with investment sizes ranging from £1 million to £50+ million. They typically have longer hold periods than VC investors (3-7+ years), reflecting established revenues and operational sophistication (Kaplan and Strömberg, 2009). PE firms pursue active operational improvement strategies, including restructuring, margin expansion initiatives, market consolidation, and strategic acquisitions that expand portfolio company capabilities. Because PE funding is often provided when ventures are in transition from early-stage development toward substantial revenues and established market positions, PE involvement can be valuable for achieving operational improvements ready to access debt financing for expansion or acquisitions (Colombo and Grilli, 2007; Bruton *et al*., 2010).

Government-Backed Equity Funds

Government-backed equity funds—such as the British Business Bank, regional venture funds, and university spinout funds—provide capital to ventures meeting specific criteria (regional location, sector, and technology focus) with typically passive governance involvement focused on economic development objectives rather than direct management participation (Park *et al.*, 2019). Government fund participation has governance implications through potential political pressure to maintain employment or pursue public policy objectives that may conflict with profit maximisation or with the strategic focus being pursued by other investors in the firm.

Accelerators and Incubators

Business accelerators and incubators—such as Y Combinator, Techstars, Plug and Play, etc.—are organisations that provide early-stage ventures with capital, business training, mentorship, office space, and networking opportunities with investors and industry experts. They typically invest from a few tens of thousands to a few hundred thousand pounds in exchange for equity stakes (3-10%) and committing ventures to intensive development programmes (Pauwels *et al.*, 2016). Accelerators operate as curated cohorts, where cohort ventures facilitate peer learning and network development along with structured mentorship from experienced entrepreneurs and domain experts. The accelerator business model generates multiple benefits, including intense mentorship and business networks. The next stage of a successful venture life cycle is expansion, and peer networks provide support and business development opportunities.

Equity Crowdfunding Platforms

Equity crowdfunding involves raising capital directly from dispersed individual investors through online platforms—Crowdcube, Seedrs, Wefunder—that typically offer equity stakes to investors who participate in funding a venture's campaign (Stevenson *et al.*, 2021; Block *et al.*, 2017). Crowdfunding democratises investment opportunities, enabling retail investors to participate in early-stage venture financing that historically was restricted to professional investors and wealthy individuals, while enabling ventures to access distributed investor bases without intermediation by professional gatekeepers. Crowdfunding investors typically adopt passive involvement approaches, with limited individual investor influence over governance given distributed ownership; however, collectively, crowdfunding participants can create significant governance attention through campaign discussions and community engagement. Equity crowdfunding introduces some distinctive governance implications: the dispersed, atomised ownership creates collective action problems where individual shareholders lack sufficient stakes for meaningful governance engagement, and the heterogeneous investor motivations—some being motivated by social impact, others by financial returns, others by customer/product interest—often lead to misaligned stakeholder objectives (Moritz and Block, 2016).

Emerging Mechanisms: Initial Coin Offerings and Security Token Offerings

Initial Coin Offerings (ICOs) and Security Token Offerings (STOs) are blockchain-enabled fundraising mechanisms that enable ventures to issue digital tokens or securities to dispersed investors via smart contracts, theoretically enabling global capital access without traditional intermediaries (Brochado and Mergulhão, 2022). ICO/STO mechanisms theoretically democratise venture funding through direct global investor access while reducing intermediation costs. However, severe regulatory uncertainty, the proliferation of low-quality projects, and substantial ICO fraud have substantially diminished ICO activity since 2018. For UK HTYEFs specifically, regulatory frameworks, including Financial Conduct Authority (FCA) regulations on crypto assets and token classification, substantially constrain ICO/STO utility compared to traditional equity mechanisms, limiting the practical relevance of these funding mechanisms for most UK high-tech ventures.

The Equity Finance Table

The following table summarises various entrepreneurial equity finance mechanisms and their level of involvement in investee firms:

Table 2-1 The Equity Finance

Equity Finance Source	**Typical Investment Size**	**Investment Approach**	**Non-Financial Support Provided**	**Governance Involvement**
Seed Funding (Davis *et al.*, 2020; Annamalaisami, 2021)	£5K - £50K	Often active, especially in cases where seed funding is provided by experienced entrepreneurs or investors.	Mentorship, industry insights, and helping in building the initial team and product development.	Moderate (advisory roles)
Friends, Family and Fools (3Fs) (Belka, 2019; Sieger and Minola, 2016)	£1K - £50K	Typically passive, usually not involved in management decisions.	Emotional support, initial trust and validation, and potentially lenient terms compared to professional investors.	Low to none
Angel Investors (BA) (Mitteness *et al.*, 2012)	£10K - £250K	Typically active, often involving direct involvement in strategic decision-making.	Mentorship, industry connections, operational expertise, and strategic guidance.	Moderate to high (board/advisory seats)
Venture Capital Firms (VC) (Gantenbein *et al.*, 2019; Gompers and Lerner, 2001)	£250K - £5M	Active, with a hands-on approach, especially in strategic and operational aspects.	Expertise in business growth, network connections, strategic planning, and additional fundraising assistance.	High (board seats, investor rights)
Private Equity Firms (PE) (Kaplan and Strömberg, 2009)	£1M - £50M+	Active, particularly in later-stage or turnaround scenarios. Often involves restructuring and operational management.	Strategic restructuring, operational improvements, financial management, and access to larger capital networks.	High (board control, operational restructuring)
Equity Crowdfunding	£50K - £1M+	Generally passive, with limited direct	Market validation, community building,	Low (dispersed ownership)

(Stevenson *et al*., 2021)		influence on management.	customer feedback, and promotion through crowdfunding platforms.	
Corporate Venture Capital (CVC) (Chen *et al*., 2022)	£100K - £5M	Varies from passive to active, often seeking strategic alignment with their core business interests.	Industry-specific expertise, access to established distribution channels, and strategic business partnerships.	Variable (strategic alignment focus)
Government-backed Equity Funds (Park *et al*., 2019)	£50K - £500K+	Often passive, focused more on economic development than direct management involvement.	Policy support, access to networks, and possibly further government grants or incentives.	Low to moderate
Accelerators and Incubators (Pauwels *et al*., 2016)	£10K - £250K	Active, particularly in the early stages of the business with a focus on rapid growth and development.	Business training, mentorship, office space, and networking opportunities with investors and industry experts.	Moderate (program requirements)
Family Offices (Welsh *et al*., 2013)	£100K - £5M+	Can vary from passive to active, depending on the family office's investment philosophy and the relationship with the investee.	Personal networks, long-term investment horizons, and sometimes industry-specific expertise.	Variable (depends on family engagement)

These diverse investor types create heterogeneous ownership structures and monitoring arrangements, directly motivating this thesis's focus on investor heterogeneity and blockholder concentration as key governance dimensions.

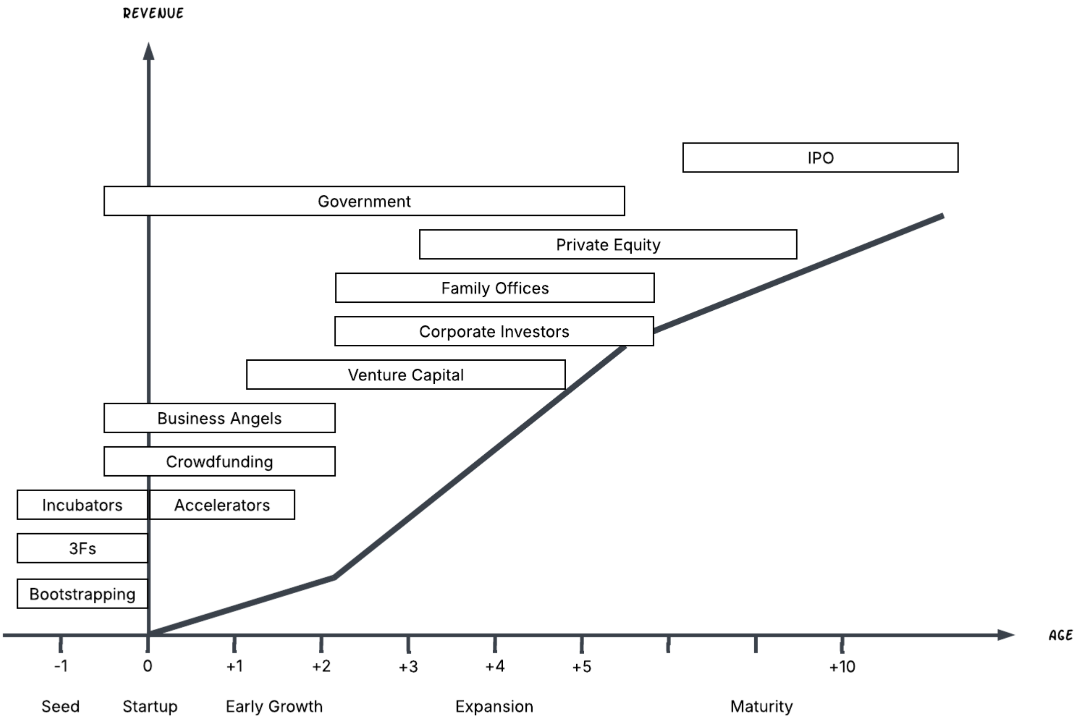
2.3 Financing Venture Lifecycle

Successful ventures follow a maturation process known as a venture lifecycle which consists of various stages: Seed/Development, then Start-up, Early Growth, Rapid Growth (Expansion) and finally Maturity (Tenca *et al*., 2021). Financing is a crucial aspect of the venture lifecycle, as it provides the capital needed for entrepreneurial firms to grow and succeed.

There are various stages in the venture lifecycle. All ventures start at the seed/development stage, then successful ventures pass through the growth stages, ending up in the mature stage. Each of these stages has specific needs and requires different types of financing.

The seed/development stage is when a venture moves from being an innovative idea to being a promising business opportunity (Gilson and Black, 1996). The idea is put to the test during the development stage, leading to the production of a prototype or trial service or process. The primary source of financing for this stage is seed financing (Gompers, 1995) through the entrepreneur's own assets and those of friends and family. Typically, new ventures also resort to financial bootstrapping methods to minimise the cash needed to exist (Winborg and Landström, 2001).

Figure 2-1 Lifecycle Stages of Successful Ventures



Source based on Tenca et al. (2021) and Leach and Melicher (2011).

During the start-up stage, the venture is developed into an organisation, an initial revenue model is developed, and the venture starts operating and selling its first products and services. Depending on personal circumstances, entrepreneurs and their friends and family may continue financing this stage; however, start-up financing normally involves external equity finance throughout early-stage investment (Lehnertz *et al*., 2022). Furthermore, ventures in the startup stage may seek support from business accelerators or incubators (Anwar *et al*., 2022). These organisations provide not only funding but also mentorship, networking opportunities, and access to resources that can help startups grow and succeed (Bergek and Norrman, 2008).

In the early stages of the venture lifecycle, entrepreneurs often rely on BAs for financing (Zheng *et al*., 2021). BAs provide capital in exchange for equity in the company and play a significant role in funding innovative ventures (Johnson and Sohl, 2012). Angel financing is particularly important for startups that are in the ideation and development stages, as it helps them turn their ideas into viable businesses (Shane, 2012).

The early growth stage is when revenues start to grow, generating funds to help pay some of the firm's outgoings. Any gap between income and expenses may be covered by borrowing or external investment, provided the venture can show sufficient business growth to repay loans or provide returns in future. Financing during this stage to cover the cash shortfall is normally through external equity first-round financing by BAs and VC sources. As the venture progresses to the expansion stage, VC financing becomes more prevalent (Lerner and Nanda, 2020). VC firms invest in high-growth potential startups in exchange for equity and provide not only capital but also expertise and networks (Lerner and Nanda, 2020). VC financing is crucial for startups in the growth stage, as it enables them to scale their operations, enter new markets, and develop innovative products or services (Lerner and Nanda, 2020).

The next stage of a successful venture lifecycle is expansion, when revenues and cash inflows grow quickly, the venture's value increasing rapidly as revenue growth outstrips rising expenses. Second-round financing during this stage typically takes the form of VC to support investment in working capital. Mezzanine financing can provide additional funds needed for expansion or supplementary activities during this stage.

The final stage in a successful venture lifecycle is maturity, when the growth of revenue and cash flow continues but at a slower rate than in the previous stage. Venture value increases steadily but at a lower rate, as most of the value appreciation happens during the rapid-growth stage. During this stage funding switches towards seasoned financing, typically by offering securities, bonds and stocks through investment and commercial banks.

Equity funding is a common financing form that accompanies the lifecycle of innovative ventures from the initial stages until maturity (Deias and Magrini, 2023). Equity funding allows entrepreneurs to raise capital without incurring debt and provides flexibility in terms of repayment. It is particularly suitable for startups that have high growth potential but may not have sufficient cash flow to support debt repayment (Deias and Magrini, 2023). Additionally, the availability of early-stage funding plays an important part in innovation. Inherently, innovation is associated with asset intangibility and information asymmetry, resulting in higher costs of external finance among more innovative firms (Cosh *et al.*, 2009).

However, high-tech entrepreneurial ventures increasingly access multiple funding sources simultaneously or sequentially rather than following linear escalator patterns. This creates complex governance structures where ventures simultaneously maintain early-stage informal investors from earlier funding rounds alongside later-stage institutional investors. The lifecycle framework reveals that governance requirements escalate with venture maturity and institutional capital access, transitioning from founder-controlled, informal governance to a more professional structure. Examining how governance escalation influences performance and innovation trajectories reveals whether governance structures enhance or constrain venture outcomes as they develop.

In summary, the evolving entrepreneurial finance landscape outlined in this chapter provides the setting for this thesis. The choice of governance architecture as the core focus for this research was motivated by observing the increasing heterogeneity of equity investors, the prominence of external finance for HTYEFs, and the complex ownership structures that emerge over the venture lifecycle. These contextual insights provide the foundation for the research objectives and questions specified in Chapter 1 and are developed into a formal theoretical framework and hypotheses in Chapters 3 and 4.

3. Literature Review

The growing recognition of entrepreneurial enterprises as catalysts for economic growth has resulted in heightened attention from scholars, policymakers and regulatory bodies alike. These firms face unique challenges in securing capital, owing to agency conflicts, informational asymmetry, and limited internal resources or collateral (Chemmanur and Fulghieri, 2014). Consequently, the influence of legal frameworks and market conditions on the accessibility and types of financing available to entrepreneurial firms has long been a focal point in both finance and entrepreneurship research (Cumming and Vismara, 2016).

3.1 Entrepreneurship and Innovation

Joseph Schumpeter's early twentieth-century theories on the role of innovation in economic growth are the foundation of the modern understanding of entrepreneurship. Schumpeter (1934, 1976) framed innovation as essential for growth and entrepreneurs as playing the key role for innovation. His groundbreaking book, *The Theory of Economic Development* (1934), argues that economies stay in stationary states with circular monetary flows in the absence of innovative entrepreneurs and that these static conditions cannot bring about significant economic change. Schumpeter (1976) developed this into the notion that competition based on innovation is the main driving force behind capitalism. In this system, entrepreneurs change the balance of power by bringing new ideas to the market, thus moving productive resources from static to dynamic uses (Kaya, 2015). Schumpeterian entrepreneurial activities are not isolated interventions at particular developmental stages; rather, they are continuous and essential components of economic evolution (Hagedoorn, 1996) and result in what subsequent scholarship has identified as "creative destruction"—the systematic displacement of established products, processes, and organisational structures by new innovations (Cantwell, 2000).

Schumpeter's conceptualisation of innovation encompasses a far broader scope than mere technological advancement, as it also embraces the creation of new products or services, novel production processes, unexploited markets, previously untapped supply sources, and innovative organisational structures (Cantwell, 2000; Schumpeter, 1934). This multidimensional understanding proves particularly relevant for contemporary high-tech contexts, where innovation manifests simultaneously across technological, business model, and organisational dimensions (Kowalkowski *et al*., 2023). Through innovation processes, necessary resources are utilised in fundamentally new ways by entrepreneurs establishing new ventures specifically organised to commercialise these innovations (O'Sullivan, 2009). Contemporary research on innovation-driven competitive advantage continues to draw on Schumpeterian ideas about the intricate relationships between a firm's innovative activities and its capacity to achieve and sustain market power and extraordinary profits (Laino, 2011). This relationship seems especially well-evidenced within technology-intensive sectors where first-mover advantages and technological superiority can generate substantial economic rents.

Contemporary interpretations continue to affirm innovation as a critical determinant of sustained economic growth (OECD, 2014) while extending the analysis to consider specific organisational contexts where innovative activities are concentrated. Edith Penrose's *The Theory of the Growth of the Firm* (1959) provides a complementary perspective to Schumpeterian thinking, emphasising how a firm's unique resource configuration and managerial capabilities shape its growth trajectory. Entrepreneurial vision and organisational learning can enable firms to identify and exploit opportunities unavailable to others. Together, Schumpeter's theory of innovation and Penrose's theory of growth establish the conceptual foundations for understanding the economic role of entrepreneurship, particularly within knowledge-intensive, technology-driven contexts where innovative capabilities can constitute primary sources of competitive advantage and value creation.

Building upon these theoretical foundations, research from the 1990s onwards focused increasingly on high-tech young entrepreneurial firms (HTYEFs) as embodiments of modern innovation-led growth. These ventures operate within uniquely turbulent environments marked by extended lead times for research and development, followed by rapid commercialisation phases and accelerated product obsolescence driven by intense global competition (Warren and Hutchinson, 2000). Unlike mature corporations with established market positions, extensive resource bases, and proven business models, HTYEFs confront multiple interrelated challenges simultaneously. Resource constraints are particularly critical, not merely in relation to access to financial capital but also the limited availability of specialised human capital, manufacturing capabilities, distribution networks, and those complementary assets necessary for successful commercialisation (Katila and Shane, 2005). These constraints create strategic vulnerabilities, as HTYEFs typically cannot compete through the economies of scale, market power or brand recognition enjoyed by established incumbents.

Information asymmetries represent another fundamental challenge for HTYEFs. The novel technological nature of their innovations, their limited operating histories and the absence of established track records create barriers to their selection by external stakeholders—potential investors, customers, partners, and employees—all of whom struggle to assess venture quality and viability (Carpenter and Petersen, 2002). These asymmetries are especially pronounced for ventures pursuing radical innovations to introduce irregular technological change, as even sophisticated evaluators lack benchmarks for quality assessment (Chod and Lyandres, 2020). Consequently, HTYEFs face considerable difficulties securing financing at reasonable costs, attracting high-calibre employees, or forming partnerships with established firms possessing complementary capabilities (Wilson *et al*., 2018). These financing challenges extend beyond the initial seed/development stage, as HTYEFs require sustained capital infusions throughout extended development periods before they achieve revenue generation. All this means HTYEFs exhibit an ongoing dependence on external equity financing from specialised investors willing to accept high risks in pursuit of exceptional returns (North *et al*., 2013).

Success within this demanding landscape depends upon multiple interdependent factors. Venture survival and growth prospects are materially influenced by founder characteristics, such as educational credentials, industry experience, prior entrepreneurial experience, and technical expertise (Colombo and Grilli, 2007). Founders with strong opportunity recognition capabilities, technological expertise and entrepreneurial leadership qualities are substantially more likely to navigate the development path successfully (Park, 2005; Swiercz and Lydon, 2002). Internal research and development capacity enables the continuous technological advancement necessary to maintain competitive positions in rapidly evolving markets (Ganotakis and Love, 2011), while collaborative relationships within supply chains and innovation ecosystems provide access to complementary capabilities and market intelligence accelerating commercialisation (Autio *et al*., 2000). Knowledge intensity—the degree to which ventures can leverage advanced scientific and technical knowledge—emerges as a particularly critical factor, which, successfully delivered, enables international expansion and competitive differentiation in global markets (Autio *et al*., 2000).

Successful high-tech startups thus have certain, distinctive traits. These include strong opportunity recognition by their founder(s) (Park, 2005); unique technologies creating defensible competitive advantages (Tornikoski *et al*., 2017); and entrepreneurial leadership from their CEOs in navigating uncertainty and mobilising resources (Swiercz and Lydon, 2002). Where present, these characteristics can enable HTYEFs to pursue innovation-driven strategies successfully despite their resource constraints and environmental turbulence (Warren and Hutchinson, 2000; Oakey, 2003). However, possessing these capabilities *alone* proves insufficient; HTYEFs must develop organisational structures capable of managing innovation processes while simultaneously satisfying the requirements of external stakeholders.

The multifaceted challenges confronting HTYEFs—resource constraints, information asymmetries, technological uncertainty, and dependence on external stakeholders—lead to fundamental demands on firm governance that are absent or, at least, less pronounced for established corporations. Traditional corporate governance frameworks designed to manage principal-agent conflicts between dispersed shareholders and professional managers are ill-adapted for entrepreneurial contexts, where founders simultaneously function as owners, managers and key intellectual capital holders while requiring sustained external financing from sophisticated investors with their own distinct objectives and governance expectations (Shleifer and Vishny, 1997; Daily *et al*., 2002). The governance configurations emerging from entrepreneurial financing decisions—encompassing ownership structures, board composition, and investor involvement—fundamentally shape whether ventures will successfully navigate development challenges to achieve sustainable competitive positions (Markman *et al*., 2001). However, the mechanisms by which the specific governance architectures arising from different funding source combinations influence entrepreneurial outcomes remain inadequately understood to this point, particularly with regard to whether governance complexity enhances performance through resource complementarity and credibility signalling or constrains outcomes through coordination costs and horizontal agency problems.

This literature review will establish the theoretical foundations that explain *why* governance matters in entrepreneurial contexts—agency theory and signalling theory—and then move to examining the specific governance dimensions that emerge from entrepreneurial financing decisions—investor heterogeneity, insider ownership, and ownership concentration—before synthesising empirical evidence on how governance structures influence performance and innovation outcomes in HTYEFs.

3.2 Theoretical Perspectives in Entrepreneurial Finance

Entrepreneurial finance scholarship examining how external equity funding and governance structures affect firm outcomes has been predominantly shaped by two theoretical frameworks: agency theory and signalling theory.

Agency theory (Jensen and Meckling, 1976; Ross, 1973) addresses conflicts arising when ownership and control separate, focusing on mechanisms to align divergent stakeholder interests and mitigate agency costs. Signalling theory (Spence, 1973; Connelly *et al.*, 2011) addresses information asymmetry problems, focusing on how informed parties credibly communicate quality to uninformed audiences through observable, costly signals. While both frameworks are relevant to entrepreneurial finance contexts—typically characterised by severe information asymmetry, a limited performance history, and governance complexity arising from heterogeneous investor participation—scholars tend to use them independently, leaving gaps in understanding regarding how these frameworks operate against each other (Bruton *et al.*, 2010; Cumming *et al.*, 2019).

This section examines how entrepreneurial finance research has used these theories, identifying key contributions, applications, and limitations, and noting the unresolved questions that led to the integrated approach developed for this research and described in Chapter 4.

3.2.1 Agency Theory and Horizontal Agency Costs

Agency theory provides a foundational framework for understanding relationships between principals and agents in organisations, serving as a central theoretical lens for examining governance challenges in entrepreneurial finance (Bosse and Phillips, 2016). The theory focuses on conflicts of interest that arise when individuals or groups delegate decision-making authority to others, suggesting that such delegation inherently involves a risk of goal misalignment since agents may act in their own self-interest, which may not be in the best interests of the principals (Jensen and Meckling, 1976; Ross, 1973). This misalignment creates agency costs, poses a critical concern in organisational economics (Jensen and Meckling, 1976) and is particularly problematic in relation to entrepreneurial ventures, where information asymmetries and governance complexities amplify agency problems compared to established corporations with professional management and mandated disclosure practices (Sahlman, 1990; Arthurs and Busenitz, 2003).

Jensen and Meckling (1976) is a foundational work that integrates theories of property rights, agency, and finance to create a comprehensive framework for understanding firm ownership structures. They identified that, due to the separation of ownership and control, decision-makers in many organisations do not bear the full financial consequences of their actions. Fama and Jensen (1983) extended this analysis by exploring incentives and conflicts between principals and agents that arise from the separation of decision management from decision control. They argue that organisational forms emerge to minimise agency and contracting costs, with ownership structures representing equilibrium solutions to these trade-offs. Corporate governance developed essentially to ensure that providers of capital receive the due returns on their investments while preventing managers from misusing or expropriating funds (Shleifer and Vishny, 1997). Agency costs, defined as the welfare loss from principal-agent misalignment, became central to this field. Early empirical research found that agency costs were lowest when managers held larger ownership stakes and highest when (non-owner) outsiders managed firms, also increasing with the number of non-manager shareholders (Ang *et al.*, 2000).

While agency theory originally developed to explain governance challenges in large corporations characterised by dispersed shareholders and professional management, the theory still proves relevant for entrepreneurial firms (Wright *et al*., 2009), though requiring important modifications to account for the specific dynamics of entrepreneurial finance (Kelly and Hay, 2002). Small and early-stage companies that are closely held present different agency problem configurations compared to established corporations, yet the fundamental insights of agency theory regarding divergent interests and asymmetric information between principals and agents are still applicable (Colombo *et al*., 2014). In entrepreneurial finance contexts, agency theory illustrates tensions between the longer-term vision of the entrepreneur(s) and the investor's quest for returns, generally over a shorter time horizon, framing these conflicts as agency costs that require active management through governance mechanisms (Fraser *et al*., 2015). A central concept with particular relevance to entrepreneurial finance is the concept of agency costs arising due to divergent interests and asymmetric information between principals and agents—generally for managers versus shareholders, but sometimes among shareholders themselves. In entrepreneurial contexts, misalignment manifests as entrepreneurs exhibiting a higher risk appetite and maintaining long-term visions for ventures while investors prioritise returns and liquidity options, creating conflicts that require governance interventions (Bitler *et al*., 2005).

Agency theory scholarship identifies three distinct types of agency problem, each with different implications for entrepreneurial firms (Panda and Leepsa, 2017). First, principal-agent conflicts can arise due to information asymmetry and differences in risk-sharing attitudes between owners and managers (Jensen and Meckling, 1976; Ross, 1973). This primarily refers to problems between owners and managers in organisations due to the separation of ownership from firm control. Misalignment of interests and lack of proper monitoring due to diffused ownership structures can lead to conflicts characterised as traditional principal-agent problems. Second, principal-principal conflicts can occur between shareholders themselves when the presence of different owners implies divergent preferences, goals, and risk perceptions concerning corporate strategies (Gogineni *et al*., 2022; Shleifer and Vishny, 1997). Third, principal-creditor conflicts occur between owners and debt providers when owners pursue riskier investment decisions against the preferences of their creditors (Berger and Udell, 1988; Jensen and Meckling, 1976). For entrepreneurial firms with heterogeneous external equity investments, principal-principal conflicts prove the most consequential, leading to what scholars term *horizontal agency costs* (Colombo *et al.*, 2013; Young *et al*., 2008). Horizontal costs arise because discrete principals have differing—and sometimes, conflicting—interests and preferences. The prevalence of these horizontal costs distinguishes entrepreneurial finance agency problems from traditional corporate governance challenges, which are much more likely to experience principal/agent conflicts (Colombo *et al*., 2014; Arthurs and Busenitz, 2003).

This distinction assumes critical importance because entrepreneurial firms are typically run by founder-entrepreneurs who maintain substantial ownership and operational control, in contrast to established corporations, typically run by salaried professionals with low equity stakes (Arthurs and Busenitz, 2003). The predominant agency problem in entrepreneurial ventures therefore shifts from traditional principal-agent conflicts toward horizontal conflicts among heterogeneous principals (Appelhoff *et al*., 2015). When ventures attract capital from multiple and varied sources—each bringing distinct objectives, expertise, and governance expectations—coordination challenges notably intensify (Cumming *et al*., 2019). Divergent preferences generate coordination costs, strategic ambiguity, and less than optimal decision-making as management attempts to satisfy multiple principals with incompatible objectives.

Horizontal agency costs can manifest in several forms, all of which impede entrepreneurial firm performance and development. Decision-making processes slow considerably when multiple investors with significant stakes and divergent preferences require consultation and consensus-building before strategic commitments are made (Bellavitis *et al*., 2023). Strategic direction becomes ambiguous when compromise solutions satisfy no stakeholder fully, resulting in ventures pursuing middle-ground strategies exploiting neither distinctive capabilities nor market opportunities effectively (Gogineni *et al*., 2022). Resource allocation decisions generate conflicts when investors disagree regarding appropriate investments in research and development, market expansion, operational infrastructure, or profitability enhancement (Dalziel *et al*., 2011). Founders and management teams consume considerable time and energy managing investor relationships, explaining decisions, justifying strategic choices, and mediating conflicts rather than focusing attention on business operations and opportunity exploitation (Neckebrouck *et al*., 2019). These coordination challenges prove particularly problematic in high-tech entrepreneurial contexts where rapid decision-making, strategic flexibility, and resource redeployment constitute critical success factors given intense competition and rapid technological change.

Colombo *et al*. (2013) provide empirical evidence on the relevance of horizontal agency costs to understanding entrepreneurial venture performance in an examination of agency relationships between owner-managers and non-manager individual shareholders in Italian high-tech firms. Their findings show that more owner-managers improve firm performance, while non-manager individual shareholders have negligible effects. This effect occurs because owner-managers create low horizontal agency costs through direct involvement and aligned interests, whereas non-manager shareholders cause high agency problems due to limited involvement, divergent preferences, and information asymmetries. Changes in the ownership structure can address knowledge and funding gaps, with ownership expansion having favourable impacts on firm performance through access to additional financial and non-financial resources and competencies (Colombo *et al*., 2014). Nevertheless, it is crucial to recognise that creating multiple owners could lead to agency costs rising, with a negative impact on a firm's overall performance, as increasing numbers and varieties of investors tend to amplify coordination challenges and governance complexity (Jensen, 1986), potentially constraining growth and limiting innovative activities carrying higher risk and longer time horizons.

Gogineni *et al*. (2022) conducted a large-scale study with data from more than 42,000 UK firms that found significant evidence of horizontal agency costs within private firms, noting that negative effects are amplified when vertical agency problems are simultaneously present. Their findings demonstrate that agency costs increase substantially as firms move from simple ownership structures with single owner-managers toward complicated structures involving multiple shareholders with varying degrees of involvement, interests, and control rights. Within each ownership structure, agency costs prove significantly higher when firms are not managed by owners, confirming traditional vertical agency problem predictions (Ang *et al*., 2000). However, their analysis reveals that horizontal agency costs are a substantial independent determinant of firm performance even when controlling for vertical agency problems, with the presence of multiple large shareholders creating coordination challenges distinct from principal-agent conflicts. Their research also identifies mitigation mechanisms, finding that the presence of a second large shareholder reduces horizontal agency costs by providing counterbalancing monitoring and preventing individual shareholder dominance. Furthermore, bank monitoring also improves private firm performance by addressing vertical and horizontal agency problems via lending covenants and financial oversight.

Effective corporate governance structures—including well-defined ownership structures and executive ownership arrangements—can mitigate agency costs, serving as counterpoints to horizontal agency problems (Zeckhauser and Pound, 1990). Such mechanisms are particularly important in entrepreneurial finance contexts where agency costs can be magnified due to the inherent uncertainties and complexities of start-up ventures (Cowling *et al*., 2012). Governance mechanisms that may address horizontal agency costs include clear contractual provisions specifying decision rights, approval thresholds, and conflict resolution procedures; a board composition that balances investor representation with independence and expertise; staged financing that allows investors to reassess commitments periodically based on achievement of milestones; and syndication arrangements wherein lead investors coordinate among investor group members, reducing the direct coordination burden on entrepreneurs (Meuleman *et al*., 2009; Cumming *et al*., 2019; Block *et al*., 2017). However, implementing these mechanisms generates costs and complexities that potentially offset the benefits of diverse investor involvement, indicating a fundamental trade-off between accessing varied resources, expertise, and networks through heterogeneous investor participation versus incurring coordination costs and strategic conflicts from managing multiple relationships (Bellavitis *et al*., 2023).

Although well established, agency theory is not without its critics. Organisational theorists have charged agency theory with being overly simplistic (Hirsch *et al*., 1987; Perrow, 1986), while microeconomists critique it as redundant and lacking precision (Kiser, 1999). Eisenhardt (1989) criticises agency theory for an over-focus on economic factors at the expense of sociological and psychological factors that also influence principal-agent relationships—particularly relevant in entrepreneurial settings where emotional factors and prior relationships can play significant roles. Wiseman *et al*. (2011) argue that the value of agency theory is limited to narrow contexts dominated by self-interested agents seeking wealth maximisation at the expense of principals. which challenges its generalisability. However, subsequent studies testing agency theory in nonprofit and community-based settings (Puyvelde *et al*., 2014; Mersland, 2009) have demonstrated an applicability beyond traditional corporate contexts. Nevertheless, the assumptions underlying agency theory merit consideration, especially regarding its applicability across diverse organisational contexts. Critics argue that agency theory's pessimistic assumptions about human behaviour and simplistic view of individual risk preferences may not accurately reflect the complexity of human behaviour and the various factors influencing individual interests and motivations (Cuevas-Rodríguez *et al.*, 2012). It is important to reflect on the contexts in which agency relationships occur and consider how these contexts may shape the interests of principals and agents respectively, and what mechanisms might be available for aligning those interests (Hill, 2024).

Scholars have proposed extensions to agency theory by incorporating other theoretical frameworks that may enhance its explanatory power. Dalziel *et al*. (2011) propose an integrated agency-resource dependence view, exploring the influence of director characteristics on research and development spending, as a precursor to innovation and entrepreneurial activity. This integrated approach expands the understanding of agency relationships and impacts on entrepreneurial outcomes by recognising that governance structures serve multiple functions beyond monitoring—that they also provide access to resources, expertise, and networks, enhancing organisational capabilities. Similarly, Arthurs and Busenitz (2003) examine the boundaries and limitations of agency theory in venture capitalist-entrepreneur relationships, arguing that while agency theory provides valuable insights for governance mechanisms and contractual arrangements, it inadequately captures collaborative value-creation aspects of successful VC investments. Their analysis suggests a stewardship theory perspective (Davis *et al.*, 1997), emphasising trust and the collaborative pursuit of goals, to complement the focus in agency theory on conflicts and monitoring as a way to deliver a more complete understanding of entrepreneurial finance relationships (Arthurs and Busenitz, 2003).

Despite the criticisms levelled against it, agency theory remains a robust analytical lens in entrepreneurial finance. Zahra and Filatotchev (2004) note that agency theory has been extensively used in corporate governance studies but argue that insufficient consideration has been given to how agency theory applies to younger, entrepreneurial companies facing unique challenges such as the liabilities of newness and smallness. This implies that agency theory would benefit from adaptation for entrepreneurial firm contexts with specific characteristics and challenges. Entrepreneurial ventures exhibit several distinctive features that affect how agency problems might manifest and the severity of implications for these firms compared to established corporations. It has been seen that the limited performance histories and significant intangible assets of, for example, HTYEFs amplify the information asymmetries between entrepreneurs and external investors, creating severe adverse selection problems wherein investors struggle assessing venture quality and management capability (Denis, 2004; Bellavitis *et al.*, 2023). Entrepreneurial firms operate in highly uncertain environments characterised by technological change, market evolution, and competitive dynamics, which makes outcome-based contracting difficult because performance metrics may reflect environmental factors rather than managerial effort or capability (Levratto *et al.*, 2018). Furthermore, while external investor engagement in strategic decision-making can offer benefits by providing expertise and resources, it also adds governance complexity, potentially causing conflicts regarding resource allocation and strategic direction (Forbes *et al.*, 2010). Finally, the dual role of the founder-entrepreneurs—as major shareholder and also as operational manager—blurs the traditional principal-agent distinctions, creating unique alignment and entrenchment dynamics absent in corporations with professional managers holding minimal equity stakes (Shleifer and Vishny, 1989; Cumming *et al*., 2021).

The natural response to alleviating information asymmetry problems within the agency theory framework involves considerable effort being undertaken by investors to negotiate complex contracts, often also requiring their direct, active involvement in business operations (Mitnick, 1975). Contracts between investors and entrepreneurial firms tend to include more stringent information disclosure obligations compared with agreements for publicly listed firms with established reporting requirements and market scrutiny (Cumming, 2008). Further measures to reduce agency costs can include staged financing, which manages investment through multiple rounds tied to specific milestones that must be achieved before additional funds are released. Staging enables investors to gain updated information on venture progress and quality, thereby reducing information asymmetry over time (Cumming and Johan, 2017). Control rights provisions define conditions under which investors gain greater governance authority, such as board control or veto rights on major decisions. These activate if performance falls below thresholds or if additional financing beyond initial commitments is required (Kaplan and Strömberg, 2003). These mechanisms align the interests of entrepreneurs and investors while protecting investors from opportunistic behaviour and performance shortfalls. However, they impose additional costs by constraining strategic flexibility, by consuming management time on investor relations and reporting, and by delaying any decisions that need investor approval.

The agency theory framework suggests that the consequential costs between investors and entrepreneurial firms are likely to constrain available funds and require additional resource allocation by entrepreneurial firms to address the supplementary (governance) processes imposed by investors. The theory holds that as the number and variety of investors increase, higher agency costs can be expected (Jensen, 1986), potentially affecting growth and innovation by consuming resources or limiting those innovative activities that carry higher risk and longer development timelines. Funding constraints and additional resource utilisation to address information disclosure requirements affect firms' abilities to grow due to a lack of funds when needed, which may limit innovative activities. Many high-tech entrepreneurial ventures keep detailed information on innovative products and services confidential to protect intellectual property and competitive advantages, resulting in reliance mainly on internal cash flows for funding investments, limiting their growth potential (Hall, 2010).

Highly innovative entrepreneurial firms also often face limited access to debt financing due to the unavailability of tangible securities to serve as collateral, the high information asymmetries surrounding intangible assets and their uncertain future prospects. Therefore, equity financing through external investments becomes an appropriate option for young and innovative ventures under certain conditions, despite information disclosure requirements and governance changes accompanying external equity participation (Carpenter and Petersen, 2002).

3.2.2 Signalling Theory and Information Asymmetry

Signalling theory is a foundational framework for understanding how parties communicate information credibly in contexts characterised by asymmetric information, where one party (the sender) possesses more or better information than another party (the receiver). Originally conceptualised by Spence (1973) to explain education's role in labour market outcomes, signalling theory contends that in markets where one party holds more information than another, the informed party can communicate its quality or objectives through signals that are understood to be credible. The theory has emerged as a critical framework within various management disciplines, addressing the complexities of communication between parties with information disparities (Connelly *et al.*, 2011). It argues that the (better informed) sender can successfully convey valuable information to the (less well placed) receiver by using deliberate signals that would be costly or difficult for low-quality actors to replicate. Spence's (1973) seminal work established the core premise: a sender chooses whether and how to communicate information, and a receiver must interpret that signal to make decisions under uncertainty. This conceptual framework has proven particularly influential in strategic management, entrepreneurship, and human resource management.

The theoretical underpinnings of signalling theory emerged from efforts to understand management of information asymmetry—how parties with different levels of information make decisions (Connelly *et al.*, 2011; Kurlat and Scheuer, 2020). Seminal work undertaken in the 1970s—Spence's job market signalling model in particular—established that observable, costly signals, such as education, could be used to convey unobservable qualities, such as worker productivity, thereby addressing adverse selection problems inherent in markets where quality cannot be directly observed prior to transacting (Spence, 1973, 1976). For a signal to be effective in separating high-quality from low-quality actors, its cost must be negatively correlated with the sender's underlying quality, making it prohibitively expensive for lower-quality individuals to mimic the signal convincingly (Connelly *et al.*, 2011; Taj, 2016). This inverse relationship between signal cost and sender quality constitutes the theoretical mechanism enabling signals to credibly convey private information to less informed receivers.

In signalling theory, the distinction between signals and indices proves fundamental to understanding which attributes can convey strategic information (Spence, 1973; Karasek and Bryant, 2012). Indices measure characteristics that cannot be strategically manipulated by individuals, such as gender or race, whereas signals address alterable attributes that actors can invest in or acquire at some cost to convey information about unobservable underlying qualities. The interaction of signals and indices generates parameters in conditional probability distributions that define the receiver's beliefs about sender quality (Spence, 1973). The critical distinction lies in strategic manipulability: since signals can be acquired by actors willing to incur the associated costs, there are possibilities for deception if signal costs are not severe enough to sufficiently differentiate sender types. A signal cannot effectively distinguish one actor from another unless the costs of signalling correlate negatively with the underlying productive ability or quality being signalled (Spence, 1973; Connelly *et al.*, 2011).

The credibility of signals constitutes the central mechanism through which signalling theory generates informational value in environments characterised by asymmetric information

(Connelly *et al.*, 2011; Taj, 2016). For signals to convey reliable information, they must satisfy three fundamental conditions: observability—receivers must be able to perceive the signal; costliness—signals must impose differentiating levels of costs on senders; and reliability—there must be a correlation with the underlying unobservable quality (Colombo, 2020; Connelly *et al.*, 2011; Spence, 1973). Observability ensures that potential receivers can perceive and evaluate the signal being sent. Costliness prevents signal mimicking by low-quality actors who might otherwise pretend to be high-quality by adopting signals associated with superior types (Taj, 2016). The costliness condition must impose unequal burdens across different sender types: specifically, the marginal cost of signalling must be higher for low-quality senders than for high-quality senders, creating a separating condition where only genuinely high-quality actors find signalling worthwhile at equilibrium prices or outcomes (Spence, 1973; Connelly *et al.*, 2011).

Recent theoretical extensions have begun addressing the cognitive foundations of signal interpretation, recognising that signalling theory's traditional focus on equilibrium properties has given insufficient attention to the psychological and cognitive processes through which individual receivers attend to, process, and interpret signals (Drover *et al.*, 2018; Connelly *et al.*, 2011). This cognitive perspective acknowledges that receivers face attentional limitations and must make decisions about which signals to focus on when confronted with multiple simultaneous signals from diverse sources. Drover *et al.* (2018) advance a cognitive view of signalling theory that explicitly models individual attention to signals and the interpretation of signal sets, rather than treating signal reception as a passive process of Bayesian updating. Their framework recognises that the prior beliefs, expertise, and contextual knowledge of the receiver shape which signals receive attention and how signals are weighted when forming quality assessments. This cognitive approach proves particularly relevant in entrepreneurial finance contexts, where potential investors receive numerous signals and must allocate limited attention across these information sources (Huang *et al.*, 2021).

Building on the foundational theories, research from the early 2000s onwards increasingly applied signalling theory to entrepreneurial and corporate finance, examining how firms mitigate information asymmetry when seeking capital (Ragozzino and Reuer, 2007; Hoenig and Henkel, 2015). Specific corporate actions and organisational attributes function as signals in this context. Initial public offerings (IPOs) serve as multi-faceted signals, simultaneously conveying information about firm value, growth readiness, and management quality while subjecting the firm to enhanced disclosure requirements and market scrutiny (Ragozzino and Reuer, 2007). Patents also serve as particularly powerful signals for startup financing in technology-intensive contexts, conveying credible information about innovative capability and intellectual property protection that external investors can objectively evaluate (Hsu and Ziedonis, 2013; Conti *et al.*, 2013). However, patents may not capture all innovation types effectively, particularly business model innovations or service innovations, suggesting that patent signals provide incomplete coverage of innovative output and must be complemented by alternative indicators (Conti *et al.*, 2013).

The most recent evolution of signalling theory—primarily since the late 2010s—extends the framework to complex environments with multiple stakeholders beyond the traditional investor-entrepreneur pairs (Huang *et al.*, 2021; Park, 2023). Contemporary research investigates how firms send and manage signals directed at diverse audiences, including customers, employees, regulators, and the public, simultaneously addressing information asymmetries across multiple relationships. For example, recent studies explore how Environmental, Social, and Governance (ESG) information functions as a signal in multi-stakeholder contexts, conveying credible information about firm values, operational sustainability, and long-term orientation (Ahmad *et al.*, 2023). Similarly, recent scholarship addresses new settings such as reward-based crowdfunding, where the act of sharing information with potential backers constitutes a quality signal that reduces information asymmetry and supports financial contributions (Shneor and Munim, 2019). Current signalling research focuses on multi-stakeholder dynamics and cognitive processes, reflecting the complex informational environments of modern entrepreneurial ecosystems.

3.2.3 Theoretical Integration and Competing Predictions

Agency theory and signalling theory generate fundamentally different predictions regarding how governance characteristics influence entrepreneurial firm outcomes, creating theoretical tensions that have remained unresolved in existing literature. Agency theory emphasises that governance complexity—heterogeneous investor participation, multiple blockholders, and divergent stakeholder interests—generates coordination costs, strategic uncertainty, and decision-making delays that constrain firm performance and innovation (Young *et al.*, 2008; Colombo *et al.*, 2014; Gogineni *et al.*, 2022). Coordination costs may arise from conflicts regarding strategic direction, resource allocation, innovation investment, and exit timing where multiple principals hold incompatible interests (Dalziel *et al.*, 2011; Bellavitis *et al.*, 2023). Conversely, signalling theory emphasises governance diversity as a credible quality signal to external audiences—enhancing firm reputation, facilitating stakeholder cooperation, and supporting value creation through mechanisms beyond direct investor participation (Connelly *et al.*, 2011; Hsu, 2004; Pollock and Gulati, 2007). Multiple independent investor types validate firm quality through investment commitments sending external stakeholders powerful multi-stakeholder credibility signals that enhance cooperation (Stuart *et al.*, 1999; Certo *et al.*, 2001).

Scholars have recognised that entrepreneurial firms realistically experience both mechanisms simultaneously, rather than one to the exclusion of the other (Bruton *et al.*, 2010; Cumming *et al.*, 2019). Governance structures generate coordination costs internally while simultaneously sending signals externally to potential employees, customers, suppliers, and other investors (Colombo, 2020; Filatotchev and Wright, 2011; Connelly *et al.*, 2011). The effect on outcomes depends on whether agency costs or signalling benefits predominate, a question that remains empirically unresolved in the current entrepreneurial finance literature (Bruton *et al.*, 2010; Cumming *et al.*, 2019). Filatotchev and Wright (2011) argue for integrating multiple theoretical lenses to understand governance effects more comprehensively, recognising that governance characteristics operate through multiple concurrent mechanisms. However, most empirical research applies a single theoretical framework—either examining agency costs in isolation (Colombo *et al.*, 2014; Gogineni *et al.*, 2022) or focusing on signalling benefits (Hsu, 2004;

Pollock and Gulati, 2007)—leaving a gap in our understanding of how these mechanisms interact to determine net outcomes.

Institutional environment characteristics—legal protections, the sophistication of the investor community, and market transparency—can be expected to moderate the relationship between governance characteristics and firm outcomes. Governance mechanisms that enable coordination among heterogeneous investors—board structure, contractual provisions, and syndication arrangements—play a similar moderating role (Cumming *et al*., 2010; Bruton *et al*., 2010). Depending on the governance dimension examined (investor heterogeneity, insider ownership, or ownership concentration), different theoretical predictions are generated, and there is a similar effect according to whether the outcome measured is financial performance or innovation, all of which adds complexity to understanding how theoretical mechanisms operate in practice. The existing literature provides limited guidance on boundary conditions determining when agency costs or signalling benefits would dominate, on what governance mechanisms enable firms to capture signalling benefits while mitigating coordination costs, and on how agency costs and signalling benefits interact as governance complexity increases (Filatotchev and Wright, 2011; Cumming *et al*., 2019; Bellavitis *et al*., 2017).

These theoretical tensions and unresolved questions have driven the integrated theoretical approach applied in this research, as detailed in Chapter 4. In summary, an integrated approach sees governance architecture as generating both agency costs and signalling benefits by operating through distinct mechanisms requiring simultaneous examination. Building on these tensions, this thesis treats each governance dimension as a joint carrier of both agency and signalling mechanisms rather than allocating different variables to different theories. Investor heterogeneity, insider ownership and ownership concentration simultaneously determine the distribution of control rights inside the firm and the quality and intensity of signals to external stakeholders. An integrated framework traces the net effect of any governance configuration as the outcome of underlying trade-offs between internal coordination and incentive alignment on the one hand and credibility signalling to access and secure external resources on the other.

An integrated framework yields a more precise set of predictions than either theory in isolation. Rather than asking whether increasing or decreasing a particular governance feature is ‘good’ or ‘bad’, the framework interrogates what conditions mean a given configuration puts the firm in a position where signalling and resource benefits dominate over horizontal agency costs (or vice versa). In doing so, it explains why the same governance characteristics can be associated with positive outcomes in some contexts and negative outcomes in others, and it motivates the competing hypotheses in Chapter 4 that empirically identify which mechanism dominates for performance and innovation in UK HTYEFs. Section 3.3.1 below elaborates further on how existing empirical studies have applied these theoretical frameworks, documenting predictions and the mixed evidence that underscore the necessity for an integrated theoretical framework.

3.3 Entrepreneurial Finance Research

Entrepreneurial finance encompasses the intersection of two distinct fields—*entrepreneurship* and *finance*. Historically, researchers in the field of finance have excluded entrepreneurship from the field of corporate finance, arguing that issues in entrepreneurial finance are sufficiently different as not to be applicable to known traditional finance theories (Denis, 2024). However, more recently, it has been recognised that entrepreneurial finance and traditional corporate finance share two fundamental issues—agency problems and problems of information asymmetry (Denis, 2004).

Research in entrepreneurial finance has evolved significantly over recent decades (Ewens and Farre-Mensa, 2022; Nguyen *et al*., 2020; Cumming and Groh, 2018), reflecting both the growing economic importance of entrepreneurial ventures and the increasing complexity of capital allocation to these firms (Bonini *et al*., 2019; Giudici *et al*., 2021). The academic investigation of entrepreneurial finance confronts distinctive challenges: severe information asymmetries between entrepreneurs and financiers; the private and often undisclosed nature of investment transactions; the heterogeneity of both funding sources and recipient firms; and the difficulty of obtaining comprehensive longitudinal data (Denis, 2004; Cumming *et al*., 2019). These challenges have fundamentally shaped research design choices, influencing which questions receive scholarly attention and creating systematic patterns in how research has developed. This section examines existing patterns of research, with the more detailed analysis of specific research gaps provided in Section 3.9 as a mapping of the gaps that have informed the research questions underpinning this thesis.

The entrepreneurial finance literature exhibits segmentation (Cumming and Vismara, 2016)—that is, a tendency for research to focus on individual funding sources in isolation rather than examining how multiple sources interact in practice. Venture capital (VC) research represents the most extensively developed stream, benefiting from commercial databases (VentureOne, ThomsonOne) that systematically track VC investments, valuations, and outcomes. This has enabled rich investigation of VC monitoring through board representation (Lerner, 2022; Çelikyurt *et al*., 2012; Gabrielsson and Huse, 2002); professionalisation of startups through recruiting external management (Hellmann and Puri, 2002); staged capital infusions to maintain control rights (Gompers, 1995; Giudici and Paleari, 2000; Cherif and Elouaer, 2008); and sophisticated contractual mechanisms using convertible securities to align incentives (Kaplan and Strömberg, 2003, 2004). Research has examined VC from multiple theoretical perspectives: agency theory explanations of monitoring and contractual structures (Gompers, 1995; Kaplan and Strömberg, 2003); signalling theory interpretations of VC endorsement effects (Megginson and Weiss, 1991; Certo, 2003; Svetek, 2022); resource-based view analyses of value-adding services beyond capital (Hellmann and Puri, 2002; Zu Knyphausen-Aufseß, 2005); and institutional perspectives on how legal environments shape VC markets across countries (Cumming *et al*., 2010; Gantenbein *et al*., 2019).

Business angel (BA) research remains markedly less developed due to severe data constraints, with studies relying predominantly on surveys of BAs or angel networks (Harrison and Mason, 2000; Wright *et al*., 2015), case studies, or hand-collected data from specific geographies. Research suggests that BAs serve a distinct niche, providing seed financing before firms reach scales attractive to institutional VCs, often investing in entrepreneurs within personal networks, and facilitating subsequent VC rounds through certification (Wong, 2002; Bonini *et al.*, 2019; Capizzi *et al.*, 2021). However, evidence on BA value-creation mechanisms remains limited compared to VC research.

Research on relationship lending (Berger and Udell, 2002) and trade credit dynamics (Deloof and Vanacker, 2018) remains relatively underdeveloped. The most recent research focuses on digitally enabled financing mechanisms, particularly equity crowdfunding and initial coin offerings (ICOs), which have emerged since 2013 as alternatives to traditional intermediated finance (Bellavitis *et al.*, 2023; Block *et al.*, 2017; Mollick, 2014). These mechanisms enable ventures to raise funds directly from dispersed individual investors via online platforms, potentially democratising entrepreneurship by reducing dependence on traditional gatekeepers (Belleflamme *et al.*, 2014). Such mechanisms create distinctive governance challenges through dispersed ownership and collective action problems (Hornuf and Schwienbacher, 2018).

This segmentation of research by funding source arises from multiple factors: data availability constraints (VC databases capture VC investments but not angel or other financing received by the same firms); theoretical simplicity issues (modelling multiple investor types with heterogeneous objectives introduces substantial complexity); disciplinary boundaries between finance and entrepreneurship journals; and geographic concentration of studies on US markets where data infrastructure is most developed (Cumming and Vismara, 2016; Bellavitis *et al.*, 2017). The net effect has been fragmented knowledge—researchers develop a profound understanding of specific financing mechanisms while lacking comprehensive frameworks that can explain how firms navigate the entrepreneurial finance ecosystem over an entire lifecycle.

Early foundational work established that optimal capital structures shift as firms mature, with different mixes of equity and debt appropriate at different developmental stages (Myers, 1984; Berger and Udell, 1998). However, subsequent research has predominantly examined single financing episodes, VC rounds, BA investments, and bank loans, rather than tracing how firms sequentially access multiple funding sources and how prior financing decisions constrain or enable future options (Denis, 2004; Bellavitis *et al.*, 2017). This represents a fundamental disconnect between research approaches and empirical reality: while scholars study funding sources in isolation, entrepreneurial firms assemble portfolios of funding sources that may have been accessed sequentially and/or simultaneously, with complex interactions among investor types, ownership structures, and governance mechanisms that remain poorly understood (Bellavitis *et al.*, 2017; Cumming *et al.*, 2019).

The relationship between ownership structures, governance mechanisms, and entrepreneurial firm performance represents an opportunity for entrepreneurial finance research to connect funding decisions with organisational outcomes. Traditional corporate governance research—focused predominantly on large public corporations—has established that ownership concentration affects monitoring effectiveness and potential for value extraction, with dispersed ownership creating free-rider problems in relation to monitoring costs while concentrated ownership enables dominant shareholders to extract private benefits (Shleifer and Vishny, 1986). However, entrepreneurial finance research reveals that these relationships manifest distinctively in early-stage ventures where information asymmetry is more severe, exit horizons are uncertain, and active involvement by investors is the norm compared to the passive monitoring characteristic of public company shareholders (Denis, 2004; Bellavitis *et al.*, 2023).

Methodological and data challenges fundamentally constrain what questions entrepreneurial finance researchers can address (Denis, 2004; Cumming and Vismara, 2016). Unlike publicly traded firms—where share prices, financial statements, and governance structures are disclosed continuously and comprehensively—entrepreneurial firms operate in relative privacy. Most financing transactions occur privately without disclosure obligations; valuations remain undisclosed except when firms reach exit events such as an Initial Public Offering (IPO) or acquisition; and detailed operational and financial data are unavailable to researchers (Kortum and Lerner, 2000). Consequently, research has systematically focused on observable subsets: firms that obtain VC funding (captured in commercial databases); firms that go public (IPO filings become available); or firms that participate in surveys (subject to response biases).

Each approach introduces selection bias due to the absence of unobservable populations, such as firms that sought VC funding but failed to secure it; firms that successfully grew without institutional investment; and firms that failed before reaching exit events. These systematically differ from the observed samples in ways that can be assumed—but not proved—to correlate with performance outcomes (Denis, 2004; Cumming and Johan, 2017). Additionally, estimating the causal effects of financing sources or contractual mechanisms on entrepreneurial firm outcomes risks problems with endogeneity, as financing is not randomly allocated but arises from matching processes in which sophisticated investors choose firms with superior, but unobservable attributes (Chemmanur and Fulghieri, 2014). The existing research also has a geographic concentration on US markets given that this is where the data infrastructure is most developed (Cumming and Vismara, 2016)—though acknowledging that the volume of non-US research has increased considerably in recent years, which will progressively reshape the field.

The most substantial gap in entrepreneurial finance research concerns integration—understanding how multiple funding sources interact rather than studying each in isolation (Bellavitis *et al.*, 2017; Cumming *et al.*, 2019). Despite evidence that entrepreneurial firms will access capital from multiple sources both sequentially and simultaneously—BA investment followed by VC rounds, bank debt alongside equity investment, and crowdfunding campaigns preceding or following institutional funding—research into how these sources interact remains limited (Cumming and Vismara, 2016). Critical questions remain unresolved: Do different investor types exhibit complementary value-addition, or does investor heterogeneity create agency costs through conflicting objectives and coordination challenges? How do prior financing choices constrain subsequent options? Does early-stage angel investment with particular contractual terms limit VC attractiveness due to unfavourable liquidation preferences or board control allocations? Conversely, does successful crowdfunding certification facilitate VC investment by validating market demand and reducing information asymmetry (Kaminski *et al.*, 2019)? These questions require multi-source longitudinal data tracking complete financing histories of in-scope firms—all equity rounds, debt facilities, and alternative financing—and setting these histories alongside firm governance structures and performance outcomes, data that remain exceptionally difficult to construct (Denis, 2004).

A related gap concerns asymmetric attention to performance versus innovation outcomes in entrepreneurial finance research (Chemmanur and Fulghieri, 2014). While research extensively examines how financing context affects traditional performance metrics, growth, survival, profitability, and exits, innovation outcomes have received less systematic investigation in entrepreneurial finance contexts. Innovation outputs such as patents, research and development (R&D) productivity, product launches, and technological breakthroughs represent primary economic rationales for supporting entrepreneurial finance yet remain understudied relative to financial performance measures. This is a notable gap, given that financing sources may differentially affect performance versus innovation: VC might enhance performance through professionalisation while imposing short-term exit pressures that constrain long-term R&D investments; conversely, patient capital from BAs or family offices might enable riskier innovation activities despite slower profitability growth (Bertoni *et al.*, 2013). Similarly, those governance mechanisms that optimise decision-making efficiency for financial performance, concentrated authority, and rapid consensus may differ substantially from governance structures that support innovation, diverse perspectives, constructive conflict, and tolerance for experimentation (Vandenbroucke *et al.*, 2016). Understanding how governance architecture influences performance and innovation outcomes—and what trade-offs exist between them—constitutes an important contribution to the field of entrepreneurial finance research.

The entrepreneurial finance literature thus establishes that funding decisions generate consequences beyond capital provision alone, creating governance structures with persistent effects on resource access, strategic decision-making, and external stakeholder perceptions. For HTYEFs operating under conditions of severe information asymmetry, limited collateral, and high uncertainty, investor composition decisions prove especially consequential as they fundamentally shape organisational development trajectories, innovation capacity, and performance outcomes, as covered in the upcoming empirical chapters. Before examining these specific research streams in detail, the following subsection establishes the theoretical foundations underlying entrepreneurial finance research by comparing agency theory and signalling theory predictions for the governance dimensions examined by this research.

3.3.1 Theoretical Frameworks in Entrepreneurial Finance Research

The existing entrepreneurial finance research into governance effects on firm outcomes has predominantly employed two complementary yet theoretically distinct frameworks: agency theory and signalling theory. Both frameworks prove relevant to HTYEFs (Young *et al.*, 2008; Colombo *et al.*, 2014) but generate competing predictions. Agency theory argues that the governance complexity arising from heterogeneous investor participation and multiple blockholders generates coordination costs and decision-making delays that constrain performance and innovation (Jensen and Meckling, 1976; Young *et al.*, 2008). Signalling theory argues that governance diversity signals quality to external audiences, enhancing cooperation (Spence, 1973; Connelly *et al.*, 2011; Hsu, 2004). This question—whether governance complexity constrains or enhances outcomes—is largely unresolved by current entrepreneurial finance research (Bruton *et al.*, 2010; Cumming *et al.*, 2019). The research predominantly uses the frameworks independently, limiting understanding of how both mechanisms operate and interact in practice (Filatotchev and Wright, 2011; Cumming *et al*., 2010).

Reconciling these competing theoretical predictions is essential to be able to interpret the empirical patterns documented in entrepreneurial finance literature. Agency theory studies reveal high coordination costs, strategic conflicts, and decision-making inefficiencies from governance complexity, especially when investors with divergent goals invest simultaneously (Colombo *et al*., 2014; Gogineni *et al*., 2022; Young *et al*., 2008). These studies indicate that multiple shareholders create horizontal agency costs through power imbalances, conflicting preferences regarding innovation investment, exit timing, and strategic direction, and the requirement for management time to be devoted to investor relations rather than core business operations (Bellavitis *et al*., 2023; Neckebrouck *et al*., 2019). Conversely, studies emphasising signalling theory perspectives have identified positive market responses to governance diversity, enhanced stakeholder cooperation, improved access to complementary resources, and superior performance outcomes associated with heterogeneous investor participation (Hsu, 2004; Pollock and Gulati, 2007; Connelly *et al*., 2011). Such studies argue that observable investor heterogeneity functions as a credible quality signal—that multiple independent investors have validated a firm's prospects attracts subsequent investors, facilitates customer relationships, and improves employee recruitment (Stuart *et al*., 1999; Certo *et al*., 2001).

However, entrepreneurial firms realistically experience both mechanisms simultaneously rather than one to the exclusion of the other. Governance structures generate coordination costs internally—management must navigate investor relationships, reconcile divergent preferences, and mediate conflicts—while simultaneously sending signals externally, indicating quality and credibility to external stakeholders. The net effect on firm outcomes depends critically on whether agency costs or signalling benefits dominate in specific contexts, a question that remains empirically unsettled in existing entrepreneurial finance literature (Bruton *et al*., 2010; Cumming *et al*., 2019). Similarly, depending on the governance dimension examined—investor heterogeneity, insider ownership, or ownership concentration—different predictions are generated by the theory, and predictions also vary depending on the outcome measured (financial performance versus innovation). These variations add further complexity to attempts to understand how the theoretical mechanisms (agency versus signalling) operate in practice.

The following table contrasts agency theory and signalling theory predictions across the three governance dimensions of investor heterogeneity, insider ownership, and ownership concentration. For each dimension, the table compares agency theory predictions (costs and coordination challenges) against signalling theory predictions (credibility and stakeholder benefits), documents empirical evidence, and identifies unresolved theoretical tensions. This theoretical comparison provides a framework for interpreting empirical patterns in the remaining sections of this chapter and motivates the research's integrated theoretical approach, which examines both mechanisms operating simultaneously.

Table 3-1 Theoretical Predictions Matrix – Agency Theory versus Signalling Theory

Governance Dimension	Agency Theory Prediction	Signalling Theory Prediction	Empirical Evidence Summary	Unresolved Tensions
Investor Heterogeneity (Diversity of external equity sources)	NEGATIVE EFFECT: Increasing investor heterogeneity generates horizontal agency costs through: • Coordination complexity requiring management time/energy • Strategic ambiguity from compromising between divergent preferences • Decision-making delays from multiple approval requirements • Resource allocation conflicts *Key sources: Colombo et al. (2014); Gogineni et al. (2022); Young et al. (2008)*	POSITIVE EFFECT: Diverse investor base signals quality through: • Multiple independent validation • Access to complementary resources and networks • Enhanced credibility attracting customers/partners • Market reputation benefits *Key sources: Hsu (2004); Connelly et al. (2011); Pollock & Gulati (2007)*	MIXED: Bruton *et al*. (2010) find institutional environment moderates effects; Dalziel *et al*. (2011) document both resource benefits and coordination costs; Gogineni *et al*. (2022) show second blockholder reduces agency costs	Critical question: Under what context do signalling benefits outweigh agency costs? Role of governance mechanisms in mitigating coordination costs remains unclear
Insider Ownership (Equity held by founder-managers)	NON-MONOTONIC: (1) Low-moderate range (0-25%): Positive effect through convergence of interests; managers internalise wealth effects, aligning incentives with external shareholders (Jensen & Meckling, 1976) (2) High range (>50%): Negative effect through entrenchment, insiders resist external discipline, extract private benefits, pursue risk-averse strategies (Morck *et al*., 1988; Stulz, 1988)	POSITIVE EFFECT (at moderate levels): Insider ownership signals: • Managerial confidence in firm prospects (credible commitment) • Alignment with shareholder interests reducing agency concerns • Founder commitment to long-term value creation *Key sources: Leland & Pyle (1977); Certo et al. (2001)*	NON-MONOTONIC CONFIRMED: Morck *et al*. (1988), McConnell & Servaes (1990), Short & Keasey (1999) document inverted-U relationships; Colombo *et al*. (2014) find optimal range 10-40% for entrepreneurial firms; Tarillon (2022) confirms 20-40% optimum	Critical question: What determines optimal threshold? Does it vary by firm lifecycle stage, sector, institutional context? How do insider ownership effects differ for performance vs innovation?
Ownership Concentration (Distribution among blockholders)	DUAL EFFECT: (1) Monitoring benefit: Concentrated ownership solves free-rider problem, large shareholders have incentives to monitor actively (Shleifer & Vishny, 1986) (2) MISUSE risk: Dominant blockholders extract private benefits through self-	POSITIVE EFFECT (with multiple blockholders): Balanced concentration signals: • Effective governance through mutual monitoring • Protection of minority interests • Strategic capability through diverse	COMPLEX: Laeven & Levine (2008) and Maury & Pajuste (2005) find multiple blockholders enhance performance; Konijn *et al*. (2011) show contested control creates value; extreme concentration (single dominant shareholder) constrains performance	Critical question: Optimal concentration level and composition? How many blockholders is optimal? Does investor type composition matter?

	dealing, related-party transactions (Claessens *et al.*, 2002; Villalonga & Amit, 2006)	perspectives • Reduced entrenchment risk *Key sources: Connelly et al. (2011); Laeven & Levine (2008)*	(Villalonga & Amit, 2006)	

Note: This table contrasts predictions from agency theory (emphasising coordination costs and conflicts) and signalling theory (emphasising credibility and certification benefits) for the three governance dimensions examined in this research. The empirical evidence column synthesises existing findings; the unresolved tensions column identifies theoretical gaps this research addresses.

3.4 Investor Heterogeneity and Its Implications

The composition of a firm's investor base—the mix of VC, BAs, corporate investors, financial institutions, and other equity providers—constitutes a fundamental governance characteristic with potentially far-reaching implications for entrepreneurial firm development, strategic decision-making, and performance outcomes (Cumming *et al.*, 2019; Bellavitis *et al.*, 2017). Research on investor heterogeneity has evolved substantially, moving from theoretical frameworks to empirical investigations that demonstrate two opposite effects—resource complementarity benefits in certain contexts and coordination costs arising from divergent investor objectives in others (Colombo *et al.*, 2013, 2014; Gogineni *et al.*, 2022). Understanding how investor heterogeneity affects governance architecture, the configuration of ownership, control rights, board composition, and the decision-making process proves essential for comprehending performance and innovation outcomes in entrepreneurial firms with complex capital structures (Filatotchev and Wright, 2011; Vandenbroucke *et al.*, 2016; Conti *et al.*, 2025).

Early research challenged the simplistic assumption that institutional investors behave uniformly, arguing instead that their diverse objectives, capabilities, and time horizons lead to fundamentally different firm-level behaviours and outcomes (Brickley *et al.*, 1988). The insight that investor heterogeneity creates differential effects provided a foundation for subsequent research examining how entrepreneurial firms may benefit or suffer from diverse investor participation (Bruton *et al.*, 2009, 2010). Some scholars applied resource-based perspectives to argue that firms assembling diverse investor types gain access to complementary resources, financial capital, strategic guidance, technical expertise, market knowledge, and network connections that individual investor types cannot supply independently (Harrison *et al.*, 2001; Das and Teng, 2000). Resource complementarity arguments, however, represent only one theoretical lens applied to investor heterogeneity questions (Kor *et al.*, 2009). Agency theory offers a counterbalancing perspective by highlighting that when principals possess varied interests, objectives, or risk preferences, the consequence is that conflicts, principal-principal costs, or horizontal agency costs can arise, creating coordination challenges, strategic disagreements, and governance complexities, offsetting any resource benefits (Young *et al.*, 2008; Dalziel *et al.*, 2011; Bruton *et al.*, 2009). These conflicting findings reveal a core tension within investor heterogeneity research: while diverse investors may bring varied capabilities, their heterogeneity simultaneously creates potential for costly conflicts of interest arising from divergent priorities (Gogineni *et al*., 2022; Colombo *et al*., 2014). Unpacking this tension to understand how principal-principal conflicts may emerge, intensify, or be mitigated is a central concern for this thesis's empirical investigation of governance effects on HTYEF outcomes.

Empirical research testing the effects of investor heterogeneity has focused substantially on trade-offs between potential benefits and demonstrated agency costs in specific entrepreneurial contexts, including high-tech firms, IPOs, and VC-backed companies (Bruton *et al*., 2010). Studies applying multiple agency theory to private equity (PE) contexts have demonstrated that different investor types exert differential impacts on firm performance, with effects moderated substantially by institutional environment characteristics, including legal protections, market development, and regulatory frameworks (Bruton *et al*., 2009, 2010; Cumming *et al*., 2010). These studies have clarified that principal-principal conflicts arise not from investor heterogeneity per se but specifically when principals hold incompatible interests regarding exit timing, strategic direction, risk tolerance, or resource allocation priorities—circumstances that are likely to arise in particular when investor types with fundamentally different objectives participate simultaneously (Dalziel *et al*., 2011; Colombo *et al*., 2013).

These findings demonstrated that the net effects of investor heterogeneity depend on specific configurations, such as the particular investor types involved, their respective ownership stakes, their governance participation levels, and coordination mechanisms employed to manage potential conflicts (Filatotchev and Wright, 2011; Cumming and Johan, 2017). Research on private firms has extended these insights, showing that unequal ownership stakes among diverse investors create horizontal agency costs through power imbalances, divergent incentives, and coordination challenges, with costs amplified when combined with traditional vertical agency problems arising from the separation of ownership and control characteristic of entrepreneurial firms with external equity financing (Gogineni *et al*., 2022; Young *et al*., 2008). Collectively, empirical studies confirm that diverse ownership may provide necessary resources but may also introduce coordination challenges and principal-principal conflicts that can undermine performance unless governance mechanisms can effectively balance out these competing interests (Colombo *et al*., 2013, 2014; Dalziel *et al*., 2011; Bruton *et al*., 2010).

Contemporary scholarship has shifted analytical focus toward external perceptions of investor diversity, exploring how investor heterogeneity functions as a positive market signal influencing firm valuation, stakeholder cooperation, and access to complementary resources beyond direct investor contributions (Connelly *et al*., 2011; Hsu, 2004). This body of work leverages signalling theory to explain how observable characteristics of a firm's investor base convey information to external stakeholders—potential investors, customers, suppliers, employees, and strategic partners—operating under conditions of severe information asymmetry regarding entrepreneurial firm quality, management capability, and strategic viability (Svetek, 2022; Huang *et al*., 2021). Entrepreneurs can strategically use investor composition as a credibility signal to attract specific types of desired subsequent investors, customers, or partners, with recipients assessing investor heterogeneity signals in combination with other observable quality indicators rather than evaluating isolated attributes (Connelly *et al*., 2011; Stuart *et al*., 1999).

Empirical studies have shown that markets react positively to certain investor diversity signals—firms' reputations for inclusive governance practices correlate with increased share valuations, suggesting that diversity signals are well-received by investors when evaluating firms under conditions of uncertainty (Bruton *et al.*, 2009). However, investors distinguish among diversity signals, valuing certain types more than others—diversity among sophisticated institutional investors generates stronger positive signals than diversity achieved through dispersed retail ownership, reflecting the differential credibility of validator types (Cook and Glass, 2014; Knyazeva *et al.*, 2015; Pollock and Gulati, 2007). Beyond investor identity, heterogeneity in investor characteristics, size, experience, and local exposure, portfolio focus directly affects market dynamics, with greater heterogeneity positively associated with increased trading volume and larger price movements around corporate earnings announcements, suggesting that diverse investor bases enhance a firm's information environment through multiple channels of information gathering, processing, and propagation (Knyazeva *et al.*, 2015; Kim *et al.*, 2020).

Since there is empirical evidence showing contradictory impacts—some documenting signalling benefits and others agency costs—the existing literature reveals an apparent paradox that requires resolution. Further research is needed to understand the conditions under which investor heterogeneity enhances or constrains firm performance; what governance mechanisms enable firms to capture signalling benefits while mitigating coordination costs; and how agency costs and signalling benefits interact when investor heterogeneity increases (Filatotchev and Wright, 2011; Bruton *et al.*, 2010; Cumming *et al.*, 2010). Understanding the governance implications of investor diversity requires recognising that its effects operate through multiple simultaneous mechanisms derived from agency and signalling theories (Filatotchev and Wright, 2011; Connelly *et al.*, 2011; Young *et al.*, 2008). These mechanisms interact in complex ways rather than operating independently (Cumming *et al.*, 2019; Bellavitis *et al.*, 2017). For example, investor heterogeneity may enhance monitoring through complementary oversight capabilities, with VCs monitoring strategic direction, BAs monitoring operational execution, and financial investors monitoring financial controls, while concurrently increasing horizontal agency costs with any conflicting priorities on strategic direction, resource allocation, or exit timing (Colombo *et al.*, 2014; Gogineni *et al.*, 2022; Dalziel *et al.*, 2011).

Similarly, investor diversity generates positive external signals attracting subsequent investors, customers, and partners (signalling benefits) while potentially creating internal governance complexity that consumes management attention otherwise given to core operations (agency costs) (Connelly *et al.*, 2011; Hsu, 2004; Svetek, 2022). Research examining these interactive effects remains limited, with most studies focusing on single mechanisms in isolation—either agency costs or signalling benefits—rather than comprehensively modelling how they both determine net outcomes (Cumming *et al.*, 2019; Bellavitis *et al.*, 2017; Filatotchev and Wright, 2011). Additionally, how dynamics change through time has received insufficient attention: investor heterogeneity's effects are likely to evolve as firms mature, with signalling benefits dominating in the early stages when credibility proves most valuable, but agency costs growing as governance complexity accumulates and strategic disagreements emerge over longer time horizons (Vandenbroucke *et al.*, 2016; Zahra and Filatotchev, 2004; Daily *et al.*, 2002).

3.5 Insider Ownership and Managerial Control

While the previous section examined investor differences and their governance effects via varied external participation, this section focuses on insider ownership—the equity share held by active founders, managers, directors, and officers—as a factor with mixed implications from agency theory (Eisenhardt, 1989; Ang *et al*., 2000; Colombo *et al*., 2014). Ownership structure—especially the balance between insider and external investor ownership—is a key governance feature that strongly affects strategy, operations, and performance in entrepreneurial firms (Jensen and Meckling, 1976; Fama and Jensen, 1983; Daily *et al*., 2002).

Research on insider ownership effects evolved through two distinct theoretical phases. Foundational work (1976-1995) established the convergence-of-interest hypothesis, predicting that insider equity stakes align managerial incentives with shareholder value maximisation, while subsequent investigations (1996-present) have identified nonlinear relationships where moderate insider ownership produces alignment benefits but excessive concentration generates entrenchment effects enabling insider value extraction at external shareholder expense (Morck *et al*., 1988; McConnell and Servaes, 1990; Jensen, 2003). Understanding how insider ownership affects entrepreneurial firm performance and innovation is essential to this thesis on governance architecture effects in HTYEFs, as insider ownership represents simultaneously a solution to vertical agency problems (principal-agent conflicts between external investors and managers) and a potential source of horizontal agency problems (principal-principal conflicts between insider and external investor coalitions) when ownership concentration enables managerial entrenchment (Young *et al*., 2008; Gogineni *et al*., 2022).

The foundational understanding of insider ownership effects emerged from agency theory developed during the 1970s and 1980s, which established conflicts arising from ownership-control separation in modern corporations as a central corporate governance challenge (Jensen and Meckling, 1976; Fama and Jensen, 1983; Ross, 1973). Jensen and Meckling's (1976) seminal integration of agency theory, property rights theory, and corporate finance identified that when professional managers acting as agents for shareholders control firms they do not fully own, conflicts arise because managers may prioritise personal objectives, including excessive perquisite consumption, empire-building, or short-term performance over shareholder wealth maximisation (Jensen, 1986; Eisenhardt, 1989). The convergence-of-interest hypothesis emerged as a primary prediction of agency theory regarding insider ownership effects: as managers acquire larger equity stakes in firms they manage, their financial interests increasingly align with external shareholders because wealth effects from value-maximising decisions accrue directly to manager-owners proportional to their ownership stakes (Jensen and Meckling, 1976; Jensen *et al*., 1992). This alignment mechanism theoretically reduces agency costs as insider-owners who share fractionally in the wealth consequences of decisions make choices more consistent with external shareholder preferences, reducing opportunistic behaviour and value-destroying strategic decisions (Demsetz and Lehn, 1985; Jensen, 2003). Early empirical research into convergence-of-interest predictions showed a positive correlation between levels of insider ownership and firm performance measured through accounting returns and market valuations, providing support for the premise that insider equity stakes function as effective governance mechanisms aligning managerial incentives with shareholder objectives (Kim *et al*., 1988; Jensen *et al*., 1992; Han and Suk, 1998).

The theoretical understanding of insider ownership effects became substantially more complex during the mid-1990s as researchers identified nonlinear relationships and reframed earlier, simple positive associations with more intricate patterns reflecting competing alignment and entrenchment forces operating across different ownership ranges (Morck *et al*., 1988; McConnell and Servaes, 1990; Jensen, 2003). The entrenchment hypothesis emerged as a critical counterpoint to convergence-of-interest predictions, suggesting that while moderate insider ownership aligns interests, excessive ownership concentration empowers managers to become entrenched, insulated from external discipline through voting control that renders them resistant to takeover threats, shareholder activism, or board intervention (Fama and Jensen, 1983; Stulz, 1988; Shleifer and Vishny, 1989). Entrenched insiders gain discretion to pursue personal objectives not firm value maximisation, including the extraction of private benefits through excessive compensation, related-party transactions, or perquisite consumption; investment in empire-building projects; or risk-averse strategies that protect managerial employment security at the expense of growth opportunities (Morck *et al*., 1988; McConnell and Servaes, 1990; Miguel *et al*., 2004).

Empirical evidence has revealed a non-monotonic relationship between insider ownership and firm value—performance improves when insider ownership is at low to moderate levels (0-25% ranges), reflecting alignment effects; is shown to decline at intermediate to high levels of ownership (25-50% ranges), reflecting entrenchment costs; and potentially improves again at very high levels of ownership (above 50%), where ownership is sufficient to align interests by giving owners a near-full claim to residual profits (Morck *et al*., 1988; McConnell and Servaes, 1990; Short and Keasey, 1999). These nonlinear patterns proved robust across institutional contexts, reflecting differences in legal protections, takeover market discipline, and governance norms shaping entrenchment barriers (Peasnell *et al*., 2001; Miguel *et al*., 2004; Huang *et al*., 2016). These studies establish insider ownership as a double-edged governance mechanism—producing benefits through incentive alignment at moderate levels but generating costs through reduced external discipline at high concentrations (Short and Keasey, 1999; Zhou, 2001).

Contemporary research examining insider ownership effects in entrepreneurial finance contexts has revealed additional complexities beyond simple alignment-entrenchment trade-offs. Entrepreneurial firms typically exhibit much higher insider ownership concentrations (founders often retain 30-70% stakes) compared to mature public companies where professional managers hold symbolic positions. This generates distinctive governance dynamics where alignment benefits prove larger because entrepreneurial decision quality depends critically on founder-manager expertise and commitment (Colombo *et al*., 2014; Daily *et al*., 2002). However, entrenchment risks simultaneously intensify because founding entrepreneurs with majority control resist external investor discipline and governance improvements (Villalonga and Amit, 2006). Empirical evidence from HTYEFs confirms nonlinear insider ownership-performance relationships: moderate founder-manager ownership (10-40% ranges) is associated with superior performance through alignment effects; high concentrations (above 50-60%) are linked to performance deterioration that reflects entrenchment, capital constraints from ownership dilution resistance, and governance rigidity (Colombo *et al.*, 2014).

The relationship between insider ownership and innovation outcomes is particularly important for this thesis given the focus on HTYEFs where innovation constitutes central value creation. Agency theory generates competing predictions. Insider ownership should enhance innovation by aligning long-term value-creation incentives and reducing managerial short-termism, which discourages risky innovation investments (Zahra, 1996). However, high insider concentration may equally constrain innovation through financial constraints when insider-controlled firms resist external equity financing to avoid dilution (Hall and Lerner, 2010), or through risk aversion when insiders prefer safer strategies (Anderson and Reeb, 2003). Empirical evidence reveals conditional relationships: moderate insider ownership is positively associated with innovation in adequately resourced firms, while high concentration is negatively associated with innovation in capital-intensive domains (Francis and Smith, 1995). Critically, governance balance proves optimal for innovation: firms combining moderate insider ownership—thus retaining founder commitment—with substantial external investor participation—supplying capital, expertise, and governance discipline—have demonstrably superior innovation performance (Colombo *et al.*, 2014; Bertoni *et al.*, 2013; Vandenbroucke *et al.*, 2016).

However, existing research predominantly examines insider ownership in either large public corporations or venture capital-backed startups, leaving empirical gaps regarding insider ownership effects in intermediate entrepreneurial firms and HTYEFs with external equity financing but not yet ready for the IPO stage (Colombo *et al.*, 2014; Gogineni *et al.*, 2022).

3.6 Ownership Concentration and Blockholder Governance

Ownership concentration—measured by the distribution of equity stakes among significant shareholders—constitutes a fundamental governance characteristic that influences a firm's strategic direction, operational decision-making, and performance outcomes in entrepreneurial ventures (Edmans, 2014; Wang and Shailer, 2013). Differences in concentration of ownership—restricted to a few large blockholders versus dispersed among many small shareholders—affect governance monitoring effectiveness, potential value extraction by dominant investors, and the balance of power in strategic decision-making (Edmans and Holderness, 2017). Research into ownership concentration has evolved by recognising a central tension: concentrated shareholdings potentially address the free-rider problem inherent in dispersed ownership by providing large shareholders with sufficient incentives and voting power to monitor management effectively (Shleifer and Vishny, 1986; Grossman and Hart, 1980), yet they also create the risk that dominant blockholders will extract private benefits at the expense of minority shareholders or impose strategic constraints reflecting their personal preferences rather than value-maximising objectives (Villalonga and Amit, 2006; Claessens *et al.*, 2002).

Agency theory holds that ownership concentration resolves the free-rider problem in monitoring. Dispersed ownership, with numerous small shareholders, discourages individual oversight, as benefits accrue to all owners in proportion to their holdings while costs fall on the monitor alone (Shleifer and Vishny, 1986; Grossman and Hart, 1980). Large blockholders with substantial equity stakes (typically 3%–5% or more) are more motivated to absorb monitoring costs because they retain a greater share of monitoring benefits. This scenario makes costly governance activities—such as board participation, strategic consultation, management discipline, and oversight of major transactions—economically rational (Shleifer and Vishny, 1986; Thomsen and Pedersen, 2000). Empirical evidence has identified that firms with concentrated ownership exhibit performance patterns that reflect monitoring effectiveness, as blockholders with significant financial stakes actively engage in governance oversight rather than remaining passive investors (Ma *et al.*, 2010; Demsetz and Lehn, 1985; Shleifer and Vishny, 1997). Agency theory thus predicts that ownership concentration reduces vertical agency costs and conflicts between shareholders and managers by enabling effective monitoring that constrains value-destroying managerial actions, including empire-building, excessive privilege consumption, or strategic decisions serving managerial interests at shareholder expense (Jensen and Meckling, 1976; Fama and Jensen, 1983).

However, this monitoring benefit perspective has faced empirical challenges. Research has revealed that concentrated ownership allows blockholders to extract private benefits of control disproportionately, undermining the monitoring benefit perspective (Barclay and Holderness, 1989; Dyck and Zingales, 2004). Dominant blockholders with voting control can engage in self-dealing transactions, award favourable contracts to affiliated entities, divert corporate opportunities for personal benefit, or impose strategic decisions serving blockholder interests, such as maintaining firm independence to preserve control at the expense of value maximisation for all shareholders (Claessens *et al.*, 2002; Bertrand and Mullainathan, 2001). Evidence from across different jurisdictions has demonstrated that private benefit extraction varies systematically with legal protections. Strong minority shareholder rights, disclosure requirements, and enforcement constrain blockholder opportunism while weaker legal environments enable substantial value diversion through pyramid structures and dual-class shares (La Porta *et al.*, 1997; Claessens *et al.*, 2002). Existing research has thus established ownership concentration as producing both monitoring benefits—reducing vertical agency costs between managers and shareholders—and horizontal agency costs—creating conflicts between controlling blockholders and minority investors (Young *et al.*, 2008; Edmans, 2014).

Contemporary research into ownership concentration in entrepreneurial contexts has shown that effects depend critically on the number and composition of large shareholders, with dispersed blockholder ownership among multiple significant shareholders creating governance dynamics distinct from single-shareholder dominance (Konijn *et al.*, 2011; Laeven and Levine, 2008). When multiple large blockholders hold substantial but non-dominant stakes (e.g., 3–5 investors each with 10–20% equity vs one with 60%), they mutually monitor each other. This limits opportunism and solves the "who monitors the monitor?" problem in single-blockholder setups (Pagano and Roell, 1998; Bennedsen and Wolfenzon, 2000). Multiple blockholders with balanced ownership stakes collectively improve strategic decision quality through diverse perspectives; create checks and balances preventing individual investor capture of strategic direction; and reduce extraction of private benefits as each blockholder monitors others for opportunistic behaviour (Laeven and Levine, 2008; Maury and Pajuste, 2005). Empirical evidence demonstrates that ownership concentration proves most beneficial when it involves multiple large shareholders rather than single-shareholder dominance, particularly when these shareholders represent heterogeneous types, founders, and investors who bring complementary monitoring capabilities and strategic resources (Wang and Shailer, 2013; Balsmeier and Czarnitzski, 2017; Konijn *et al.*, 2011; Attig *et al.*, 2008).

However, the composition of concentrated ownership critically shapes governance effectiveness: concentration among long-term-orientated sophisticated investors, including VC firms and strategic corporate partners, generates different dynamics than concentration among short-term-orientated financial investors or passive institutional holders (Edmans, 2014). Ownership concentration also affects strategic flexibility and adaptation capabilities essential for entrepreneurial firm success. Dispersed ownership among multiple blockholders enables adaptation to changing technological and market conditions without dominant shareholder constraints, potentially supporting performance in dynamic entrepreneurial environments where strategic pivots prove necessary for competitive survival (Thomsen and Pedersen, 2000). Conversely, extreme concentration creates rigidity as dominant blockholders impose individual preferences—resisting dilution to preserve control, prioritising near-term profitability over investment for innovation, or resisting strategic changes that threaten the status quo—and rejecting the strategic pivots necessary for performance optimisation (Villalonga and Amit, 2006).

It has also been shown that ownership dispersion among blockholders generates signalling effects that influence external stakeholder perceptions: multiple blockholders with significant voting power signal governance credibility and stakeholder protection, with external stakeholders—investors, employees, customers, and suppliers—interpreting balanced blockholder ownership as an indicator of effective monitoring and reduced entrenchment (Connelly *et al.*, 2011). Conversely, extreme ownership concentration signals private benefit extraction and raises concerns about whether the firm prioritises value creation for all stakeholders or serves dominant blockholder interests at the expense of resource access and stakeholder cooperation critical to entrepreneurial firm scaling (Pollock and Gulati, 2007).

Existing research examining ownership concentration predominantly focuses on large public corporations with established markets and professional management, leaving empirical gaps regarding concentration effects in HTYEFs with external equity financing but pre-IPO status operating under conditions of high uncertainty, information asymmetry, and resource constraints (Edmans and Holderness, 2017; Colombo *et al.*, 2014).

3.7 Governance and Firm Performance Outcome

Firm performance is considered a key outcome in entrepreneurial finance research, as it offers a quantifiable measure of a firm's success in turning external funding and governance into value through financial growth, operational scaling, and asset accumulation (Sidek *et al.*, 2016; Denis, 2004). The relationship between firm performance and governance structure is complex and potentially non-monotonic—moderate governance diversity may enhance performance through resource complementarity and credibility signalling, yet extreme governance complexity or concentration may constrain performance through coordination costs and strategic conflicts (Dalziel *et al*., 2011; Young *et al*., 2008). Understanding the governance features arising from external equity funding is crucial for HTYEFs facing resource constraints, information asymmetry, and technological uncertainty, where performance hinges on governance-shaped strategic resource allocation (Colombo *et al*., 2014; Fraser *et al*., 2015).

Research on governance-performance relationships has evolved to recognise that entrepreneurial firms face governance dynamics distinct from large public corporations. Principal-principal conflicts among heterogeneous external investors and owner-managers often dominate traditional principal-agent conflicts between dispersed shareholders and professional managers in corporate governance literature (Connelly *et al*., 2010; Ward and Filatotchev, 2010). Firm growth represents a multidimensional concept encompassing various indicators, including employment expansion, revenue scaling, asset accumulation, and market penetration (Bonča *et al*., 2018; Hall, 2002), with performance measurement in entrepreneurial contexts needing metrics that capture growth trajectories, not merely the static profitability measures suited to established firms (Levratto *et al*., 2018). Existing literature examining determinants of entrepreneurial firm growth has highlighted several factors operating simultaneously: the characteristics of the founding entrepreneurs including their human capital and risk orientation (Colombo and Grilli, 2010; Mousa and Wales, 2012); firm-specific attributes including age, size, sector, and geographic location (Almus, 2002; Bertoni *et al*., 2013); economic environment conditions affecting opportunity availability (Vidal-Suñé and López-Panisello, 2013); and critically for this thesis, the governance characteristics arising from external financing decisions that shape resource access, strategic decision-making, and stakeholder coordination (Tarillon, 2022; Jensen, 2003).

Empirical studies on entrepreneurial finance and firm performance have shown that external financing is crucial for scaling performance, as ventures lack internal cash flows for growth investments. However, the source and structure of financing shape outcomes beyond simple capital provision (Sidek *et al*., 2016; Fraser *et al*., 2015). Studies examining funding source effects link different external equity sources with distinct performance implications. VC backing is associated with accelerated employment growth and revenue expansion through active governance involvement, strategic guidance, and ecosystem connections that enable portfolio companies to scale more rapidly than comparable unfunded or debt-financed ventures (Bertoni *et al*., 2013; Cole *et al*., 2016). BA investment shows similar positive performance effects, particularly for very early-stage ventures where BAs provide not only capital but also expertise, operational mentoring, and initial market validation that enable ventures to progress through critical early development stages (Kerr *et al*., 2010; Bonini *et al*., 2019).

Very recent work on venture boards underscores that board composition and control allocations in high-growth ventures differ systematically from those in mature listed firms. A dedicated special issue on venture boards highlights how board roles, investor representation and board dynamics evolve over the venture lifecycle and interact with growth trajectories (Clarysse *et al*., 2026). Empirical evidence from growth firms and VC-backed startups shows that board characteristics and the presence of VCs on boards are strongly associated with positive performance outcomes, while investor-dominated boards generate distinct agency risks, including the risk of higher fraud incidence in founder-controlled structures (Li *et al.*, 2021; Dyck *et al.*, 2026). However, the performance effects of external equity funding depend more on governance features derived from investor participation than on capital provision alone. Ventures receiving equivalent funding from different investor types or governance structures show substantially different performance outcomes (Colombo *et al.*, 2014; Wu and Wu, 2016). This suggests that the governance architecture mediates the relationship between funding and performance, with resource provision, signalling credibility, and strategic oversight mechanisms operating concurrently to influence how effectively firms deploy external capital toward performance objectives (Dalziel *et al.*, 2011; Pollock and Gulati, 2007). The relationship between ownership structure—a fundamental governance characteristic arising from funding decisions—and firm performance has received substantial empirical attention with findings revealing complex patterns where ownership concentration and insider ownership exhibit non-monotonic effects on performance outcomes (Colombo *et al.*, 2014; Tarillon, 2022).

Concentration of ownership among a restricted number of blockholders shows differing effects. Moderate concentration is beneficial: it enables effective monitoring by providing large shareholders with sufficient incentive and voting power to oversee management actively, thus constraining value-destroying activities and improving strategic decision quality, enhancing firm performance (Shleifer and Vishny, 1986; Chatterjee and Bhattacharjee, 2021). However, excessive ownership concentration creates horizontal agency costs where dominant blockholders extract private benefits through self-dealing transactions, related-party dealings, or strategic decisions that serve blockholder interests at the expense of overall firm value, potentially constraining performance, particularly in weak institutional environments that lack protections for minority shareholders (Claessens *et al.*, 2002; Villalonga and Amit, 2006). Empirical evidence from technology-based firms suggests that balanced ownership structures (involving multiple significant blockholders rather than single-shareholder dominance) generate superior performance outcomes through monitoring effectiveness, with governance checks and balances preventing individual investor opportunism (Tarillon, 2022; Maury and Pajuste, 2005).

Measuring firm performance in entrepreneurial contexts requires growth-focused metrics rather than static profitability measures designed and better-suited for established firms. Measuring financial performance through accounting-based indicators—including return on assets (ROA), return on equity (ROE), or earnings metrics—has the benefit of providing standardised comparability based on published financial data. However, these established metrics are limited for private and young entrepreneurial firms that lack complete financial reporting or published consolidated financial statements (Murphy *et al.*, 1996; Venkatraman and Ramanujam, 1986), and alternative metrics are needed. For example, employment growth can be measured by expansion of staffing levels or employment growth rates, and this shows the degree of organisational expansion, giving a reflection of firm development and market penetration, particularly in technology-intensive ventures, and offering a signal of scaling success and market validation that is independent of profitability measures (Birch, 1987; Henrekson and Johansson, 2009). Revenue growth and revenue per employee can also provide indicators of financial expansion and operational efficiency, capturing firm financial scaling in a form that is particularly appropriate for growth-stage ventures transitioning from startup to scale-up (Haltiwanger *et al.*, 2013). Asset growth measured through total asset expansion can be useful as it reflects capital accumulation and financial resource depth that should also enable firm scaling. This measure has particular relevance for research examining how external financing translates to organisational capability expansion (Hall, 2002).

Contemporary empirical research increasingly employs composite performance measures, combining multiple objective indicators to capture performance dimensionality and reduce measurement error that is inherent in single-metric approaches. Tarillon (2022) employed composite performance indices combining employment growth, revenue growth, and asset expansion; Colombo *et al*. (2014) utilised composite firm valuation metrics reflecting both operating performance and investor valuations; and empirical approaches have demonstrated that growth-orientated entrepreneurial firms exhibit substantial performance variation across employment, revenue, and asset dimensions, requiring composite measurements to capture growth across multiple scalable dimensions rather than focusing exclusively on profitability (Levratto *et al*., 2018; Bonča *et al*., 2018).

3.8 Governance and Firm Innovation Outcome

Innovation is a second key outcome by which HTYEFs create long-term value. This outcome area reflects an ability to develop novel technologies, secure intellectual property, and convert R&D into marketable products and services that yield competitive advantages in technology-intensive sectors (Hall and Lerner, 2010; Schumpeter, 1934). Unlike financial performance, which measures operational efficiency and resource utilisation, innovation outcomes reflect long-term strategic capabilities. These depend on sustained R&D investment, tolerance for uncertain technology development, and patient capital for projects with long timelines and unpredictable commercial success (Aghion *et al*., 2013; Baysinger and Hoskisson, 1990). In HTYEFs, technological advancement and intellectual property development drive competitive differentiation and long-term value (Kortum and Lerner, 2000; Conti *et al*., 2013); consequently, understanding how governance from external equity funding affects innovation is crucial.

Governance structures influence innovation differently than they impact firm performance (see Section 3.7 for a discussion of how governance choices affect performance outcomes). Since innovation depends on long-term focus, higher or sustained risk tolerance, and protection from short-term pressures, any forms of governance prioritising immediate accountability, near-term returns, and operational discipline may constrain it (Francis and Smith, 1995; Bushee, 1998). Research examining governance-innovation relationships has developed from the recognition that entrepreneurial firms face innovation-specific governance challenges that fundamentally fail to be met by governance targeted around financial performance. Issues include a mismatch between investor return expectations (typically 5-7 year horizons) and innovation development timelines (often 10+ years for fundamental breakthroughs); differing investor risk tolerances for technological uncertainty, creating conflicts over optimal R&D investment levels, with risk-averse investors preferring incremental improvements that enhance certainty while technology-orientated investors are pursuing breakthrough innovations; and severe information gaps about technological feasibility and commercial potential which make it very hard for non-technical investors to evaluate whether innovation strategies justify the major resource commitments being requested (Lerner, 2022; Hsu, 2004).

Empirical studies on entrepreneurial finance and innovation have shown that external equity financing is essential for technology ventures pursuing innovation-intensive strategies. R&D requires sustained capital exceeding the internal cash flows of early-stage firms that would typically not have profitable revenues (Hall and Lerner, 2010; Carpenter and Petersen, 2002). However, the source and governance of external financing influence innovation outcomes beyond the provision of capital. Different investor types provide varying capabilities, time horizons, priorities, and governance approaches, all of which influence the innovation strategies and investments available to firms (Kortum and Lerner, 2000; Chemmanur and Fulghieri, 2014). VC backing is associated positively with innovation outputs measured through patents and R&D intensity, with empirical evidence from Kortum and Lerner (2000) documenting multiple positive innovation effects through VC involvement. VC investors facilitate access to specialised technical talent and service providers necessary for sophisticated technology development; VC governance monitoring provides discipline for technology development processes without unduly constraining the experimentation and false starts required for breakthrough innovation; and VC staged financing enables strategic pivots as technological information emerges and market conditions evolve rather than premature commitment to technology directions subsequently proven ineffective (Chemmanur *et al*., 2011; Kaplan and Strömberg, 2004).

BA investments similarly show positive innovation effects, especially for very early-stage ventures. BAs provide domain expertise to evaluate radical innovations; tolerance for technological uncertainty (reflecting the BA's own technology background); and longer investment horizons for uncertain projects (Kerr *et al*., 2011; Conti *et al*., 2013). However, the overall effect of external equity funding on firm innovation depends critically on governance characteristics arising from investor participation, with ventures that secured equivalent funding amounts but from different investor types or through different governance structures exhibiting notably different innovation trajectories (Nguyen *et al*., 2021). The evidence indicates that governance mediates the funding-innovation relationship. Specifically, resource provision enables R&D investment; strategic guidance enhances innovation effectiveness; and protection from short-term pressures supports patient capital, all acting jointly to improve a firm's use of external funding to achieve innovation (Dalziel *et al*., 2011; Knockaert *et al*., 2010).

Ownership structure affects innovation outcomes in ways that are different from, but related to, performance effects because governance features have varying implications depending on the outcome under consideration. Ownership concentration among blockholders demonstrates dual effects on innovation: moderate concentration among multiple sophisticated investors enables sustained R&D investment by providing patient capital with longer time horizons, protecting ventures from short-term performance pressures, and supplying strategic guidance for technology commercialisation without imposing premature revenue generation expectations (Aghion *et al*., 2013; Baysinger and Hoskisson, 1990). Conversely, excessive ownership concentration among a few blockholders or a single dominant shareholder creates innovation constraints for multiple reasons: risk-averse concentrated owners may prefer safer operational strategies over uncertain innovation investments, constraining R&D resource allocation; single-blockholder dominance can lead to strategic direction capture, imposing idiosyncratic technology preferences that may be misaligned with optimal innovation strategies as technological landscapes evolve; concentrated ownership constrains access to additional external capital that may be necessary for scaling innovation investments as ventures progress through development stages, creating financial resource constraints limiting innovation intensity (Nguyen *et al*., 2021); and blockholder entrenchment into established technology positions can create resistance to changes in the focus or direction of the firm's innovation that might be signalled as needed by market feedback or technological breakthroughs (Zahra, 1996).

Empirical studies on technology-based firms have shown that ownership dispersed among multiple sophisticated blockholders—such as VCs, corporate strategic investors, and BAs—produces superior innovation outcomes compared to dominance by a single blockholder or widely dispersed small-shareholder ownership (Nguyen *et al*., 2021; Belderbos *et al.,* 2018; Chatterjee and Bhattacharjee, 2021). Multiple blockholders provide patient capital while also offering governance checks that prevent any single investor from dictating the direction of technology development and foster the firm's ability to adapt to technological changes (Nguyen et al., 2021). Insider ownership demonstrates non-monotonic effects on innovation that may differ from performance effects. Moderate insider ownership (20%-50% equity) is associated positively with innovation—enabling long-term focus on technology development, signalling founder commitment to R&D, and protecting ventures from premature pivot pressures. However, excessive insider ownership (exceeding 60-70%) constrains innovation through resource limitations, isolation of the firm from external networks, founder entrenchment in initial technology positions, and the loss of diverse perspectives that could be provided by external blockholders (Zahra, 1996; Sapienza *et al*., 1996). Recent studies provide a nuanced view of the VC–innovation relationship, with both firm-level and multi-jurisdictional studies indicating that VC backing is generally associated with stronger R&D activity and patent claims but that effects vary across institutional contexts and investor types (Guo and Jiang, 2022; Pantea and Tkáčik, 2024). Some research suggests VC entry can initially inhibit innovation inputs before improving innovation efficiency, highlighting the importance of governance mechanisms at each stage, above and beyond capital provision alone (Qiao *et al*., 2021).

Innovation measurement in entrepreneurial firm contexts presents methodological challenges that require close attention to how researchers have captured innovation across heterogeneous sectors and firm stages. Established approaches employing patent counts and citations provide objective, externally validated indicators of technological innovation with strong correlation to R&D intensity and technology advancement (Griliches, 1990; Hall *et al*., 2000). However, patent-based measures systematically understate innovation in sectors with lower patent tendencies, including software and business services, and in young firms working with trade secrets rather than formal patent strategies (Arundel and Kabla, 1998; Cohen *et al*., 2000). R&D expenditure measures capture the investment effort in innovation across both successful and unsuccessful innovation efforts yet face limitations for private ventures and young firms lacking formal R&D reporting requirements (National Science Foundation, 2014). Composite IP-based measures prove particularly suitable for measuring entrepreneurial firm innovation (Hall and Lerner, 2010; Ménière *et al*., 2023).

Together, these recent studies support the notion that patents are a good proxy measure for innovation and can signal a firm's innovative capability, attracting financing and investment. Patents provide a tangible representation of a firm's technological advancements and can convey valuable information to investors and lenders (Alvi and Ulrich, 2023; Ménière *et al.*, 2023). However, it is important to note that while patents are often used as an indicator of innovation, they may not capture all types of innovation in entrepreneurial firms. While patents can indicate a firm's technological advancements and attract financing and investment, it is crucial to consider alternative measures that encompass the entire range of innovation activities in entrepreneurial firms for a more comprehensive assessment (Reeb and Zhao, 2020; Taques *et al.*, 2021). Overall, the literature suggests that entrepreneurial finance can have a positive impact on firm innovation rates. External financing and the associated governance structures can significantly improve a firm's innovation activities, providing the necessary resources for R&D and the implementation of new technologies along with useful monitoring disciplines. However, the nature of the impact can vary depending on the type of external financing, the industry, and the specific innovation activities in question. There is a need for further research into the mechanisms through which entrepreneurial finance influences innovation rates and to develop standardised measures for assessing innovation rates.

3.9 Research Gap and Need for This Research

This chapter has discussed how funding decisions have consequences beyond the provision of capital, introducing governance structures that profoundly shape organisational development. However, while the existing literature provides extensive insights into entrepreneurial finance, key gaps remain, particularly regarding the complex relationship between external equity finance and entrepreneurial success in the context of HTYEFs. This literature review identifies persistent knowledge gaps that still require systematic investigation, building on the strong foundations provided by existing empirical research into entrepreneurial finance ecosystems.

The following table lists the existing key empirical studies that research relationships between governance and performance or innovation outcomes in entrepreneurial firms. The table documents sample characteristics, key variables, main findings, and identified limitations, providing a summary picture of current research patterns and their inherent constraints. These patterns have informed this research's governance architecture framework, which takes an integrated approach to questions of investor heterogeneity, insider ownership, and ownership concentration effects on both performance and innovation outcomes in HTYEFs in the UK.

Table 3-2: Key Empirical Studies on Governance and Entrepreneurial Firm Outcomes

Study	Sample & Context	Key Variables	Main Findings	Limitations Identified
Colombo, Croce & Murtinu (2013)	255 Italian high-tech firms, 1994-2003	IV: Owner-managers, non-manager shareholders DV: Productivity	Owner-managers improve firm performance through	Limited to single country (Italy); does not examine

		performance based on employment, sales	direct involvement and aligned interests; non-manager individual shareholders have negligible effects due to limited involvement and information asymmetries	investor type heterogeneity; focuses on institutional investors; ignores financial effects and the role of ownership concentration
Gogineni, Linn & Yadav (2022)	42,000 UK public and private firms, 2004-2013	IV: Ownership complexity, multiple large shareholders DV: Agency Cost, Firm profitability, operational efficiency: assets, sales	Agency costs increase substantially with multiple shareholders; second large shareholder reduces horizontal agency costs through counterbalancing monitoring; bank monitoring mitigates both vertical and horizontal agency problems	Cross-sectional variation emphasised; limited investigation of innovation outcomes; does not distinguish investor types (VC, BAs, corporate)
Bertoni, Colombo & Grilli (2011, 2013)	538 Italian high-tech startups, 1994-2004	IV: VC backing, investor type DV: Sales growth, employment, patent intensity	VC-backed firms grow faster than non-VC firms after controlling for selection; different VC types (independent vs corporate) have differential effects on performance vs innovation	Selection bias concerns; limited generalisability beyond VC; does not examine other or mixed financing structures
Kerr, Lerner & Schoar (2011)	2500 ventures across two US angel groups, 2001-2006	IV: BA investor backing (regression discontinuity design) DV: Survival, employment, exit outcomes, follow-on-financing	BA financing increases survival rates and employment growth; effects strongest for ventures near decision threshold; certification effects facilitate subsequent VC rounds	US-specific; focuses on single investor type; limited insight into governance mechanisms; survival bias in outcome measurement
Bonini, Capizzi & Zocchi (2019)	690 deals by 380 angels, ~111 companies, 2008-2012	IV: BA backing, syndication DV: Growth rates, survival, IPO/acquisition	BA-backed firms outperform comparable non-backed firms; syndicated BA investments generate stronger effects; certification effects enable follow-on financing	Italian focus limits generalisability; Survey Data Biases; survival bias; does not examine interaction with other investor types
Tarillon (2022)	253 French technology-based firms, 1999-2015	IV: Insider ownership, ownership concentration DV: Composite performance	Non-monotonic relationship between insider ownership and performance; optimal at moderate levels (20-	Limited to France; relatively small sample; does not examine investor heterogeneity or

		(employment, revenue, assets)	40%); extreme concentration constrains performance	multiple external investor types; Self-Reported Data
Bruton, Filatotchev, Chahine & Wright (2010)	224 matched IPOs (UK and France only) 1996 - 2002	IV: Investor Type; Ownership Concentration: Herfindahl-Hirschman Index (HHI) of retained ownership by blockholders. DV: IPO price premium, post-IPO performance	Different investor types exert differential impacts; effects moderated by institutional environment; principal-principal conflicts vary with legal protections	IPO firms only (selection bias); focuses on exit event rather than growth period; limited innovation outcome examination
Dalziel, Gentry & Bowerman (2011)	221 established US biotechnology and pharmaceutical firms listed on US exchanges, continuously operating 2001–2003	IV: Directors' human capital and relational capital, measured separately for inside vs outside directors and then aggregated. DV: Average R&D expenditure level (mean R&D spending over 2001–2003), not an intensity ratio.	Develops an integrated agency–resource dependence view: directors' independence (inside vs outside) and their human/relational capital jointly shape how boards influence R&D spending. Shows that board capital matters for R&D, and that inside vs outside directors' capital has asymmetric effects on innovation-related investment.	US biotech only; limited generalisability; Cross-Sectional Design: The study establishes associations but cannot prove causality; does not examine innovation outputs (patents); survey-based board data
Pollock & Gulati (2007)	404 IPOs by US internet-based technology firms (entrepreneurial ventures), 1995–2000, during the internet boom.	IV: IPO-related signals DV: Cumulative number of post-IPO strategic alliances formed by the firm within 6, 12, and 24 months after the IPO.	Multiple affiliations signal quality but create complexity; signalling benefits diminish with excessive board complexity; investor heterogeneity conveys credibility	IPO context; US tech bubble period; may not generalise to private firms or other periods; Survival Bias
Vandenbroucke, Knockaert & Ucbasaran (2016)	80 Belgium high-tech ventures, longitudinal qualitative interviews; 2001-20111	IV: Board diversity, ownership structure, decision processes DV: Technological and market Performance (patents and products)	Governance diversity enhances innovation through multiple perspectives but creates coordination costs; optimal balance required; temporal evolution matters	Small qualitative sample; Belgium only; limited quantitative generalisability; Endogeneity
Block & Fathollahi (2023)	204 DACH ventures, Large and mid-sized foundation-owned firms; 2010-2019	IV: VC investor type (Foundation ownership) DV: Sales and Employee Growth	foundation- owned firms grow significantly less than non-foundation-owned firms in terms	Regional specificity; Lack of detailed data on charters, governance of foundations, or precise goals means

				of sales but not with regard to employees;	mechanisms remain partly inferred rather than directly tested

Note: This table summarises major empirical studies examining relationships between governance structures and outcomes in entrepreneurial firms. Studies are selected to represent diverse methodologies, contexts, and theoretical perspectives. IV = Independent Variables; DV = Dependent Variables.

Existing research on venture syndication, investor networks and hybrid funding structures has begun to examine how multiple investors co-participate in entrepreneurial deals, showing that syndicates and mixed funding arrangements can influence certification, value-added services, and growth (Tian, 2012; Hong *et al.*, 2025; Lutz and Nörthemann, 2025). However, these studies typically focus on specific combinations of financing sources or on investor-network properties, rather than on the firm-level ownership and control configuration created by accumulated funding decisions (Audretsch and Belitski, 2020). They rarely model how the joint structures of investor heterogeneity, insider ownership and blockholder concentration—dimensions of the governance architecture of the firm—simultaneously shape both performance and innovation outcomes, nor do they integrate agency and signalling mechanisms within a single framework (Li *et al.*, 2020). This thesis addresses that gap by conceptualising governance architecture as a three-dimensional ownership structure arising from multiple funding sources and testing how this architecture affects both performance and innovation in UK HTYEFs through combined consideration of the role of agency costs versus signalling mechanisms.

Recent research extends the classical scholarly view of syndication, showing that syndicate structure and coordination quality materially influence monitoring effectiveness and outcomes. Kang et al. (2022) show that better-coordinated, geographically proximate syndicates reduce the need for intensive contractual control while improving portfolio firm performance. Network-analytic studies additionally show that ventures backed by syndicates whose lead investors occupy central positions in syndication networks exhibit higher survival rates and stronger innovation performance (Christopoulos *et al.*, 2022; Cao and Li, 2023). Cross-border evidence indicates that syndication between domestic and foreign VCs can enhance innovation but that institutional frictions and increasing 'foreignness' can introduce non-linear effects into the likelihood and effectiveness of syndication initiatives (Hao *et al.*, 2022; Gang *et al.*, 2025).

The final subsections, below, offer closing thoughts on the significance of the gaps identified:

The Segmentation of Entrepreneurial Finance Research

Perhaps the most fundamental limitation characterising entrepreneurial finance scholarship is its fragmented approach caused by the studying of funding sources in isolation (Denis, 2004; Cumming *et al.*, 2019). This is a poor match to contemporary entrepreneurial firm behaviour as such firms do not select single funding sources; rather, they assemble portfolios of capital accessed both sequentially and simultaneously from multiple investor types, resulting in complex ownership structures where participants with divergent objectives, time horizons, and governance expectations co-invest alongside each other (Cumming *et al.*, 2019; Bellavitis *et al.*, 2017). Critical questions consequently remain unclear, in particular whether the presence of different investor types adds value through signalling or creates excessive agency costs through conflicting objectives and coordination challenges. These questions require multi-source longitudinal data tracking financing histories mapped against governance structures and performance outcomes—data that remain exceptionally difficult to construct (Denis, 2004).

The Governance Architecture Deficit

The existing entrepreneurial finance literature provides a rich understanding of individual governance dimensions, yet lacks comprehensive frameworks examining how these dimensions collectively constitute governance architectures. Different studies show, variously, resource complementarity benefits *and* coordination costs from investor heterogeneity (Colombo *et al.*, 2014); non-linear insider ownership effects (Morck *et al.*, 1988); and monitoring benefits alongside private benefit extraction from ownership concentration (Shleifer and Vishny, 1986). Entrepreneurial firms securing heterogeneous external equity experience key changes to governance—investor diversity increases, insider ownership decreases, and blockholder concentration shifts. The net effect cannot be determined by examining dimensions in isolation, as theoretical mechanisms operate concurrently and may reinforce or counteract each other. Existing single-dimension research provides insufficient understanding for firms with complex, multi-dimensional governance structures (Filatotchev and Wright, 2011; Cumming *et al.*, 2019).

Firm Value Creation Outcome Deficit

Existing entrepreneurial finance research has established that governance structures affect both firm performance and innovation outcomes, yet studies of these outcomes have developed independently of each other. Performance research emphasises the role of governance in monitoring, injecting discipline to constrain wasteful expenditure (Jensen, 1986). Innovation research emphasises the role of governance in enabling long-term focus and risk tolerance for sustained R&D investment (Francis and Smith, 1995; Bushee, 1998). These distinct emphases suggest governance mechanisms may operate differently, or oppositely, across outcome domains. Governance architectures that optimise performance through concentrated authority and operational discipline may constrain innovation by limiting diverse perspectives and imposing near-term accountability inconsistent with patient R&D investment (Vandenbroucke *et al.*, 2016). As Block *et al.* (2017) note, the current entrepreneurial finance research predominantly examines performance while innovation receives substantially less attention despite its centrality to high-tech venture success.

Theoretical Ambiguity Between Agency Costs and Signalling Benefits

Agency theory predicts that governance complexity generates horizontal agency costs due to coordination challenges and resource diversion (Young *et al.*, 2008). Signalling theory predicts that governance architecture communicates firm quality to external stakeholders with less information, with diverse investor participation signalling that multiple independent evaluators have validated firm quality (Connelly *et al*., 2011). The two theories generate competing predictions—that governance complexity will constrain outcomes through increased agency costs or enhance outcomes through signalling benefits—yet most empirical research applies only a single theoretical framework. Consequently, studies emphasising agency costs reveal coordination challenges (Colombo *et al*., 2014), while studies emphasising signalling benefits highlight positive market responses to diverse investor participation (Hsu, 2004). In practice, entrepreneurial firms may experience both mechanisms concurrently, governance complexity generating coordination costs internally and signalling benefits externally. Understanding whether agency costs or signalling benefits dominate in specific contexts requires an integrated theoretical framework not the application of a single theoretical framework (Bruton *et al*., 2010).

Geographic and Contextual Limitations

The existing entrepreneurial finance literature exhibits substantial geographic concentration on US markets, reflecting the availability of data (Bauer *et al.*, 2023). While US-based research has generated foundational insights, institutional environments differ substantially across contexts, with legal frameworks, investor communities, and regulatory requirements all shaping how funding decisions translate into governance effects (Cumming *et al*., 2010; Bruton *et al*., 2009). The UK context exhibits distinctive characteristics: the requirement for formal reporting of private company data through Companies House creates an opportunity for systematic governance research that is impossible in most jurisdictions; a diverse funding ecosystem that comprises VC, BAs, corporate investors, and crowdfunding; and an institutional proximity to US traditions combined with European regulatory frameworks (Sanders *et al*., 2020). Nonetheless, there is currently limited research systematically examining governance architecture effects in UK HTYEF contexts, despite UK policy emphasis on entrepreneurial ecosystem development (Dodd and Anderson, 2001). Building on early research ideas, recent work has converged on a structured conceptualisation of entrepreneurial ecosystems as configurations of interdependent elements—formal institutions, networks, leadership, finance and culture—that jointly enable or constrain productive entrepreneurship (Stam and van de Ven, 2021). Recognising that principal-principal conflict effects are moderated substantially by institutional characteristics and that findings from one context cannot be assumed to generalise without explicit investigation (Bruton *et al*., 2010), there is a growing emphasis on the need to study these elements as interacting systems, not as isolated factors (Wurth *et al.*, 2021; Ferreira *et al.,* 2024).

Addressing the Gaps: This Research's Contribution

This research addresses the identified gaps in the existing literature through a governance architecture framework. It examines how heterogeneous external funding shapes three governance dimensions—investor heterogeneity, insider ownership, and ownership concentration—and their combined effects on firm performance and innovation in HTYEFs in the UK. The study employs panel data analysis, providing substantial statistical power while maintaining focus on the target population of technology-intensive entrepreneurial ventures. A dual research design combines longitudinal panel analysis of performance outcomes with cross-sectional analysis of innovation outcomes, enabling rigorous testing of competing theoretical predictions from agency and signalling theories. The objective is to contribute meaningfully to understanding the conditions in which governance structures predominantly constrain firm outcomes through coordination costs or enhance outcomes through resource complementarity and credibility signalling benefits. By analysing multiple governance dimensions, dual outcomes, and competing theoretical mechanisms in a large sample of UK HTYEFs, this study advances entrepreneurial finance theory and provides practical guidance for entrepreneurs, investors, and policymakers on funding structures and governance. The UK institutional setting, with its comprehensive private company disclosure requirements and vibrant entrepreneurial finance ecosystem, offers excellent empirical conditions for this study while generating insights with relevance for entrepreneurial finance theory and practice globally.

4. Theoretical Foundation

This chapter describes the theoretical foundations underpinning this study of how external equity funding and resulting governance characteristics affect firm performance and innovation in High Tech Young Entrepreneurial Firms (HTYEFs). The theoretical grounding of this research integrates two complementary theoretical perspectives—agency theory and signalling theory—synthesising their insights into a unified governance architecture framework. Where Chapter 3 examined how agency and signalling theories have been applied in existing entrepreneurial finance literature, this chapter defines an integrated framework specific to this study. The theoretical perspectives reviewed in Chapter 3, highlighting both what is known and what remains unresolved in the literature, inform this study's governance architecture framework, which operationalises both agency and signalling mechanisms to explain how governance characteristics influence firm performance and innovation outcomes.

Agency theory (Jensen and Meckling, 1976; Ross, 1973) provides the foundational lens for understanding conflicts arising from heterogeneous investor participation, particularly horizontal agency costs among principals with divergent interests (Young *et al.*, 2008). This perspective is considered in subsections that examine the foundations of agency theory; horizontal agency costs specific to entrepreneurial finance; and information asymmetry challenges in entrepreneurial firms. Signalling theory (Spence, 1973; Connelly *et al.*, 2010) complements this agency perspective by explaining how governance structures communicate firm quality to external stakeholders, reducing information asymmetry and enhancing stakeholder confidence (Khalidi *et al.*, 2025). Here, these two theoretical perspectives are brought together into an integrated governance architecture framework that guides the empirical investigation and hypothesis development presented in subsequent chapters.

4.1 Agency Theory: Foundations and Entrepreneurial Applications

Agency theory provides a foundational framework for understanding the relationship between principals and agents in organisations and serves as a central theoretical lens for examining governance challenges in entrepreneurial finance (Bosse and Phillips, 2016). The theory focuses on the conflicts of interest that arise when individuals or groups delegate decision-making authority to others, suggesting such delegation inherently involves the risk of goal misalignment, given that agents may act in their self-interest (Jensen and Meckling, 1976; Ross, 1973). This misalignment manifests as agency costs, which are a critical concern for organisational economics and particularly consequential in entrepreneurial contexts where information asymmetries and governance complexities are amplified (Bunyaminu *et al.*, 2024).

The separation of ownership and control in organisations, as addressed by agency theory, proves relevant to understanding the dynamics of entrepreneurial finance (Kelly and Hay, 2002). While agency theory is often associated with large corporations with dispersed shareholders and professional management, it can also be applied to small and early-stage companies that are closely held, albeit with important modifications to account for differences in governance structures and agency problem types (Colombo *et al.*, 2014). In the context of entrepreneurial finance, agency theory helps explain the challenges and dynamics that occur when entrepreneurs seek external financing from investors or lenders. Specifically, it illuminates the tension between the entrepreneur's long-term vision and an investor's quest for immediate returns, encapsulating these conflicts as agency costs.

A central concept of agency theory—with particular relevance to entrepreneurial finance—is the notion of agency costs that arise due to divergent interests and asymmetric information between principals and agents (Jensen and Meckling, 1976). These costs emerge from conflicts of interest between different stakeholders in a firm, such as managers and shareholders, or between shareholders themselves. In entrepreneurial finance contexts, agency costs can arise from the misalignment of incentives between entrepreneurs and investors. Entrepreneurs may exhibit a higher risk appetite and maintain long-term visions for their ventures, while investors may prioritise short-term returns and liquidity options (Sahlman, 1990; Gompers and Lerner, 2001). These differences in incentives and time horizons can lead to conflicts and agency costs that require active management through governance mechanisms (Arthurs and Busenitz, 2003).

Agency theory provides an invaluable framework for analysing how governance structures, information asymmetry, and monitoring mechanisms shape the relationship between entrepreneurial finance and the success of HTYEFs (Bellavitis *et al*., 2017). It highlights the importance of developing strategies to minimise agency costs and information gaps, thereby facilitating access to crucial external financing that supports firm growth and innovation endeavours (Ghio *et al*., 2017). Through this lens, the theory addresses not only the challenges faced by HTYEFs in securing finance but also points toward solutions that can enhance their success in the highly competitive and innovative high-tech sector (Yimfor and Garfinkel, 2023).

Building on these foundational concepts of agency theory and noting their applicability to entrepreneurial finance, the following section examines a specific manifestation of agency problems with particular impacts for entrepreneurial firms—horizontal agency costs arising from heterogeneous investor participation.

4.2 Horizontal Agency Cost in Entrepreneurial Finance

Building on the agency theory foundations established in Section 4.1, this section examines horizontal agency costs, a specific form of principal-principal conflict particularly prevalent in entrepreneurial firms with diverse external investors. Horizontal agency theory focuses on the challenges and incentives that arise when multiple actors collaborate within an organisation or across different organisations, with particular relevance to entrepreneurial ventures attracting capital from heterogeneous investor types (Ireland, 1994).

In specialised entrepreneurial finance contexts, horizontal agency costs have gained significant prominence (Mönkemeyer *et al*., 2026), particularly in HTYEFs, where understanding the interplay between horizontal agency costs and ownership structure offers valuable insights into firm performance (Colombo *et al*., 2014). Horizontal agency costs arise when principals have heterogeneous interests, preferences, and objectives, creating coordination challenges even when all parties ostensibly share a goal of firm value maximisation (Connelly *et al*., 2010; Walsh and Seward, 1990; Ward and Filatotchev, 2010). The emergence of diverse investor types—including venture capital (VC), business angel investors (BA), corporate investors, family investors, and crowdfunding platforms—has led to complex combinations of different investors in entrepreneurial firms becoming increasingly prevalent (Cumming *et al*., 2019).

The presence of different types of investors with varying goals, objectives, resource capabilities, and investment approaches can bring numerous benefits to entrepreneurial companies. These diverse investors offer unique perspectives, expertise, and financial resources that can enhance firm growth and development (Verbouw et al., 2023; Bellavitis et al., 2017). However, it is essential to acknowledge that such diversity also creates challenges, particularly in terms of conflicts and agency costs among the principals themselves. Conflicts may arise due to divergent interests and preferences, leading to disagreements on critical decisions, strategic directions, or risk tolerance levels (Chen and Lambrecht, 2025; Drover et al., 2017). These conflicts can hinder effective decision-making and result in suboptimal outcomes for company performance (Neckebrouck *et al*., 2019).

Horizontal agency costs are linked to firms losing out on potential benefits due to certain prominent investors preferring short-term gains over long-term value creation by the firm. Alvi and Ulrich (2023), Francis and Smith (1995), and Eng and Shackell (2001) have contributed to the body of evidence concerning how agency costs can be a drag on a firm’s long-term investments, revealing challenges that can arise when shareholder interests diverge around research and development (R&D) decision-making and strategic investments. Although HTYEFs should prioritise long-term commitments to R&D and strategic investments (Wiseman and Gomez-Mejia, 1998), a powerful principal with a short-term perspective might push the firm in another direction, resulting in principal-principal costs that constrain innovation and growth.

Colombo *et al*. (2014) explore the relevance of agency theory in understanding the performance of entrepreneurial ventures by examining agency relationships between owner-managers and non-manager individual shareholders. Their study highlights the impact of agency costs on the performance of HTYEFs, finding that the number of owner-managers has a positive effect on firm performance, while the effect of non-manager individual shareholders is negligible. This pattern emerges because owner-managers cause low horizontal agency costs through their direct involvement and aligned interests, while non-manager individual shareholders generate higher horizontal agency problems due to their limited managerial involvement combined with their divergent preferences and information asymmetries.

Changes in a company's ownership structure can address both knowledge and funding gaps effectively, with expansion of ownership having favourable impacts on firm performance through access to additional financial and non-financial resources and competencies (Colombo *et al*., 2014). Nevertheless, it is essential to recognise that having multiple owners can lead to increased agency costs, which negatively affect the firm's overall performance. The increasing number and variety of investors amplify coordination challenges and governance complexity (Jensen, 1986; Chen and Lambrecht, 2025), potentially constraining growth and limiting innovative activities that carry higher risk and longer time horizons.

Coordination among VC investors favouring scalability, BAs valuing founder autonomy, and corporate investors prioritising commercialisation requires negotiation and compromise, potentially slowing down firm decision-making and creating conflicting strategic pressures. This coordination complexity represents horizontal agency costs—costs arising not from manager-shareholder conflicts but from conflicts among heterogeneous principals themselves. When all owners actively participate in managing the firm and can easily monitor each other's actions, the horizontal agency costs arising from these differences may remain low (Colombo *et al.*, 2014). However, even in such scenarios, enlarging the owner-manager team may lead to free-riding problems in monitoring activities (Aghion and Tirole, 1997) and increase coordination costs around the firm's decision-making processes (Kahneman *et al.*, 1982).

Effective corporate governance structures, including well-defined ownership structures and executive ownership arrangements, can mitigate agency costs, serving as counterbalancing measures to horizontal agency problems (Zeckhauser and Pound, 1990). Such mechanisms are particularly vital in entrepreneurial finance contexts, where agency costs can be magnified due to the inherent uncertainties and complexities of start-up ventures (Chen and Lambrecht, 2025; Cowling *et al.*, 2012). The challenge lies in balancing the benefits of diverse investor participation—access to varied resources, expertise, and networks—against the horizontal agency costs attached to coordination challenges and the potentially conflicting strategic preferences among heterogeneous principals.

Having examined horizontal agency costs arising from diverse investor participation, the following section explores the fundamental informational challenge underlying these agency problems—information asymmetry between entrepreneurs and external investors in entrepreneurial finance contexts.

4.3 Information Asymmetry and Agency Problems in Entrepreneurial Firms

Information asymmetry represents a fundamental challenge in entrepreneurial finance, creating and exacerbating agency problems between entrepreneurs and external investors. This section examines how information asymmetry operates in entrepreneurial contexts and its implications for agency costs and governance structures.

A significant distinction between entrepreneurial finance and conventional corporate finance concerns the substantially higher information asymmetry between founder-entrepreneurs and external finance providers. New ventures lack track records, and what information exists may not be reliable (Denis, 2004). Furthermore, founder-entrepreneurs who retain majority control possess significantly more information about the business than external investors, creating severe adverse selection and moral hazard problems. This information asymmetry generates additional agency costs for investors in entrepreneurial firms beyond those present in established corporations with professional management and established information disclosure practices (Cumming *et al.*, 2019).

An entrepreneur's ability to leverage financial resources is crucial to the success of their venture. However, at the start of an entrepreneurial venture, uncertainties around not having solid financial plans or clearly defined markets and the lack of a proven operational history run contrary to investor preferences (Denis, 2004) and make it difficult to secure external financial investment. The decision-making process in entrepreneurial finance is characterised by significant uncertainty and information asymmetry, making it difficult for external investors to assess venture quality, management capability, and future prospects (Ferrati and Muffatto, 2021). These difficulties are particularly critical in the early stages of the venture lifecycle when successfully securing funding is vital in setting up the firm for success in the future.

According to Jensen and Meckling (1976), the ownership structure of a firm is influenced by two key factors: information asymmetries and agency costs resulting from the separation of owners and managers, and the costs and benefits associated with diversifying the risk of owner-managers through outside equity ownership. They observe that where the monitoring and contracting costs of bringing in funding and setting up new ownership structures become prohibitively high, owner-managers will choose to retain significant equity stakes in their firms, foregoing the benefits of diversification (Francis and Smith, 1995). This creates a self-reinforcing dynamic where information asymmetry influences ownership structure, which in turn affects the severity of ongoing information asymmetry and agency costs. The agency theory framework suggests that consequential costs between investors and entrepreneurial firms are likely to constrain available funds and trigger further resource allocation by the HTYEF to address the additional processes imposed by investors (Cumming and Johan, 2008). The theory holds that as the number and variety of investors increase, higher agency costs can be expected (Jensen, 1986), potentially affecting growth and innovation (Gompers *et al.,* 2001). Funding constraints and additional resource utilisation to address information disclosure requirements can affect a firm's ability to grow due to a lack of funds when needed or may limit innovative activities that carry higher risk and longer development timelines (Kerr and Nanda, 2015; Lin *et al.,* 2017).

To attract external finance, many high-tech entrepreneurial ventures prefer not to disclose detailed information on their innovative products and services as a tactic to protect their intellectual property (IP) and competitive advantages (Cumming et al., 2019). As a result, these firms continue to rely primarily on internal cash flows for funding their investments, limiting their growth potential. Additionally, HTYEFs often have limited access to debt financing due to the lack of tangible securities that could serve as collateral and high information asymmetries regarding the firm's intangible assets and uncertain future prospects (Czarnitzski and Kraft, 2009). Therefore, equity financing through VC and BA investments is often an appropriate option for young and innovative ventures under certain conditions, despite the information disclosure requirements and governance changes that accompany external equity participation.

The information asymmetry between founders and external investors puts non-manager individual investors at a disadvantage since it hinders their access to financial information, understanding of strategic decisions made by the founding entrepreneur, and ability to make an assessment of the reliability of the entrepreneur's expectations and projections (Berger and Udell, 1998; Levratto *et al.,* 2018). This information disadvantage provides valuable context for understanding the potential conflicts of interest and challenges that arise between founders and individual investors in entrepreneurial ventures (Cosh *et al.,* 2009). Non-manager individual investors find themselves compelled to compensate for their lack of knowledge by imposing more stringent demands on the firm for information and governance rights (Cumming and Johan, 2008). However, this leads to firm management spending valuable time meeting these increased requirements, explaining their decisions, and justifying their actions (Hellmann and Puri, 2002), which detracts from the entrepreneur's ability to focus on managing the business and exploring new opportunities. As a result, coordination problems arise, and the performance of the investee company may suffer despite the governance improvements theoretically enabled by external investor oversight (Arthurs and Busenitz, 2003).

Although agency theory originates from ownership and control in large corporations (Jensen and Meckling, 1976), it remains applicable in entrepreneurial firms due to the persistence of information asymmetry when non-manager individual investors are involved. Ultimately, understanding the challenges posed by limited access to financial resources means recognising the imperfections in capital market allocations arising from asymmetric information and imperfect markets. Entrepreneurs must be proactive in seeking out investors who can provide the necessary funding and resources while also being strategic in managing their financial structure and leveraging available sources of capital, such as debt financing, BA financing, VC investments, and alternative financing mechanisms (Chemmanur *et al.,* 2011).

Having established how information asymmetry creates and amplifies agency problems in entrepreneurial finance, the following section examines an alternative theoretical perspective, signalling theory, which explains how firms can reduce information asymmetry through credible signals—a theoretical framing complementary to agency theory's focus on costs and conflicts.

4.4 Signalling Theory: Quality Signals and Credibility in Entrepreneurial Finance

This section builds on the earlier summary of the foundational principles of signalling theory (Section 3.2), bringing signalling theory into the framework being applied to analysing the governance architecture of entrepreneurial firms. This section examines how the specific governance dimensions of investor heterogeneity, insider ownership, and ownership concentration can function as credibility signals to enhance firm performance and innovation.

In the context of entrepreneurial ventures, investor composition and endorsement are powerful signals to potential external stakeholders (Hsu, 2004; Hoenig and Henkel, 2015). A VC's decision to provide capital to a firm can serve as a strong signal to other capital providers, indicating a sophisticated assessment of the company's investment prospects and reducing information asymmetry for subsequent investors (Sahlman, 1990; Stuart *et al.*, 1999). Positive signals from reputable investors—particularly sophisticated institutional investors with expertise in evaluating ventures—carry weight because these investors' reputations and future deal flow are dependent on successful portfolio company outcomes (Hsu, 2004; Pollock and Gulati, 2007). Conversely, a failure to attract investment from reputable sources may signal quality concerns to other potential investors, creating self-reinforcing dynamics impeding subsequent financing prospects and constraining firm trajectories (Busenitz *et al*., 2005).

When applied to the concept of investor heterogeneity, signalling theory explains how governance structures communicate firm quality to external stakeholders—employees, customers, suppliers, and potential future investors—affecting their willingness to cooperate and engage with the firm (Connelly *et al*., 2011; Filatotchev and Wright, 2011). When multiple independent investor types each invest capital in the firm, external stakeholders receive powerful multi-stakeholder credibility signals (Hsu, 2004). Multiple expert evaluations create substantially stronger signals than homogeneous investment from single investor types, as several separate experts with different evaluation criteria, each independently validating firm quality through their investment commitments, are seen as reducing the probability that quality estimates are overblown—a reduction that factors multiplicatively with the number of independent assessments (Certo *et al*., 2001). These credibility signals facilitate labour market effects through enhanced employee recruitment and retention; product market effects through improved customer adoption; and business relationship effects through stronger supplier credit terms (Stuart *et al*., 1999; Pollock and Gulati, 2007).

Insider ownership similarly sends multifaceted signals to external stakeholders about venture quality and prospects, with the signalling effects exhibiting non-monotonic relationships with ownership levels (Leland and Pyle, 1977; Cosh *et al*., 2009). Moderate insider ownership signals founder commitment and confidence in firm prospects, generating positive signals about founder quality and firm viability; founders willing to maintain substantial personal investment in their ventures signal confidence in future prospects, as they would be unlikely to tie personal wealth to ventures they perceive as overly risky or limited in potential (Leland and Pyle, 1977). However, excessive insider ownership may signal that sophisticated external investors lack confidence in firm prospects, generating negative signals to potential employees, customers, and suppliers regarding firm quality or sustainability (Cosh *et al*., 2009; Busenitz *et al*., 2005). When founders retain near-complete ownership despite opportunities to attract external investment, observers may infer that external investors conducting due diligence identified concerns about venture prospects, concerns that led sophisticated investors to decline participation (Busenitz *et al*., 2005).

Ownership concentration among external blockholders generates additional signalling effects relevant to governance architectures. Multiple blockholders with significant voting power signal governance credibility and stakeholder protection, as external stakeholders may take dispersed ownership among multiple blockholders to indicate the presence of effective monitoring, reduced entrenchment risk, and balanced governance that prevents dominance by any individual shareholder (Connelly *et al*., 2011; Shleifer and Vishny, 1986). Conversely, extreme ownership concentration signals entrenchment risk and potential for private benefit extraction by dominant blockholders, generating negative signals about minority shareholder protection and raising concerns about whether the firm will prioritise value creation for all stakeholders or primarily serve the interests of the controlling blockholder (Villalonga and Amit, 2006).

The next section integrates agency theory and signalling theory into a governance architecture framework that explains how external equity funding creates governance characteristics that influence performance and innovation through multiple mechanisms that operate concurrently.

4.5 Theory Integration

This section synthesises the theoretical perspectives of agency theory and signalling theory into an integrated governance architecture framework that explains how external equity funding translates into governance mechanisms that affect firm performance and innovation outcomes. The core premise here is that different combinations of external equity funding lead to varying governance structures, and these structures in turn influence a firm's strategic decision-making, resource allocation, and ultimately, performance and innovation outcomes.

Integrating Agency Theory and Signalling Theory

The preceding subsections have examined agency theory and signalling theory as distinct theoretical lenses for understanding how funding structure and ownership patterns affect firm outcomes. However, these theories are not competing alternatives but rather exist as complementary perspectives on how governance structures operate. The integrated governance architecture framework applied in this research integrates these perspectives by recognising that governance characteristics operate concurrently via multiple mechanisms; some are explained by agency theory (internal conflicts and costs), and others by signalling theory (external stakeholder perceptions of the firm and management of information asymmetry).

Agency theory emphasises the costs and conflicts arising from the separation of ownership and control (Jensen and Meckling, 1976). Applied to entrepreneurial finance contexts with heterogeneous external investors, agency theory predicts that multiple investor types with divergent interests, risk tolerances, and time horizons create principal-principal conflicts that complicate, and increase the costs of, governance (Young *et al*., 2008; Connelly *et al*., 2010). Coordination among VC investors favouring scalability, BA investors valuing founder autonomy, and corporate investors prioritising commercialisation requires negotiation and compromise, potentially slowing decision-making and creating conflicting strategic pressures. This coordination complexity leads to horizontal agency costs—costs arising not from manager-shareholder conflicts but from conflicts among heterogeneous principals themselves.

Agency theory also identifies insider ownership as critical to incentive alignment. At moderate levels, insider ownership aligns managers' interests with shareholder value creation, reducing principal-agent conflicts. However, beyond certain thresholds, concentrated insider ownership generates entrenchment effects, where founder-managers prioritise personal objectives over shareholder value (Claessens *et al*., 2002; Park and Jang, 2010). These entrenchment costs manifest in various ways: extraction of personal benefits; empire-building that is resistant to external influence; and avoidance of accountability to external investors. Similarly, ownership concentration among external blockholders can create dual effects. Shleifer and Vishny (1986) argue that concentrated ownership reduces the free-rider problem in monitoring activities, enabling effective oversight of management. However, excessive concentration enables dominant blockholders to extract private benefits at the expense of minority shareholders and overall firm value (Villalonga and Amit, 2006; Chang, 2003).

Signalling theory offers a complementary perspective, emphasising quality signalling and the resolution of information asymmetries (Spence, 1973; Connelly *et al.*, 2010). Applied to governance, the signalling theory focuses on how the governance architecture communicates firm quality and credibility to external stakeholders—employees, customers, suppliers, and potential investors—affecting their willingness to cooperate and engage with the firm. When multiple independent investor types each invest capital in the firm, external stakeholders receive powerful multi-stakeholder credibility signals (Hsu, 2004). Multiple expert evaluations with different evaluation criteria, each validating firm quality, create substantially stronger signals than homogeneous investment from single investor types. These credibility signals facilitate labour market effects through enhanced employee recruitment and retention; product market effects through improved customer adoption; and business relationship effects through stronger supplier credit terms and distribution partnerships.

Insider ownership similarly sends dual signals. Moderate insider ownership signals founder commitment and confidence in firm prospects, generating positive signals about founder quality and firm viability (Leland and Pyle, 1977). However, excessive insider ownership signals that sophisticated external investors lack confidence in firm prospects, generating negative signals to potential employees, customers, and suppliers regarding firm quality or sustainability (Cosh *et al.*, 2009). Ownership concentration among external blockholders also generates signalling effects. Multiple blockholders with significant voting power signal governance credibility and stakeholder protection, as external stakeholders interpret dispersed ownership among multiple blockholders as indicating effective monitoring and reduced entrenchment risk. Conversely, extreme ownership concentration signals entrenchment risk and potential for private benefit extraction, generating negative signals about shareholder protection.

The governance architecture framework integrates agency theory and signalling theory perspectives by recognising that governance characteristics operate through dual, simultaneous processes. Agency processes operate internally, determining decision-making efficiency, coordination costs, and monitoring effectiveness. Signalling processes operate externally, determining stakeholder perception, credibility assessment, and cooperation willingness. The overall effect of governance characteristics on firm outcomes depends on the balance between internal agency costs and external signalling benefits. In entrepreneurial contexts characterised by high levels of uncertainty, information asymmetry, resource constraints, and strong stakeholder influence on outcomes, signalling benefits may offset or exceed agency costs. This creates conditions where diverse governance structures may generate positive net effects through credibility signalling and resource complementarity, despite the higher coordination complexity; moderate insider ownership may generate positive net effects through incentive alignment and confidence signals; and dispersed ownership among blockholders may generate positive net effects through monitoring and governance credibility signals.

Three Dimensions of Governance Architecture

The governance architecture framework incorporates three interrelated governance characteristics representing a firm's ownership and control structure. These dimensions are not independent but rather represent the firm's governance architecture collectively, an integrated system determining the firm's strategic decision-making processes, resource allocation efficiency, and stakeholder relationships (Filatotchev and Wright, 2011; Colombo *et al.*, 2014).

The first dimension—investor heterogeneity—reflects the diversity of external equity sources funding the firm. High investor heterogeneity indicates that funding for the firm is spread across multiple distinct investor types, each bringing different characteristics, evaluation criteria, expertise, and strategic perspectives (Bruton *et al.*, 2010; Cumming and Johan, 2013). Agency theory predicts that heterogeneity increases principal-principal conflicts and coordination complexity, as divergent investor interests create governance challenges (Young *et al.*, 2008). However, signalling theory sees heterogeneity as generating multi-stakeholder credibility signals that invite stakeholder involvement (Connelly *et al.*, 2010; Hsu, 2004). The empirical question is whether coordination costs exceed the benefits from credibility signalling. This dimension is operationalised through the Investor Heterogeneity Index (IHI), calculated as a Herfindahl-Hirschman Index (HHI) measuring the concentration of capital across investor types.

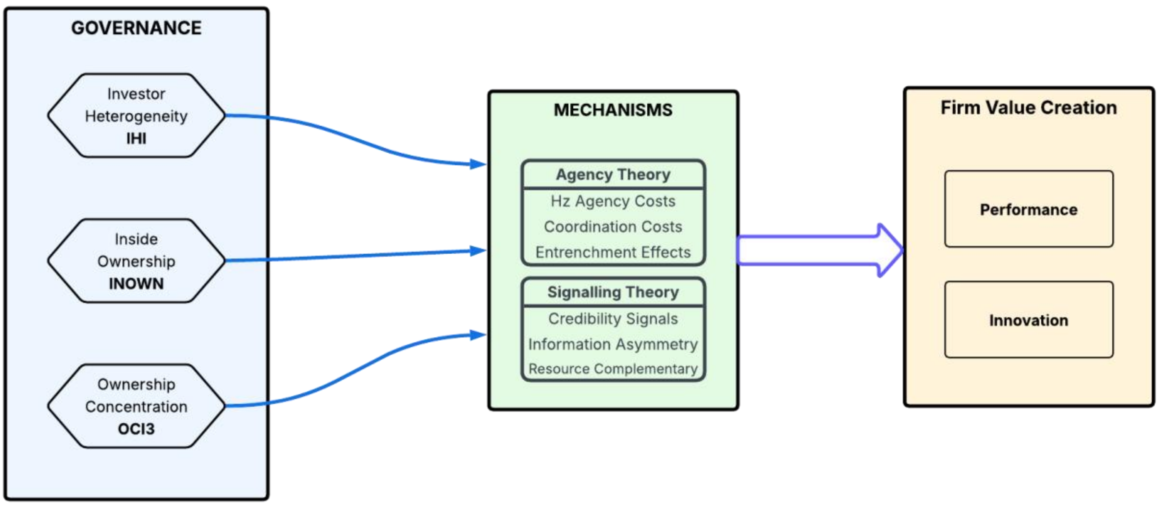
The second dimension—insider ownership—captures the proportion of equity controlled by managers and founders actively involved in firm operations. This governance characteristic reflects the degree of ownership-control alignment and directly affects incentive structures (Jensen and Meckling, 1976; Fama and Jensen, 1983). Agency theory suggests that moderate insider ownership reduces agency costs by aligning incentives between principals and agents, but excessive concentration creates entrenchment risks where founders may prioritise personal objectives over value creation (Claessens *et al.*, 2002; Morck *et al.*, 1988). Insider ownership also affects access to external capital and expertise, as founder-dominated structures may constrain the inflow of additional external resources necessary for scaling (Cosh *et al.*, 2009). Signalling theory provides the insight that insider ownership sends mixed signals; moderate levels signal founder confidence (Leland and Pyle, 1977), while excessive levels may signal that external investors lack confidence in firm prospects (Busenitz *et al.*, 2005). The non-monotonic relationship between insider ownership and outcomes reflects these dual theoretical predictions (Holderness, 2003; Morck *et al.*, 1988). This dimension is operationalised as an insider ownership percentage (INOWN), measuring equity held by active directors and founders as a proportion of total equity.

The third dimension—ownership concentration—measures the distribution of significant equity stakes among blockholders, that is, shareholders holding at least 3% of a firm’s equity. This governance characteristic reflects the concentration of voting power and governance influence among significant shareholders (La Porta *et al.*, 1999; Thomsen and Pedersen, 2000). Agency theory predicts that concentration enables more effective monitoring by reducing free-rider problems, as blockholders with substantial stakes have both the incentive and the capability to monitor management actively (Shleifer and Vishny, 1986). However, extreme concentration enables dominant blockholders to extract private benefits through self-dealing transactions and strategic decisions favouring controlling shareholders at the expense of minority shareholders and overall firm value (Villalonga and Amit, 2006; Chang, 2003; Bertrand and Mullainathan, 2001). Signalling theory adds the perspective that the degree of ownership concentration acts to signal governance quality to external stakeholders, with dispersed blockholder ownership signalling effective monitoring and stakeholder protection, while extreme concentration signals entrenchment risk (Connelly *et al*., 2010). This is operationalised through the Ownership Concentration Index (OCI3), calculated as an HHI for shareholders holding 3% equity or more.

Although all three governance dimensions arise from equity ownership, they capture analytically distinct governance mechanisms. Investor heterogeneity focuses on external equity providers and how diverse their objectives, expertise and evaluation criteria are, as these shape resource complementarity and multi-stakeholder signalling effects. Insider ownership captures the degree of managerial control of equity, determining the balance between incentive alignment and entrenchment risks. Ownership concentration among blockholders reflects the distribution of significant external stakes, as these influence monitoring, the potential for dominant shareholder expropriation and the extent to which strategic decisions require consensus among multiple powerful investors. In this framework, investor heterogeneity concerns diversity across investor types, whereas ownership concentration considers how the largest equity positions are distributed among those investors, so the two concepts are related but non-redundant.

The following diagram presents the architecture framework for this research, integrating governance characteristics through various mechanisms to influence two key modes of firm value creation.

Figure 4-1 Governance Architecture Framework



4.6 Connecting Theory to Research Questions

The governance architecture framework introduced in Section 4.5 establishes the theoretical logic guiding the empirical research focus of this thesis. This section explicitly connects the theoretical foundations to the two research questions that frame the thesis, showing how the theory predicts specific relationships that can be tested empirically.

Research Question 1 (RQ1) investigates how external equity funding and the resulting governance characteristics affect firm performance in HTYEFs. The theoretical prediction derived from the governance framework is that external equity funding creates governance characteristics that influence firm performance through concurrent mechanisms operating in opposite directions (Colombo *et al.*, 2014; Filatotchev and Wright, 2011). Agency costs from coordination complexity, entrenchment risk, and monitoring challenges operate to constrain performance (Young *et al.*, 2008; Walsh and Seward, 1990), while signalling benefits from credibility signals, resource complementarity, and stakeholder confidence operate to enhance performance (Connelly *et al.*, 2010; Hsu, 2004; Spence, 1973). Since HTYEFs are ventures with high uncertainty and information asymmetry, signalling benefits may offset or exceed agency costs in many contexts, creating potential positive net effects of diverse governance on performance (Stuart *et al.*, 1999; Pollock and Gulati, 2007). However, at extreme concentrations or imbalances, with excessive insider ownership, extreme blockholder concentration, or coordination paralysis from unmanageable investor heterogeneity, agency costs may dominate, constraining HTYEF performance (Claessens *et al.*, 2002; Morck *et al.*, 1988).

This theoretical prediction suggests a potentially non-monotonic relationship between governance characteristics and performance, where moderate governance diversity enhances performance, but extreme diversity or concentration may constrain it (Dalton *et al.*, 2003). Hypotheses H1 through H3 empirically test the direction and magnitude of governance effects on performance for each governance dimension, examining whether investor heterogeneity, insider ownership, and ownership concentration independently influence firm performance in directions predicted by the integrated agency-signalling framework.

Regarding investor heterogeneity, the integrated framework predicts that agency costs dominate when investor syndicates are highly fragmented, misaligned in objectives, or lack effective monitoring capacity, thus leading to weaker performance as coordination frictions outweigh resource and knowledge benefits. In contrast, signalling and resource-based mechanisms dominate when heterogeneous investors are sophisticated and complementary, such that investor diversity strengthens external validation, knowledge access and follow-on funding. H1 therefore tests whether, in the UK HTYEF context, the net effect of investor heterogeneity on performance aligns more closely with the agency cost or signalling benefit prediction.

Regarding insider ownership, agency theory predicts that higher insider stakes initially improve performance by aligning incentives, but that beyond a threshold level, they instead generate entrenchment and weaken external discipline, reducing performance. Signalling theory, by contrast, views substantial insider ownership as a commitment signal that may reassure external investors about managerial confidence in the venture. H2 tests the mechanism that dominates in practice by examining whether higher insider ownership is associated with better or worse performance among UK HTYEFs.

Regarding ownership concentration, agency logic suggests that large blockholders enhance monitoring and reduce classic principal–agent problems, supporting superior performance, whereas signalling and resource-based perspectives highlight that highly concentrated ownership can limit access to diverse external resources and weaken signals of broad investor endorsement. H3 tests whether, for HTYEFs, concentrated ownership structures are associated with higher performance (consistent with the monitoring view embedded in agency theory) or lower performance (consistent with the diversity-issue view encapsulated in signalling theory).

Research Question 2 (RQ2) investigates how external equity funding and the resulting governance characteristics affect the rate of innovation in HTYEFs. The theoretical prediction is that governance characteristics influence innovation through innovation-specific mechanisms that are distinct from general performance mechanisms (Baysinger *et al.*, 1991; Zahra, 1996). Governance enabling access to diverse expertise and capital for R&D investment enhances innovation capability, as different investor types contribute specialised knowledge relevant to technological development (Chemmanur *et al.*, 2011; Knockaert *et al.*, 2010). Credibility signals from governance architecture enable recruitment of talent and the adoption by customers necessary for innovation validation and market success, as employees with deep technical expertise preferentially join firms with governance credibility and customers more readily adopt unproven innovations from firms perceived as credible and sustainable (Pollock and Gulati, 2007; Stuart *et al.*, 1999). Governance structures that support strategic flexibility enable the sustained focus on long-term innovation and withstand pressure to achieve near-term performance goals that would constrain commitment to R&D, both dynamics that are critical for innovation success in uncertain technological domains where development timelines often exceed investor expectations (Baysinger *et al.*, 1991; Hill and Snell, 1988). Governance that prevents founder entrenchment into ineffective technology directions also enhances innovation adaptation as new technical information emerges, enabling course corrections and pivots to more promising directions (Zahra, 1996; Sapienza *et al.*, 1996).

The theoretical prediction suggests that governance supporting sustained R&D commitment, diverse expertise access, stakeholder confidence, and strategic flexibility will enhance innovation outcomes, while governance imposing near-term performance pressure, constraining resource allocation, or reducing stakeholder cooperation will reduce innovation (Baysinger and Hoskisson, 1990). Hypotheses H4 through H6 empirically test governance effects on innovation outcomes across the three governance dimensions, examining whether the theoretical predictions differ between innovation and general performance outcomes.

Regarding investor heterogeneity, the integrated framework predicts that greater investor heterogeneity will support innovation outcomes in conditions where signalling and resource complementarity dominate—for example, when diverse specialist investors provide access to technological, market and scaling expertise—but may hinder innovation when coordination costs and conflicting innovation objectives prevail. H4 therefore evaluates which mechanism dominates for HTYEF innovation.

In the case of insider ownership, the framework suggests that moderate managerial stakes can foster innovation by strengthening commitment to uncertain, long-horizon R&D projects, whereas very high insider ownership may impede innovation through entrenchment, heightened risk aversion, and limited receptiveness to external knowledge. H5 therefore tests whether, for UK HTYEFs, higher insider ownership is associated with stronger or weaker innovative output. With regards to ownership concentration, the integrated framework indicates that concentrated blockholder positions may promote innovation when a small number of sophisticated investors provide patient capital and strategic guidance, but may suppress innovation when dominant owners constrain experimentation and reduce strategic diversity. H6 therefore investigates whether concentrated ownership structures in HTYEFs are linked to higher or lower innovation, revealing whether monitoring or diversity-and-signalling effects dominate.

This theoretical-to-empirical connection (Whetten, 1989) establishes that the research questions and hypotheses tested in Chapters 6 and 7 flow directly from the governance architecture framework presented progressively through Chapter 4. The empirical investigation translates theoretical predictions into testable specifications to generate evidence as to whether governance characteristics affect HTYEF performance and innovation outcomes in ways predicted by agency theory or from signalling theory perspectives (Sutton and Staw, 1995; Colquitt and Zapata-Phelan, 2007).

4.7 Conceptual Framework

Central to this research is the conceptualisation of the firm's governance structure as the key mechanism through which funding decisions translate into firm-level outcomes.

This study defines governance structure as the grouping of three interrelated dimensions arising from external equity funding choices: (1) investor heterogeneity, reflecting the diversity of external equity sources and the presence of multiple investor types with distinct expertise, networks, and strategic perspectives; (2) insider ownership, capturing the proportion of equity controlled by managers actively involved in firm operations and the degree of managerial control over strategic decisions; and (3) ownership concentration among blockholders, measuring the extent to which equity stakes are dispersed among multiple significant investors or concentrated in few dominant shareholders.

Together, these three dimensions constitute the firm's governance architecture, a fundamental structural characteristic that agency theory suggests significantly influences strategic decision-making, resource allocation, and organisational outcomes (Jensen and Meckling, 1976; Colombo *et al.*, 2014). The theoretical foundation for examining these governance dimensions rests on the recognition that entrepreneurial firms with heterogeneous external equity investors face distinct agency challenges compared to traditional corporations. Rather than the classical principal-agent conflict between dispersed shareholders and professional managers, entrepreneurial firms primarily confront principal-principal conflicts (horizontal agency costs) arising from heterogeneous investors with divergent interests, preferences, time horizons, and risk tolerances (Young *et al.*, 2008; Connelly *et al.*, 2010; Ward and Filatotchev, 2010).

Agency theory predicts that increasing investor diversity and ownership complexity intensifies coordination costs and governance conflicts, potentially constraining firm performance and innovation through resource diversion toward managing stakeholder disagreements (Jensen, 1986; Walsh and Seward, 1990). However, this traditional prediction requires context-dependent refinement. In entrepreneurial settings—which are characterised by high uncertainty, information asymmetry, and resource constraints—diverse governance structures may generate resource complementarity benefits with access to specialised networks, technical expertise, and ecosystem connections that exceed coordination challenges (Dalziel *et al.*, 2011). Different investor types can offer distinct comparative advantages, with VC investors providing strategic guidance and ecosystem connections, BA investors contributing domain expertise and mentoring relationships, and corporate investors offering technical resources and commercialisation channels.

Signalling theory (Spence, 1973; Connelly *et al.*, 2011) provides a complementary lens to agency theory, framing governance architecture as a powerful multi-stakeholder credibility signal. Diverse external investor participation signals that independent expert evaluators with distinct evaluation criteria have each validated firm quality through capital commitment, creating substantially stronger credibility signals—to labour markets (employee recruitment), product markets (customer adoption), and business relationship markets (supplier creditworthiness, distribution partnerships)—than concentrated investment from single investor types. Conversely, insider-dominated governance structures may generate negative signals regarding firm quality, as external stakeholders interpret limited external investor participation as reflecting unobserved concerns about firm prospects or founder capabilities.

The ownership structure resulting from funding decisions fundamentally shapes information asymmetry between principals and agents (Gogineni *et al.*, 2022). Jensen and Meckling (1976) argue that firms with greater separation between ownership and control face higher monitoring and contracting costs. In entrepreneurial contexts, high insider ownership may initially align incentives between owner-managers and the firm, but beyond certain thresholds, concentrated insider control can lead to entrenchment effects where founders prioritise personal objectives over external shareholder interests (Claessens *et al.*, 2002; Park and Jang, 2010). Moreover, insider-dominated structures constrain access to external capital and create financial resource limitations that directly impact firms' ability to sustain R&D investments and pursue innovation-intensive strategies.

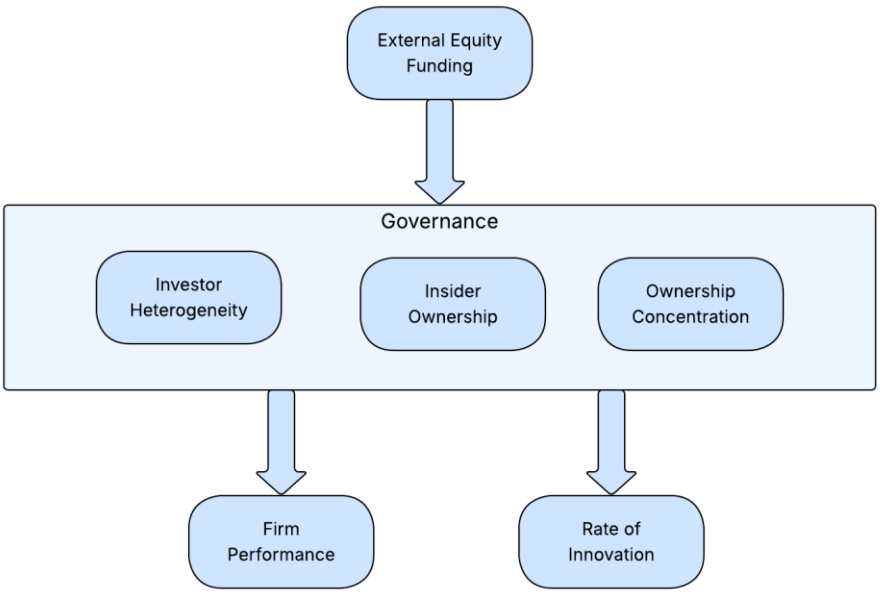
Ownership concentration among blockholders represents a possible dual influence. While concentrated ownership can provide effective monitoring and reduce free-rider problems in governance oversight (Shleifer and Vishny, 1986), excessive concentration may enable dominant shareholders to extract private benefits at the expense of minority shareholders and long-term value creation (Villalonga and Amit, 2006; Chang, 2003). Dispersed blockholder ownership creates checks and balances, ensuring innovation receives adequate strategic attention and that individual shareholders cannot deprioritise innovation in favour of personal preferences or near-term performance pressure (Edmans, 2014). Multiple blockholders—with voting power sufficient for board representation and governance influence but not for unilateral control—collectively improve strategic decision quality through diverse perspectives while preventing individual investor capture of strategic direction (Edmans and Manso, 2011).

In the specific context of the HTYEFs examined in this study, governance architecture proves particularly consequential because these firms operate under conditions of extreme uncertainty regarding technological feasibility, market acceptance, and competitive positioning (Subrahmanya, 2022). These firms require sustained investment in R&D and innovation activities with long development timelines and uncertain outcomes, precisely the contexts where governance structures most powerfully influence resource allocation decisions.

The governance dimensions examined in this research operate through multiple interconnected mechanisms: (a) resource provision mechanisms, whereby diverse investors provide complementary financial and non-financial resources; (b) signalling mechanisms, whereby governance architecture communicates firm quality to external stakeholders; (c) monitoring and discipline mechanisms, whereby external investors impose strategic oversight constraining suboptimal managerial decisions; and (d) strategic flexibility mechanisms, whereby dispersed ownership enables adaptation to changing technological and market conditions without dominant shareholder constraints.

In the conceptual models for RQ1 and RQ2, governance architecture is operationalised through three distinct dimensions: investor heterogeneity—capturing diversity across external investor types and their associated resources and signals; insider ownership—capturing managerial equity control and alignment versus entrenchment; and ownership concentration among blockholders—capturing the distribution of significant external stakes and the balance between mutual monitoring and dominant shareholder power. The following research framework diagram traces the theoretical logic guiding the research, showing external equity funding as shaping governance characteristics across three dimensions, which interact to impact firm outcomes.

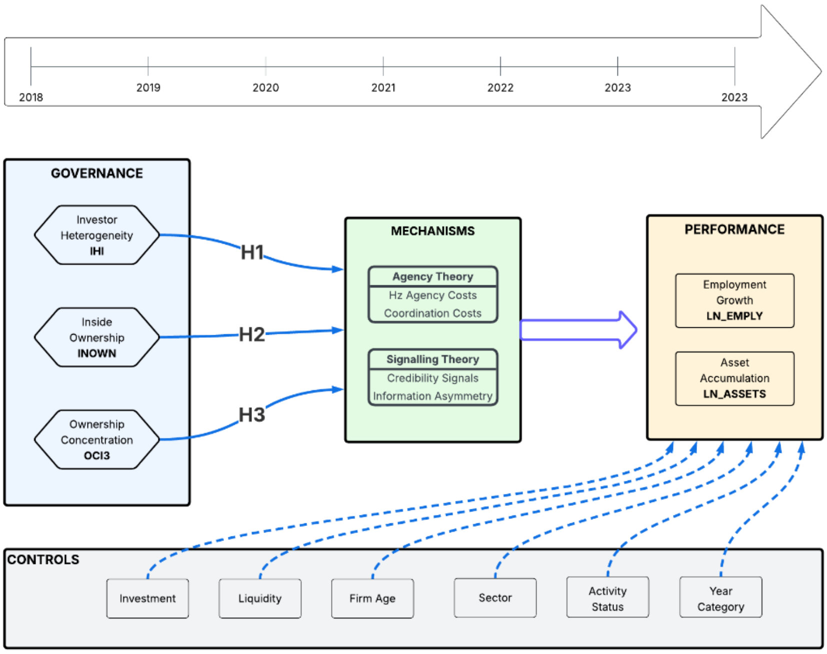
Figure 4-2 Research Framework



Drawing from the research architecture framework and theoretical foundations presented above gives rise to the conceptual models detailed in the following subsections.

4.7.1 Relationship Between Funding Structure and Firm Performance

Figure 4-3 RQ1 Conceptual Model



The governance framework established in Section 4.7 proposes that external equity funding decisions generate governance characteristics across three interrelated dimensions: (1) investor heterogeneity, reflecting the diversity of external equity sources; (2) insider ownership, capturing managerial equity control levels; and (3) ownership concentration among blockholders, representing the distribution of equity stakes among significant shareholders. Together, these ownership dimensions affect the firm's governance architecture, which agency theory and signalling theory suggest should significantly influence strategic decision-making, resource allocation, and ultimately, firm performance outcomes. This topic is the focus of RQ1.

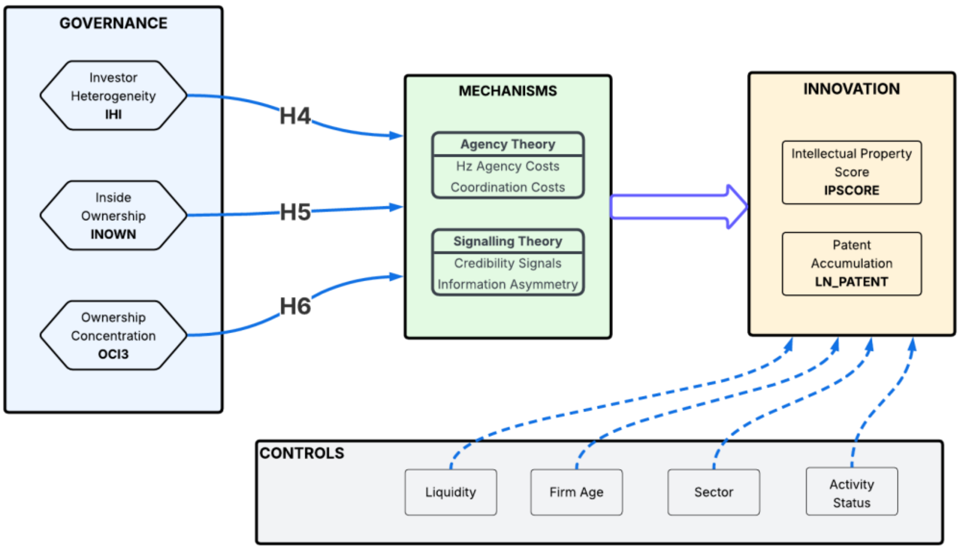
Agency theory predicts that governance structures arising from diverse external equity funding create horizontal agency costs, conflicts among principals with divergent interests, time horizons, and risk preferences (Jensen and Meckling, 1976; Young *et al*., 2008). As investor heterogeneity increases, coordination challenges may intensify, potentially constraining performance through resource diversion toward managing stakeholder disagreements. Similarly, ownership concentration patterns affect monitoring effectiveness and potential for blockholders to extract private benefits at the expense of overall firm value (Shleifer and Vishny, 1986; Villalonga and Amit, 2006).

However, signalling theory (Spence, 1973; Connelly *et al*., 2010) offers a counterbalancing perspective. Diverse external investor participation signals to interested parties that multiple, independent expert evaluators have validated firm quality by their capital commitments, creating credibility signals to labour markets, product markets, and business relationship partners. These multi-stakeholder credibility signals may generate performance benefits, improved employee recruitment, enhanced customer adoption, and stronger supplier relationships that exceed coordination costs from governance complexity.

The governance characteristics resulting from the funding structure fundamentally shape information asymmetry and incentive alignment. High insider ownership may initially align incentives between owner-managers and the firm, but beyond certain thresholds may lead to entrenchment effects where founders prioritise personal objectives over value maximisation (Claessens *et al*., 2002; Park and Jang, 2010). Conversely, dispersed ownership among external blockholders creates checks and balances that can improve strategic decision quality through diverse perspectives while curbing individual investor opportunism.

4.7.2 Relationship Between Funding Structure and Firm Innovation

Figure 4-4 RQ2 Conceptual Model



RQ2 draws on agency theory and signalling theory to examine how diverse external equity financing affects innovation through ownership structure complexity.

Classic agency theory (Jensen and Meckling, 1976) suggests that conflicts arise between investors and managers regarding long-term innovation investments, which are characterised by high uncertainty and extended time horizons that may not align with investor expectations for returns. This traditional vertical agency problem is compounded by horizontal agency costs that emerge when firms secure funding from multiple, heterogeneous sources, such as VC, BAs, corporate investors, and crowdfunding, each investor type having distinct risk preferences, strategic objectives, and investment horizons (Colombo *et al*., 2013). Divergent investor types can generate coordination costs, strategic conflicts, and decision-making complexity which constrain innovation investments as disagreements about innovation direction (incremental vs radical innovation, market focus, and risk tolerance) lead to delayed decisions, compromised strategies, or underinvestment in R&D activities. The resulting horizontal agency costs are particularly detrimental to innovation because innovative activities require sustained, patient investment and tolerance for failure—characteristics that become increasingly difficult to maintain as investor heterogeneity grows.

Signalling theory (Spence, 1973; Connelly *et al*., 2010) provides a complementary perspective by examining how funding and ownership structures convey information about a firm's innovation quality and potential in contexts characterised by severe information asymmetries. When multiple sophisticated investors from diverse sources commit capital to a firm, this heterogeneous investor base signals that the venture has undergone rigorous due diligence from multiple independent parties. This certification effect enhances the firm's reputation and facilitates access to strategic partners and high-quality talent. These positive externalities, in turn, support higher innovation outcomes (Hsu, 2004; Pollock and Gulati, 2007). Additionally, high insider ownership serves as a credible signal of manager confidence in a firm's innovative trajectory, since those with the most intimate knowledge of its innovation capabilities have chosen to maintain substantial personal financial exposure to the firm's innovation outcomes (Leland and Pyle, 1977). However, signalling pressures may also redirect innovative efforts toward safer, more demonstrable innovations rather than radical, transformative projects, as firms with visible, diverse investor bases face pressure to meet varied stakeholder expectations through frequent progress demonstrations (Vanacker *et al*., 2014).

The interaction between agency theory and signalling theory creates potentially competing predictions for how funding structures affect innovation outcomes. Agency theory predicts that greater investor heterogeneity and complex ownership structures constrain innovation through increased coordination costs and conflicting investor preferences. By contrast, signalling theory predicts that diverse funding sources and concentrated insider ownership enhance innovation through certification effects and improved access to strategic resources. The net effect on innovation depends on whether the negative agency cost burdens outweigh the positive signalling benefits or vice versa. This theoretical tension is particularly relevant for HTYEFs, which require multiple funding rounds from diverse sources to finance innovation-intensive activities. The resulting complex ownership structures simultaneously generate both agency cost challenges and signalling advantages, creating empirical ambiguity about the net effect on innovation outcomes. In this research, empirical investigation of RQ2 will generate evidence to help determine which theoretical mechanism predominates in shaping innovation outcomes by examining whether funding source heterogeneity and resulting ownership concentration patterns ultimately enhance or constrain innovative performance through their combined effects on agency costs, coordination complexity, and information signalling.

4.8 Research Hypothesis

Building on an integrated theoretical framework combining agency theory and signalling theory, this research develops six testable hypotheses to examine how external equity funding and associated governance characteristics influence firm performance (RQ1) and innovation (RQ2).

Investor heterogeneity—the diversity of external equity sources—represents a fundamental governance characteristic arising directly from funding structure decisions. From an agency theory perspective, increasing investor diversity intensifies horizontal agency costs as divergent investors bring conflicting objectives, risk tolerances, and target time horizons, complicating strategic decision-making (Jensen, 1986; Walsh and Seward, 1990). Complementing this argument, signalling theory predicts that diverse investor participation sends stronger credibility signals than concentrated investment from single investor types. Multiple independent evaluators with distinct evaluation criteria, each validating firm quality by investing, create substantially stronger signals for external stakeholders—investors, employees, customers, and suppliers—than endorsement from homogeneous investors (Hsu, 2004; Connelly *et al.*, 2010). These signalling benefits may translate directly into performance advantages and higher innovation outcomes through access to strategic partners, improved high-quality talent recruitment, customer adoption, and supplier credit terms.

Insider ownership—the proportion of equity controlled by managers actively involved in firm operations—constitutes a critical governance characteristic shaping incentive alignment between shareholders. Traditional agency theory argues that higher insider ownership reduces principal-agent conflicts by aligning managerial incentives with shareholder value maximisation (Jensen and Meckling, 1976). However, in entrepreneurial contexts, insider ownership offers dual effects. While moderate insider stakes align incentives and signal founder confidence (Leland and Pyle, 1977), excessive insider concentration may generate entrenchment effects where founders prioritise personal objectives, consumption of perquisites, empire-building, and resistance to external influences over a firm's value creation (Claessens *et al.*, 2002; Park and Jang, 2010). From a signalling perspective, excessively high insider ownership may send negative signals to stakeholders. External parties, employees, customers, and suppliers may interpret limited external investor participation as indicating that sophisticated evaluators lack confidence in firm's prospects or founder's capabilities. This negative signalling may constrain performance through reduced stakeholder cooperation and may also redirect innovative efforts toward safer, more demonstrable innovations rather than radical, transformative projects.

Ownership concentration among blockholders—shareholders holding significant equity stakes (≥3%)—represents a governance characteristic affecting monitoring effectiveness, decision-making quality, and potential for value extraction. Agency theory suggests that concentrated ownership reduces free-rider problems in monitoring, enabling blockholders with substantial stakes to exercise active oversight and constrain value-destroying activities (Shleifer and Vishny, 1986). However, excessive ownership concentration creates agency problems of its own. Dominant blockholders may extract private benefits, initiate self-dealing transactions and favourable contractual terms, and direct corporate opportunities at the expense of minority shareholders and overall firm value (Villalonga and Amit, 2006; Chang, 2003).

In entrepreneurial firms with limited corporate governance protections, concentrated blockholders may exert disproportionate influence over strategic decisions, potentially constraining performance through opportunistic behaviour (Young *et al*., 2008; Shleifer and Vishny, 1997; Claessens *et al*., 2002). Conversely, dispersed ownership among multiple blockholders can create checks and balances. Multiple significant shareholders—each with voting powers sufficient for board representation and governance influence but not for unilateral control—collectively improve strategic decision quality through diverse perspectives while preventing capture of strategic direction by individual investors. This may optimise performance by combining monitoring effectiveness with protection against blockholder opportunism. Ownership dispersion also promotes strategic flexibility, allowing for adaptation to changing technological and market conditions that might be resisted by a dominant shareholder, thus potentially boosting performance in dynamic entrepreneurial environments. Concentrated ownership may create rigidity, with dominant blockholders enforcing their own preferences or near-term performance pressure that constrains those strategic pivots needed for performance optimisation. According to the signalling theory, ownership dispersion signals effective governance and reduces extraction risk, sending stronger credibility signals than concentrated ownership among blockholders (Connelly *et al*., 2011; Hsu, 2004). These signalling advantages can directly enhance firm performance via superior talent acquisition, customer uptake, and supplier financing terms (Pollock and Gulati, 2007; Devers *et al*., 2007).

Hypotheses Summary Table

Each hypothesis pair tests one governance dimension across both performance and innovation outcome variables, maintaining conceptual consistency between research questions while testing domain-specific mechanisms.

Table 4-1 Research Questions and Hypotheses

<table>
<tr><th colspan="2">RQ-Hypothesis</th><th>Null Hypothesis</th><th>Alternative Hypothesis</th></tr>
<tr><td rowspan="2">RQ1) There is a relationship between funding structure through the governance characteristic and HTYEF performance.</td><td>H1</td><td>Heterogeneity of sources of external equity finance has no significant influence on the performance of HTYEFs.</td><td>A more diversified mix of external equity finance sources, creating more heterogeneous governance structures, is expected to be positively associated with the performance of HTYEFs.</td></tr>
<tr><td>H2</td><td>The proportion of equity owned by insider investors has no significant influence on the performance of HTYEFs.</td><td>A higher proportion of equity owned by insider investors (managers actively involved in firm management) is expected to be negatively associated with the performance of HTYEFs.</td></tr>
</table>

	H3	Ownership concentration has no significant influence on the performance of HTYEFs.	Higher ownership concentration among blockholders is expected to be negatively associated with the performance of HTYEFs.
RQ2) There is a relationship between funding structure through the governance characteristic and HTYEF rate of innovation.	H4	Heterogeneity of sources of external equity finance has no significant influence on the rate of innovation of HTYEFs.	A more diversified mix of external equity finance sources, creating more heterogeneous governance structures, is expected to be positively associated with the higher rate of innovation in HTYEFs.
	H5	The proportion of equity owned by insider investors has no significant influence on the rate of innovation of HTYEFs.	A higher proportion of equity owned by insider investors (managers actively involved in firm management) is expected to be negatively associated with the rate of innovation in HTYEFs.
	H6	Ownership concentration has no significant influence on the rate of innovation of HTYEFs.	Higher ownership concentration among blockholders is expected to be negatively associated with the rate of innovation in HTYEFs.

4.9 Scope of Theoretical Framework

The governance architecture framework developed in this thesis advances entrepreneurial finance theory by showing that the same governance dimensions (investor heterogeneity, insider ownership and ownership concentration) can generate opposite outcome effects depending on the relative strength of agency cost versus signalling mechanisms.

Rather than treating agency and signalling as separate or sequential lenses, the framework conceptualises governance choices as joint vehicles for incentive alignment and quality signalling and uses competing hypotheses (H1–H6) to identify empirically which mechanism dominates performance and innovation in HTYEFs.

The application of this integrated framework in the present study is nevertheless bounded by a set of scope conditions. This subsection clarifies those conditions and explains how they shape the way the framework is applied and interpreted in the empirical analysis.

Geographic and Institutional Scope of the Framework

The governance architecture framework was applied in this research to HTYEFs operating in the UK. This focus reflects both the research interest in addressing gaps in a literature that is predominantly US-centred and the practical advantage of the UK's institutional environment, where comprehensive ownership and financial data on private firms are available through related databases.

The UK's market-based financial system, common law tradition, and developed entrepreneurial ecosystem together provide a coherent institutional setting in which to examine how external equity funding structures shape governance, performance, and innovation.

Behavioural Scope of Agency-Theoretic Assumptions

The governance architecture framework adopts the conventional agency-theoretic view of entrepreneurs and investors as predominantly rational, utility-maximising actors concerned with risk, return, and control. This behavioural stance is consistent with the focus in this research on ownership structures, monitoring incentives, and information asymmetries in external equity relationships. The research recognises that entrepreneurs may also be motivated by broader objectives—seeking autonomy, reputation, or personal vision fulfilment—but treats these as operating within, rather than replacing, the economic optimisation logic that underpins the agency perspective used to model governance mechanisms in HTYEFs.

Information-Structure Focus of the Signalling Perspective

The signalling component of the governance architecture framework focuses on how ownership structures and investor compositions convey information about venture quality and credibility under conditions of information asymmetry. This information-structure emphasis is appropriate given the research questions, which interrogate how external equity funding patterns shape the perceptions and responses of key stakeholders. Other mechanisms through which governance may influence outcomes—for example, through resource provision, network access, or conformity to institutional expectations—are recognised in the entrepreneurial finance and corporate governance literature. In this thesis, they are considered only to the extent that they operate through, or are captured by, the signalling role of governance arrangements in HTYEFs.

5. Research Methodology

5.1 Philosophy and Methodological Approach

The success and credibility of any research undertaking heavily hinge on its methodological framework. This section sets out the foundational philosophical underpinnings guiding this study, as well as the chosen research approach and methods. This investigation adopts a comprehensive methodological framework grounded in explicit philosophical positioning to ensure coherence between ontological assumptions, epistemological stance, and analytical approaches employed throughout the research process.

5.1.1 Philosophical Foundations

By laying out the ontological and epistemological positions, a clear framework for understanding the nature of the reality under investigation and the manner in which knowledge is acquired and interpreted is set (Kothari, 2004). Furthermore, the specific approach and method will reveal insights into the systematic steps taken to gather, analyse, and interpret data (Easterby-Smith *et al.*, 2021). Together, these elements present a comprehensive roadmap of the research journey undertaken.

Ontological Foundation: Objectivism

In business research, ontology is defined as “the science or study of being”, addressing the nature of reality (Blaikie, 2010). Ontology is a system of beliefs that reflects an individual's interpretation of what constitutes a fact. This research adopts an objectivist ontological stance, conceptualising social phenomena as external, objective realities that exist independently of human perception or influence (Bell *et al.*, 2018). It recognises entrepreneurial finance phenomena as observable and measurable realities, distinct from individual interpretations or beliefs.

This stance is particularly appropriate given the structured nature of financial systems, which operate according to consistent regulations, standardised practices, and universal principles that exceed subjective interpretations. Financial systems present objective data points, investment amounts, ownership percentages, patent counts, and performance metrics that reflect broader market forces, regulatory frameworks, and competitive dynamics rather than individual cognitive processes.

Epistemological Stance: Positivism

Building upon an objectivist foundation, this study adopts a positivist epistemological stance, emphasising that reliable knowledge emerges through systematic observation, measurement, and empirical validation (Wilson, 2010). Positivism's commitment to factual, observable data aligns perfectly with the quantitative nature of financial metrics and the study's emphasis on hypothesis testing through statistical analysis. This epistemological choice ensures research findings are grounded in verifiable evidence rather than subjective interpretations, supporting the objective ontological view that only factual information gained through observation and measurement is dependable.

Alternative Philosophical Approaches

While this study is rooted in an objectivist and positivist paradigm, alternative research philosophies were also considered. Interpretivism emphasises the subjective and socially constructed nature of reality, prioritising the exploration of meaning, lived experiences, and contextual depth through qualitative methods such as interviews and ethnography (Schwandt, 1994). An interpretivist approach is effective for research aims centred on personal perception and understanding social phenomena, but it is less suited for studies focusing on objective measurement and hypothesis testing using quantitative data (Creswell and Poth, 2024). Critical realism, meanwhile, occupies a middle ground between positivism and interpretivism. It acknowledges the existence of an objective reality independent of our perceptions, yet it contends that this reality is only partially accessible and shaped by deep underlying mechanisms that may not always be directly observable. Critical realism often advocates for a mixed-methods approach to uncover both observable patterns and underlying causal structures (Lewis, 2015).

For the purposes of this research, examining measurable relationships between funding, ownership, and firm performance in HTYEFs, a positivist, objectivist approach was deemed more appropriate. This orientation enables rigorous hypothesis testing, generalisability, and robust statistical validation using large-scale, quantifiable data, which aligns best with the research objectives and data environment of this study. Ultimately, this philosophical foundation provides the logical and methodological basis necessary to produce valid, reliable, and impactful findings in the field of entrepreneurial finance research.

5.1.2 Methodological Strategy and Justification

Building on this philosophical framework, the following methodological strategy will be aligned to ensure coherence between theoretical assumptions and empirical investigation.

This research explores a new non-traditional financial environment, which means that established theories from traditional finance may not always apply seamlessly. This study begins with these established theories and tests them in this novel context to validate their applicability or identify deviations, thereby contributing to a more detailed understanding of financial dynamics in unconventional settings.

Deductive Research Approach

The philosophical positioning of this research naturally leads to a deductive methodological framework, commencing with established theoretical frameworks (agency theory and signalling theory) and testing their applicability in the novel context of HTYEFs. This approach investigates well-established theory and tests whether that theory remains valid under the specific observational circumstances of entrepreneurial finance, directly answering the research questions through systematic hypothesis testing.

The deductive approach offers several critical advantages aligned with this study's objectives, enabling theory testing and causal relationship exploration (Ketokivi and Mantere, 2010; Saunders *et al.*, 2019):

- **Theory Testing Capability**: Enables rigorous examination of whether traditional finance theories apply in entrepreneurial contexts.
- **Causal Relationship Exploration**: Facilitates investigation of cause-and-effect relationships between funding structures and firm outcomes.
- **Generalisability Potential**: Supports development of findings applicable beyond the immediate sample context.
- **Explaining Causal Relationships**: Provides the prospect of explaining causal relationships between variables under investigation.

Quantitative Research Strategy

A quantitative research method has been employed, emphasising quantified data gathering and analysis. This approach involved collecting quantitative data to answer the research questions under study and analysing them using statistical methods to test the relevant theories.

The philosophical foundation justifies the adoption of quantitative methods for multiple compelling reasons:

Alignment with Positivist Principles: Quantitative approaches emphasise measurement, statistical testing, and objective analysis, directly supporting the positivist commitment to empirical validation and factual knowledge generation.

Financial Data Characteristics: Entrepreneurial finance data naturally exists in quantitative form (investment amounts, ownership percentages, and financial ratios), making quantitative analysis the most appropriate analytical approach for capturing these objective realities.

Hypothesis Testing Requirements: The study's theoretical propositions require statistical testing to determine relationships' significance and direction, necessitating quantitative analytical techniques capable of rigorous empirical validation.

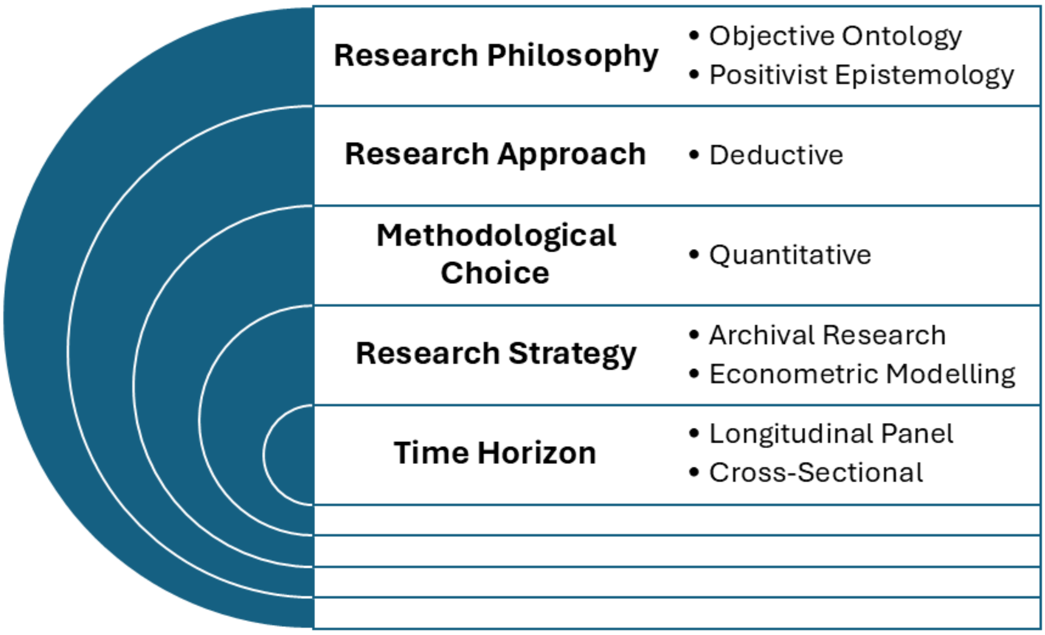
Replication and Verification: Quantitative methods enable other researchers to replicate analyses and verify findings, supporting the positivist emphasis on objective, verifiable knowledge that exists independently of the researcher.

Established Research Precedent: Prior studies in this area (Davidsson, 2004; Wilson *et al*., 2018; Bonini *et al*., 2019; Ahlers *et al*., 2015) have successfully employed quantitative approaches, offering methodological validation and facilitating comparative analysis of findings.

5.1.3 Philosophical Coherence and Research Validity

The alignment between ontological assumptions, epistemological stance, research approach, methodological choice, and empirical techniques is illustrated in the following figure, using a research onion structure adapted from Saunders *et al.* (2019). The outer layers reflect the adoption of an objectivist, positivist stance and a deductive, quantitative research design, while the inner layers represent the archival and econometric strategy, a predominantly longitudinal time horizon, and the specific data collection and analysis procedures employed in this study.

Figure 5-1 Research Onion†: Philosophical and Methodological Choices



Note †: adapted from Saunders et al. (2019)

This integrated philosophical framework ensures methodological coherence while providing robust foundations for investigating entrepreneurial finance relationships through systematic, empirical analysis. The alignment between ontological assumptions (objective financial realities), epistemological stance (positivist knowledge validation), and methodological choices (quantitative deductive analysis) strengthens the study's capacity to generate reliable, generalisable insights into the complex dynamics of entrepreneurial finance.

The philosophical approach proves particularly appropriate for this research context, where the objects under study, financial transactions, ownership structures, and performance metrics, are observable and quantifiable phenomena that exist independently of researcher interpretation. This framework supports the generation of knowledge that is both academically rigorous and practically applicable to entrepreneurial finance decision-making.

5.2 Research Design and Methods

Building on the philosophical foundations and quantitative approach established in Section 5.1, this section details the research design and methodological strategy employed to investigate how external equity funding and resulting governance characteristics affect firm performance and innovation in High Tech Young Entrepreneurial Firms (HTYEFs).

This section addresses strategic methodological decisions, research design types, data collection approachs, and analytical methods that operationalise the governance architecture framework developed in Chapter 4. This research employs a dual research design tailored to address the distinct characteristics of the two research questions. This methodological diversity reflects the different temporal and measurement characteristics of performance outcomes versus innovation outcomes.

Research Question 1 (RQ1) (Firm Performance): Investigates how external equity funding and resulting governance characteristics influence firm performance. This question requires an analysis of temporal dynamics, how governance characteristics evolve over time and how these changes affect performance. Accordingly, RQ1 is addressed through a longitudinal panel research design, utilising firm-year observations across six consecutive years (2018-2023). The panel structure enables investigation of within-firm changes in governance characteristics and their concurrent effects on performance metrics while controlling for unobserved firm-specific heterogeneity through advanced panel data econometric methods.

The panel design offers several advantages for addressing RQ1. First, it enables analysis of within-firm temporal variation, observing how performance changes when governance characteristics change within the same firm over time. This within-firm analysis provides stronger causal inference than cross-sectional comparisons across different firms. Second, panel data methods control for time-invariant unobserved heterogeneity, stable firm characteristics such as founder quality, initial industry niche, and early-stage capabilities that affect both governance and performance but cannot be directly observed or measured. Third, panel designs enable investigation of dynamic relationships, whether governance changes lead or lag performance changes, and how rapidly governance effects materialise.

Research Question 2 (RQ2) (Innovation): Investigates how external equity funding and resulting governance characteristics influence the rate of innovation. Innovation outputs (patents, patent citations, innovation scores) represent cumulative stocks measured at specific points in time rather than flows. Accordingly, RQ2 is addressed through a cross-sectional research design, utilising a single observation per firm, measured in 2023. This cross-sectional approach measures governance characteristics as minimum values observed across the 2018-2023 period, paired with cumulative innovation outcomes measured in 2023. The cross-sectional design with minimum governance values reflects the theoretical understanding that innovation accumulation depends on the governance constraints faced by firms during the innovation development period. The minimum governance values impose the strictest constraints, serving as the binding restrictions on governance flexibility that may hinder sustained innovation investments.

The cross-sectional design appropriately matches the measurement characteristics of innovation variables. Since patent stocks are cumulative measures that do not decline over time, year-on-year panel analysis would introduce autocorrelation and measurement artefacts. The cross-sectional approach provides a clean test of whether binding governance constraints (minimum values) affect long-term innovation accumulation, consistent with theoretical predictions about governance scope enabling sustained innovation investment.

This dual methodology represents an optimal approach for addressing the distinct temporal and measurement characteristics of each research question. The longitudinal panel design for RQ1 captures the dynamic relationship between governance evolution and performance changes, enabling analysis of how governance mechanisms operate over time. The cross-sectional design for RQ2 appropriately addresses cumulative innovation outcomes while testing whether binding governance constraints inhibit innovation accumulation.

This methodological plurality is well-established in entrepreneurial finance research (Cumming and Johan, 2013; Denis, 2004; Rindfleisch *et al.*, 2008). Performance research commonly employs panel designs to capture temporal dynamics and control for unobserved heterogeneity (Baltagi, 2021; Hsiao, 2022). Innovation research frequently employs cross-sectional designs when analysing patent stocks and cumulative innovation measures (Sampat, 2018; Artz *et al.*, 2010). The dual design enables a comprehensive empirical investigation of the governance architecture framework across both performance and innovation outcomes.

5.3 Analytical Strategy

This subsection provides an overview of the analytical approaches employed to test the governance architecture framework developed in Chapter 4. This overview addresses strategic analytical decisions, choice of panel data methods, cross-sectional methods, and diagnostic procedures. Detailed model specifications, including variable definitions, functional forms, and control variables, are presented in Chapter 6; empirical results and robustness tests appear in Chapter 7.

5.3.1 Panel Data Analysis

RQ1 employs a balanced firm-year panel of approximately 300–310 firms observed annually from 2018–2023 (≈1,800–1,860 observations). This structure enables within-firm estimation of how changes in governance characteristics relate to changes in firm performance while controlling for time-invariant unobserved firm heterogeneity via firm fixed effects. Panel data econometric methods provide stronger causal inference than cross-sectional analysis by controlling for unobserved heterogeneity and exploiting temporal variation.

Two complementary panel data models are estimated for RQ1:

Fixed Effects (FE) Model: The FE specification controls for unobserved firm-specific heterogeneity by including firm dummy variables that absorb all time-invariant firm characteristics. These time-invariant characteristics include founder quality, initial industry positioning, early-stage capabilities, network effects, and other stable attributes that cannot be directly measured but affect both governance characteristics and performance outcomes.

The FE model estimates governance effects using only within-firm variation over time and changes in governance characteristics within the same firm across different years. The core identifying question is: "When a firm's governance characteristics change from one year to the next, does performance change correspondingly?" By relying on within-firm variation, the approach substantially reduces omitted-variable bias from time-invariant confounding factors. Any firm attribute that is stable over the sample period, whether observed or unobserved, is absorbed by the firm fixed effects.

The FE specification strengthens causal interpretation relative to cross-sectional models by controlling for time-invariant firm heterogeneity; however, because the analysis is observational, the estimates should be interpreted as associations rather than definitive causal effects (Allison, 2009).

Random Effects (RE) Model: The RE specification treats unobserved firm-specific heterogeneity as a random component drawn from a population distribution, rather than estimating a separate fixed parameter for each firm. This approach relies on the key assumption that firm-specific effects are uncorrelated with governance characteristics and other explanatory variables. If this assumption holds, RE can produce more efficient estimates than FE.

The RE model utilises both within-firm variation (changes over time within-firms) and between-firm variation (differences across firms). The core question becomes: "Do firms with persistently different governance characteristics exhibit different average performance levels?" This broader identification strategy provides estimates of both temporal effects (within-firm) and cross-sectional effects (between-firms).

However, if unobserved firm traits are correlated with governance, for example, if higher-quality founders systematically select particular governance structures, then the RE estimates are biased and inconsistent, whereas the FE estimates remain consistent under the weaker requirement that unobserved heterogeneity is time-invariant.

Hausman Specification Test: The Hausman test compares FE and RE estimates to determine which specification is more appropriate. The test evaluates whether the RE assumption (no correlation between firm effects and regressors) is empirically supported.

If the Hausman test rejects the RE assumption ($p < 0.05$), the result indicates systematic correlation between firm effects and governance characteristics, validating FEs as the appropriate specification. If the test fails to reject the RE assumption ($p \geq 0.05$), this suggests the no-correlation assumption is held, supporting REs as the more efficient specification.

This dual approach, estimating both FE and RE models, then applying the Hausman test, represents standard practice in panel data econometrics (Baltagi, 2021; Greene, 2020; Wooldridge, 2020). This strategy contrasts the robustness of FE with the correlation between unobserved firm heterogeneity and the regressors, with the potential efficiency gains of random effects, with the Hausman test providing empirical evidence on the more appropriate specification for the data.

5.3.2 Cross-Sectional Analysis

RQ2 examines innovation outcomes (patents granted and IP activity scores) that are naturally cumulative stocks. Because these measures reflect innovation accumulated over the 2018–2023 period and are observed as end-of-period totals (measured in 2023), they are analysed using a cross-sectional design with Ordinary Least Squares (OLS) regression, with specifications aligned to the cumulative nature of the dependent variables.

Governance characteristics (investor heterogeneity, insider ownership, and ownership concentration) are operationalised as the minimum value observed for each firm over 2018–2023 and matched to the cumulative innovation outcomes measured in 2023. This “minimum” specification is intended to capture the most restrictive governance conditions a firm faces during the innovation development period.

The theoretical rationale for minimum values reflects the governance architecture framework's prediction that innovation accumulation depends on governance scope and the flexibility available to sustain innovation investment despite external pressures. Minimum governance values represent the tightest constraints, the periods when governance limitations were most binding. If governance constraints inhibit innovation, minimum values should show stronger effects than average or maximum values, as they capture the binding constraint periods when innovation investment faced its greatest governance-imposed limitations.

Robust (heteroscedasticity-consistent) standard errors are used to ensure valid p-values and confidence intervals in the presence of heteroscedasticity, which is common in cross-sectional firm data due to systematic differences in variance across firms (e.g., by size or sector).

5.3.3 Diagnostic Procedures

Both RQ1 (balanced panel) and RQ2 (cross-sectional) analyses employ comprehensive diagnostic procedures to validate model assumptions and assess specification quality. Diagnostic testing ensures that results are robust and not artefacts of specification violations or data irregularities.

Multicollinearity Assessment: Variance Inflation Factor (VIF) diagnostics assess whether independent variables are excessively correlated. High multicollinearity (VIF > 5) inflates standard errors and makes coefficient estimates unstable. VIF diagnostics ensure that governance characteristics and control variables can be reliably distinguished in their effects on outcomes.

Heteroscedasticity Testing: Tests assess whether error variance is constant across observations (homoscedasticity assumption). For panel models, tests evaluate whether error variance is constant across firms and time periods. For cross-sectional models, tests evaluate whether error variance differs across firm characteristics. When heteroscedasticity is detected, robust standard errors provide appropriate corrections.

Normality Assessment: Evaluates whether regression residuals follow approximately normal distributions, which is important for the validity of hypothesis tests and confidence intervals. Q-Q plots and formal normality tests assess this assumption. Moderate departures from normality can be tolerated with large samples (Central Limit Theorem; Wooldridge, 2020), but severe non-normality may indicate outliers or specification issues requiring investigation.

Model Fit Assessment: R-squared and adjusted R-squared evaluate the proportion of variance explained by the model. F-statistics tests overall model significance. For panel models, within-R-squared (variance explained by time-varying components) and between-R-squared (variance explained by cross-sectional differences) distinguish temporal effects from cross-sectional effects. These fit statistics assess whether governance characteristics and controls provide meaningful explanatory power for performance and innovation outcomes.

5.4 Identification Strategy and Causal Inference

While this research aims to understand the relationship between governance structures and firm outcomes, establishing definitive causality in observational settings remains challenging due to three primary concerns: omitted variable bias, reverse causality, and selection into governance structures.

Endogeneity Concerns:

1. Omitted variable bias: Unobserved firm characteristics (e.g., founder quality, organisational culture, initial technology capability) may influence both governance choices and performance/innovation outcomes, creating forged associations.

2. Reverse causality: High-performing or innovative firms may attract diverse investors and dispersed ownership, rather than governance causing, superior outcomes.
3. Selection: Firms may non-randomly select into different governance structures based on characteristics that also determine outcomes.

Mitigation Strategies:

For RQ1 (performance), the panel data design with FE models addresses time-invariant omitted variable bias by differencing out all stable firm characteristics. The Hausman tests consistently reject RE in favour of FE confirming that controlling for firm-specific heterogeneity is empirically necessary. By exploiting within-firm variation over time, the FE approach establishes temporal precedence (governance changes precede performance changes) and controls for stable confounding factors. However, FE does not address time-varying omitted variables or fully resolve reverse causality.

For RQ2 (innovation), the cross-sectional design with minimum governance values (measured 2018-2023) paired with cumulative innovation outcomes (measured in 2023) establishes temporal ordering, reducing but not eliminating reverse causality concerns. The use of minimum values captures the most binding governance constraints during the innovation development period, consistent with theoretical predictions.

Interpretation: Given these design features, the findings should be interpreted as providing strong evidence of associations consistent with causal relationships, rather than definitive proof of causality. The convergence of results across multiple specifications, time periods, and outcome measures strengthens confidence in the substantive interpretation, while remaining limitations suggest future research employing instrumental variables, natural experiments, or quasi-experimental designs will further strengthen causal claims.

5.5 Research Data Strategy

This research utilises secondary data from multiple publicly available commercial databases rather than primary data collection through surveys, interviews, or field research. This strategic decision reflects several methodological advantages and practical considerations.

Secondary data from established commercial databases contain historical records spanning multiple years, enabling the construction of balanced or near-balanced panels necessary for robust panel data analysis (Johnston, 2017; Smith, 2008). The databases employed in this research (FAME, Crunchbase, IPqwery, and MarketLine) provide consistent annual data coverage across the full sample of 400 firms.

Primary data collection would require retrospective surveys asking firms to report historical financial data, ownership structure, and investor composition for prior years (Golden, 1992; Miller *et al.*, 1997). Such retrospective reporting introduces substantial recall bias; respondents may misremember or reconstruct past data, particularly for sensitive ownership and financial information (Chandler and Hanks, 1993). Primary collection of panel years of historical data would require access to archived internal documents that many firms may not retain systematically. Secondary databases provide objectively recorded historical data, avoiding these recall and reconstruction biases (Saunders *et al.*, 2019; Cowling, 2004).

Furthermore, secondary databases enable access to substantially larger samples than typical primary data collection methods permit. Survey-based primary data collection in entrepreneurial finance research typically achieves sample sizes of 50-100 firms due to low response rates (typically 10-20% in business surveys), respondent burden, and resource constraints (Baruch and Holtom, 2008; Bartholomew and Smith, 2006). This research includes a sample of 400 firms, approximately four times larger than typical primary data samples. Larger samples provide greater statistical power for detecting governance effects (Cohen, 1988). The sample size achieved through secondary data enables robust estimation of governance effects and comprehensive control variable specifications.

Data Objectivity and Measurement Quality

Secondary data from established commercial databases undergo quality control procedures and verification processes that enhance measurement quality. Financial data in FAME derives from audited financial statements and regulatory filings with Companies House, which provide objective performance measures verified by external auditors. Patent data in IPqwery originates from official UK Intellectual Property Office records, providing verified innovation measures. Investor data in Crunchbase undergoes crowdsourced verification and commercial provider quality checks.

Primary survey data introduce measurement concerns, including social desirability bias (respondents reporting what they believe researchers want to hear), strategic response bias (respondents providing answers that present their firms favourably), and common method bias (all variables measured through the same self-report instrument) (Saunders *et al.*, 2019; Smith, 2008). Secondary data from independent sources reduces these measurement biases by providing objective, externally verified measures from multiple independent databases.

Multi-Source Data Integration

This research uniquely integrates four distinct databases (FAME, Crunchbase, IPqwery, and MarketLine) to create a rich, multi-dimensional dataset unavailable through a single-source collection (Harrison, 2013). This integration enables measurement of governance dimensions (investor heterogeneity, insider ownership, and ownership concentration) from independent sources while measuring performance outcomes (employment growth and fixed assets) and innovation outcomes (patents and IP scores) from separate databases.

Multi-source integration enhances construct validity; governance measures derive from investor databases (Crunchbase), while outcome measures derive from financial databases (FAME) and patent databases (IPqwery), eliminating common method variance concerns. The integration also enables comprehensive variable coverage unavailable through single databases; each database contributes unique data elements essential for testing the governance architecture framework.

Cost and Time Efficiency

Secondary data collection through institutional database subscriptions proves substantially more cost and time-efficient than primary data collection (Saunders *et al.*, 2019). Survey-based primary collection requires survey design, pilot testing, institutional review board approval, sample frame development, contact information acquisition, survey administration, multiple follow-up waves, and data entry, typically requiring 6-12 months and substantial budg*et* allocation (Bartholomew and Smith, 2006).

Secondary data access through University of West London library subscriptions enables immediate data extraction once sample criteria are defined, with data collection completed within 3-6 months. This efficiency enables resource allocation toward rigorous data analysis, robustness testing, and theoretical development rather than data collection logistics.

Software and Computational Implementation

All analyses are conducted using IBM SPSS Statistics (Version 30), selected for its comprehensive panel data analysis capabilities, diagnostic procedures, and institutional availability through the University of West London licences. SPSS enables specification of FE models, RE models, Hausman tests, robust standard errors, and the full range of diagnostic procedures necessary for rigorous quantitative analysis. Alternative software (R, Version 4.5.1) was also used in some calculations for ease of use and further validation of SPSS output.

5.5.1 Data Collection

Our sample data is collected on UK HTYEFs—defined conceptually in Section 1.1 as nascent companies operating in sectors characterised by rapid technological innovation—that were founded between the periods 2010–2020. The term HTYEF is based on what Tarillon (2022) defines as a new technology-based firm (NTBF): ‘independent (not listed) innovative entrepreneurial firms less than 25 years old, which market products and services with high technological content and have a high potential for growth’ (Tarillon, 2022).

This research utilises the comprehensive, unique longitudinal data on external investment information from Crunchbase and cross-checks this data with the MarketLine database. Crunchbase serves as a comprehensive platform that compiles data on financing, ownership, and acquisitions pertaining to both public and private enterprises worldwide. Crunchbase and MarketLine provide detailed information on all external investments, as well as the type and size of each investment round. The wealth of data provided by Crunchbase has enabled researchers to substantially expand their sample sizes and, crucially, to investigate the dynamics of equity funding. Crunchbase has gained substantial legitimacy as a data source for entrepreneurial research, with studies utilising the platform appearing in journals indexed in Thomson Reuters' Journal Citation Report. A systematic review of Crunchbase-based research identified multiple distinct research streams, including a rapidly developing field employing artificial intelligence for entrepreneurship analysis using the Crunchbase dataset (Besten, 2020). Several previous studies in entrepreneurial finance (Deias and Magrini, 2023; Block *et al*., 2017; Capizzi *et al*., 2021; Cumming *et al*., 2019; Dalle *et al.,* 2017) have used data from Crunchbase.

Financial and ownership data for the selected firms were systematically collected from the Fame database (Financial Analysis Made Easy), provided by Bureau van Dijk, now a Moody's Analytics company. Fame has achieved substantial legitimacy as a financial data source in business and entrepreneurship research, with Bureau van Dijk databases widely used in studies appearing in peer-reviewed journals and cited in over 700 academic publications (Bajgar *et al*., 2020).

Fame specialises in comprehensive UK and Irish private company information, containing detailed financial records on over 17 million companies with up to 20 years of financial history per firm. This longitudinal depth proves essential for the panel data methodology employed in this study. This research extracted annual financial data, including sales, assets, employment figures, and current shareholding structures, for each sample firm across the observation period. Fame's specialised focus on private company data addresses a critical limitation in entrepreneurial finance research: most small firms do not publicly report detailed financial figures due to a lack of regulatory requirements (Beuselinck *et al*., 2021).

Sample firms include the following high-tech sectors: Financial Technology, Medical Technology, Computers and Internet, Artificial Intelligence, Biomedical, Energy, Data and Analytics and Telecommunication. All sample firms were privately held at the foundation date and remained independent until the exit event. Firms selected are majority equity-financed with low leverage to reduce factors affecting growth (such as fear of bankruptcy and repayment commitments) and owner-managers involved in C-level management.

Quantitative data on financial information involving sales, assets, and other relevant financial data; information on ownership structure; external finance; and any exit events were collected. Firms that did not report detailed financial data or were not available due to reporting requirements were rejected from the sample. All firms were cross-checked across all databases with registration and directorship information to ensure the correct data was used.

The selection of sample data is based on the following criteria: Firstly, only UK firms (with headquarters registered in the United Kingdom) established in 2010 or later were included.

Secondly, only firms that have had external funding were considered. To qualify as externally funded, the firm must have had a minimum of one million US dollars in external equity investment from at least one external investor.

Thirdly, only privately held and independent firms were selected, with those that were publicly listed or owned wholly by a group or larger company excluded (they were not controlled by another business organisation, although other organisations may have held a minority stake). These firms were independent at the foundation date and remained so up to the end observation date.

Fourthly, to qualify as high-tech organisations, only firms with a non-zero IP Activity Score were selected. The IP Activity Score (commonly referred to as the IP Score) is a composite innovation measure available in the IPqwery database (IPqwery.com), a specialised intellectual property data analytics provider. This measure represents a quantitative assessment of a firm's innovativeness based on a trailing 5-year window of intellectual property filing activity, encompassing both patent and trademark applications detected by IPqwery across multiple jurisdictions.

Finally, any firm whose financial and ownership data were unavailable or incomplete was excluded from the dataset. After applying the eligibility filters, 1,520 UK HTYEFs met all criteria.

All Companies	3,346,893
UK Companies	222,415
Have External Funding	23,369
Have Raised Minimum $1M	15,426
Founded After 1/1/2010	10,914
IP Activity	1,894
Private and Independent	1,719
Financial and Ownership Data Available	1,520
Simple Random Observations	400

From this sampling frame, a simple random sample without replacement of 400 firms was drawn. Randomisation was implemented by assigning each eligible firm a uniformly distributed random number in Excel and selecting the 400 firms with the lowest random values. This procedure ensured that each eligible firm had an equal chance of selection, maintaining an unbiased and representative sample. The subsequent balanced panel used for RQ1 is derived from this firm sample, after excluding firms with incomplete observations across all panel years.

5.5.2 Sample Period

The global financial crisis of 2007-2008, which had a significant impact on the economic growth of many countries, including the UK (Ahmad *et al.*, 2023), represents a major decline in entrepreneurial firms' performance. Bartram and Bodnar (2009) report a global equity reduction of just under $30 trillion and a market capitalisation decline of more than 56% at the beginning of 2009 due to the global financial crisis.

Furthermore, another global crisis hit businesses in early 2020. The outbreak of the novel coronavirus (COVID-19) gravely affected the global economy, leading to a major stagnation and drop in demand (Brown and Cowling, 2021). In the early months of the pandemic, UK gross domestic product (GDP) fell by around 20% before partially recovering over the summer (ONS, 2022). In February 2021, the UK's economy was 7.8% lower than before the effects of Covid-19 (February 2020) and 3.1% below the initial recovery peak (October 2020) (De Lyon and Dhingra, 2021).

Additionally, the UK left the European Union (known as BREXIT) at the end of 2020, adversely affecting the volume of trade and business with Europe as a result of increasing barriers and regulations. Total exports of goods were reduced by around 20%, which was influenced by a nearly 40% drop in exports to the EU (ONS, 2021).

The selection period of 2010-2020 studies firms founded in a relatively stable economic environment between the two major global events of the enormous financial crisis and the global Covid pandemic, as well as the UK-specific BREXIT event. As performance and growth lag activities and investment, the sample set contains data for the latest year available.

5.5.3 Survivorship

One drawback of studying factors in the performance of entrepreneurial firms is survivorship bias (Delmar and Shane, 2006; Eckhardt *et al.*, 2006). Because, in principle, only firms that survive and remain active at the time of measurement can be included, while, due to the entrepreneurial nature of these firms, many fail to survive the full period under study. Consequently, the coefficients on variables that significantly influence both survival and performance will be biased downward in regressions predicting performance if the sample only includes surviving firms, which leads to biased estimates (Delmar and Shane, 2006; Carpenter and Lynch, 1999).

To account for survivorship bias, data will need to include both surviving and non-surviving firms in the sample. This means that data is collected on whether the firm experienced the event of interest (undesired exit, such as bankruptcy or forced closure) during the observation period. To account for survivorship bias in the regression model, a binary variable is included to indicate whether a firm is still active (1 if active, 0 if non-surviving) as an additional independent variable (Heckman, 1979; Greene, 2020). The regression model is then estimated using all firms in the sample, including both surviving and non-surviving firms.

For left-censored data, the last available measurement of the independent variables for the failing firms is used. While this approach assumes that the independent variables do not change substantially between the last available measurement and the time of failure, it may be a reasonable approximation in most cases (Allison, 2010; Cohen *et al*., 2003).

5.6 Ethical Considerations and Research Compliance

This research employs secondary data from publicly available commercial databases, raising specific ethical considerations distinct from primary data collection research (Tripathy, 2013). This subsection addresses research ethics, data access permissions, regulatory compliance, and research integrity measures. No research data is derived from confidential sources, non-public company information, or proprietary databases requiring restricted access. All research data derives from public sources, and all databases are commercially available with appropriate licensing arrangements. This reliance on public sources eliminates many ethical concerns associated with primary data collection.

Data Protection and GDPR Compliance

This research operates in full compliance with UK data protection regulations and General Data Protection Regulation (GDPR) requirements (European Commission, 2018):

- All research data are aggregated at the firm level (firm financial metrics, firm patent counts, firm ownership structures). No individual personal data, such as employee names, personal contact information, salary details, or personal identifiers, is included in the research dataset or analysis.
- All database sources are GDPR-compliant commercial providers. FAME is a subsidiary of Bureau van Dijk (part of Moody's Analytics), operating under established GDPR frameworks. Crunchbase complies with GDPR principles for business information. IPqwery derives from official government patent registries operating under UK and European legal frameworks. MarketLine is a Euromonitor subsidiary with established GDPR compliance procedures.
- This research does not process sensitive personal data requiring special Data Protection Impact Assessments (DPIAs). Firm-level data about company performance, ownership, and innovation metrics do not constitute sensitive personal data under GDPR Article 9 definitions.
- Research data are retained solely for research and publication purposes. Database access follows the University of West London’s information security policies and institutional guidelines for secure data handling.

Research Governance and Ethics Approval

- This research was conducted in accordance with the University of West London's Research Ethics policy framework. Given the exclusive reliance on publicly available secondary data with no primary data collection, no human subjects' involvement, and no sensitive personal data processing, formal Research Ethics Committee review and approval were given under UWL protocols for secondary data analysis projects.

Research Integrity and Transparency

This research maintains high standards of research integrity through transparent methodological reporting:

- All methodological decisions, data sources, sample construction, variable operationalisation, and analytical specifications are explicitly reported, enabling full replicability. Detailed variable definitions and measurement procedures appear in Chapter 6, enabling other researchers to verify or replicate findings.
- All analyses addressing the stated research questions are reported, including null findings and non-significant results. No results are excluded based on statistical significance or alignment with theoretical predictions. Robustness tests addressing alternative specifications and assumptions are reported in Chapter 7.
- De-identified firm-level data (with company identities removed and replaced with firm identification numbers) can be made available to other researchers for verification and replication purposes, subject to database licensing restrictions and University of West London data governance policies. Researchers wishing to access research data for replication purposes are encouraged to contact the author.
- The author declares no financial, institutional, or personal conflicts of interest relevant to this research. This research was conducted as doctoral work within the University of West London without external funding sources or industry affiliations that might create conflicts of interest.

5.7 Research Limitations and Mitigation

While this study employs robust methodological approaches and comprehensive datasets, all research involves inherent limitations. This section acknowledges these limitations and the mitigation strategies implemented to reduce their potential impact on validity and reliability.

5.7.1 Data Limitations

Sample Selection and Survivorship Bias

The focus on privately held HTYEFs that have secured external funding introduces potential survivorship bias, as unsuccessful firms may exit the market before data collection or fail to attract sufficient financing, enabling inclusion in investment databases. This limitation could lead to upward-biased performance estimates by systematically excluding firms that ceased operations during the observation period or never achieved sufficient prominence to enter commercial databases.

Mitigation Strategy: The study incorporates a comprehensive exit tracking mechanism, coding firm outcomes as 0 (firm failure) or 1 (firm survival). This categorical approach captures the full spectrum of firm outcomes, enabling more detailed analysis of performance drivers across different exit scenarios. The ACTIVE binary control variable in all regression specifications explicitly accounts for operational status, addressing survivorship bias concerns that would arise from analysing only surviving firms. Additionally, the panel data FE specifications control for time-invariant firm characteristics that might correlate with both firm survival and performance outcomes, further mitigating selection bias concerns.

Data Availability and Disclosure Constraints

The private nature of HTYEF operations creates significant challenges in obtaining comprehensive financial data, as owner-managers often demonstrate reluctance to disclose sensitive information beyond regulatory requirements. UK Companies House filing requirements exempt small companies from full financial statement disclosure, limiting the range of consistently available financial metrics across the entire sample. This constraint particularly affects profitability measures, detailed cash flow data, and detailed cost structures that would enable richer analysis of performance drivers.

Mitigation Strategy: The research employs multiple database triangulations (Fame, Crunchbase, and MarketLine) with systematic cross-verification procedures to ensure data integrity and completeness. Only firms with sufficient data quality across all the required variables are included, maintaining analytical rigour despite reducing the sample size. The employment and asset growth measures chosen as dependent variables prove more consistently available than sales or profitability metrics for privately held firms, enabling larger sample sizes while maintaining measurement validity. The six-year observation window provides sufficient temporal depth for panel estimation despite data availability constraints.

Temporal and Geographic Scope

The six-year observation period (2018–2023) and UK-specific focus limit generalisability to other temporal contexts and geographic regions with different entrepreneurial ecosystems, regulatory frameworks, and investor cultures. The UK ecosystem's specific characteristics, including the post-BREXIT regulatory environment, a mature venture capital market, and strong government support programmes, may influence governance and performance relationships in ways that differ from those in emerging ecosystems or other institutional settings.

Mitigation Strategy: The study period deliberately captures both stable economic conditions (2018-2019) and significant disruption (COVID-19 pandemic 2020-2021, post-pandemic recovery 2022-2023), providing varied economic contexts that strengthen robustness and external validity. Control variables include year fixed effects (YEAR_CAT) to account for temporal variations in macroeconomic conditions, while sector controls (13 industry dummies) address industry-specific dynamics. The UK context, while specific, represents a mature, internationally integrated entrepreneurial ecosystem with substantial cross-border investment that enhances relevance beyond purely domestic contexts. The theoretical mechanisms examined—signalling credibility, agency costs, and resource provision—operate across geographic contexts, supporting theoretical generalisability even if specific coefficient magnitudes may vary across institutional environments.

Measurement and Construct Validity

Operationalising complex constructs such as investor heterogeneity (IHI), insider ownership (INOWN), and ownership concentration (OCI3) through proxy variables may not capture the full multidimensional nature of these governance phenomena. Investor heterogeneity measured through the Herfindahl-Hirschman Index captures investor type distribution but not qualitative differences in investor engagement, governance involvement, or strategic contribution quality. Similarly, insider ownership percentage captures economic stake but not operational control mechanisms, voting rights concentration, or founder authority over strategic decisions.

Mitigation Strategy: Multiple performance measures (employment growth and asset accumulation for RQ1; patent counts and IP Activity Score for RQ2) validate findings across different success metrics, addressing concerns that results reflect measurement idiosyncrasies rather than genuine governance effects. The dual dependent variable approach for each research question provides convergent validity evidence; if governance structures genuinely influence firm success, effects should manifest across multiple outcome dimensions. Robustness checks using alternative variable specifications (logarithmic vs linear transformations and minimum vs mean aggregations) confirm the consistency of core relationships across measurement approaches.

Innovation Measurement Limitations

The use of patent counts and IP Activity Scores as innovation proxies entails several limitations. Patent-based measures capture only formally protected innovation, excluding innovations protected through trade secrecy, speed-to-market, or complementary assets. The proprietary construction of the IP Activity Score limits transparency over internal weighting, and its composite nature may obscure differences between patents, trademarks and designs. Sectoral variation in IP filing intensity further complicates interpretation, as some industries (e.g., biotechnology, advanced manufacturing) rely heavily on formal IP, whereas others (e.g., software, services) often favour alternative protection strategies. Moreover, patent counts treat all patents as equivalents, regardless of quality, technological significance or commercial value.

Mitigation Strategy: These limitations are partially mitigated through (1) comprehensive sector controls in empirical models addressing cross-industry IP filing activity variations; (2) logarithmic transformations addressing distributional properties and reducing outlier influence; and (3) the dual-measure approach comparing results across patent counts and IP Activity Score, assessing consistency across complementary innovation operationalisations. The convergent validity of both measures strengthens confidence that the findings reflect genuine innovation effects rather than measurement artefacts specific to a single innovation proxy.

5.7.2 Methodological Limitations

Endogeneity Concerns

The relationship between funding structure and firm outcomes may be subject to reverse causality, where high-performing firms attract more diverse funding sources and dispersed ownership structures rather than diverse governance, which causes superior performance. Unobserved firm characteristics, founding team quality, initial technology endowment, and founder networks may simultaneously determine both governance structure and performance outcomes, creating spurious correlation between governance and success if not properly controlled.

Mitigation Strategy: The panel data approach with FE models for RQ1 controls for time-invariant firm characteristics (founding team quality, initial technology, and organisational culture), substantially reducing omitted variable bias concerns. The Hausman specification tests consistently reject RE in favour of FE demonstrating that controlling for firm-specific unobserved heterogeneity suggests empirical necessity, validating the panel methodology's value for causal inference strengthening. The temporal structure of panel data enables examination of within-firm governance changes and subsequent performance evolution, establishing temporal precedence (governance changes precede performance improvements) that strengthens causal interpretation beyond cross-sectional correlations.

For RQ2's cross-sectional design, where panel methods prove inappropriate for cumulative innovation outcomes, the minimum governance value specification (measuring the most extreme governance configurations experienced during 2018–2023) addresses reverse causality concerns by ensuring governance measures temporally precede final innovation outcomes. Lagged variable specifications and robustness checks using alternative temporal aggregations (mean and median) confirm consistency across measurement approaches.

Model Specification and Interaction Effects

The complexity of entrepreneurial finance relationships implies that interaction effects and non-linearities may not be fully captured by the primary linear specifications. Governance dimensions (investor heterogeneity, insider ownership, and ownership concentration) may interact with firm characteristics (age, sector, and size) and with each other, generating context-contingent effects beyond main-effects models. Threshold or inverted-U relationships may also characterise some governance–performance links, implying that different functional forms could reveal additional nuance.

Mitigation Strategy: To address these concerns, the research employs a deliberate strategy of separate hypothesis-specific model estimation. Preliminary correlation analysis (Section 7.1.3) revealed that key governance variables exhibit substantial intercorrelation, particularly between investor heterogeneity (IHI) and insider ownership (INOWN), where $r = 0.702$. A correlation of this magnitude exceeds the conventional 0.70 threshold, signalling multicollinearity risk (Hair *et al.*, 2010), creating a methodological dilemma: the joint estimation of all governance variables simultaneously in a single equation would introduce variance inflation that could obscure individual governance construct effects through statistical noise rather than substantive misspecification. Consequently, this research adopts a *distinct estimation strategy* wherein separate models isolate each governance dimension: investor heterogeneity (models 1 and 4), insider ownership (models 2 and 5), and ownership concentration (models 3 and 6), which improves identification of the marginal effect of each variable on firm outcomes and reduces multicollinearity concerns, although it cannot fully address all potential interaction or non-linear effects. This approach prioritises the clarity of individual governance effects over comprehensive joint modelling.

Additionally, comprehensive robustness testing, including alternative functional forms (logarithmic vs linear transformations, and minimum vs mean aggregations), validates core findings across different specifications. Sector fixed effects and control variable specifications capture important sources of heterogeneity, strengthening confidence in the linear main effects specifications as appropriate baseline models. Sensitivity analyses ensure robustness across different functional forms, with consistent findings across specifications strengthening confidence in the empirical relationships identified.

Dual Outcome Framework and Inter-Outcome Relationships

This research employs a dual outcome framework examining performance (RQ1) and innovation (RQ2) as distinct dependent variables, both predicted by the same governance architecture dimensions. The empirical findings demonstrate that governance characteristics systematically influence both outcome domains, with all six hypotheses supported. An important theoretical question emerges from this dual-outcome design: whether performance and innovation outcomes are themselves correlated and whether observed correlation might reflect causal interdependencies or common governance influences. Investigating inter-outcome relationships would require different analytical approaches and theoretical frameworks than those employed to examine governance-outcome relationships. The decision to examine performance and innovation as separate outcome domains rather than investigating inter-outcome correlations or causal pathways between them represents a deliberate scope delimitation that enables the rigorous testing of agency and signalling theory predictions while maintaining analytical tractability.

Mitigation Strategy: This approach is justified by two design features. First, RQ1 employs longitudinal panel data to analyse performance flows, while RQ2 uses cross-sectional data to analyse cumulative innovation stocks, fundamentally different temporal structures precluding direct correlation analysis. Second, this research examines governance as a cause of both outcomes, rather than whether performance and innovation are causally linked to each other. Testing such relationships would require alternative theoretical foundations (resource-based theory, dynamic capabilities) beyond the agency-signalling integration here. The consistent finding that governance diversity enhances both outcomes suggests that governance operates as a broad capability infrastructure. Whether such effects occur through complementary mechanisms, sequential pathways, or common factors remains open for future research using structural equation modelling or mediation analysis.

6. Research Model

This research examines how external equity funding and the resulting governance characteristics influence firm outcomes in High Tech Young Entrepreneurial Firms (HTYEFs). The research framework (Figure 1.1) shows how funding decisions shape governance structures, which in turn affect both firm performance and innovation outcomes. This relationship gives rise to the following research models.

6.1 Relationship Between Funding Structure and Firm Performance

Research Question 1 (RQ1) – To what extent do external equity funding and the resulting governance characteristics affect firm performance in HTYEFs?

The hypotheses developed for RQ1 establish the theoretical predictions to be tested. The subsequent sections of 6.1 operationalise these governance constructs and specify an empirical model.

6.1.1 Dependent Variables

Research question 1 implies a measure of firm performance as a dependent variable affected by the stated independent variables. Performance measurement in small enterprises often requires proxies due to challenges in obtaining meaningful financial and non-financial data (Rashid *et al*., 2018). Additionally, young entrepreneurial firms include a range of businesses in different sectors, which creates difficulties in establishing universal performance metrics (Makhija and Goel, 2019).

Determining the ideal index to determine firm performance growth has been debated widely in the literature. Ahmad and Petersen (2008) maintain that measures of profit, growth, and survival should be considered complementary. However, profit in entrepreneurial firms in pursuit of market share growth is not often a key objective. Market share, on the other hand, as a measure of growth, can only be meaningful within sectors with a similar product range (Delmar *et al*., 2003). Literature has highlighted some other measures, including return on assets (ROA), client retention, price-to-earnings ratio (P/E), debt-to-equity ratio, and innovation capacity (Al-kalouti *et al*., 2020; Delen *et al*., 2013; Watson, 1991; Selling and Stickney, 1989). Use of ordinal variables as a performance index is also employed in some research (Pasanen, 2003).

The most widely used measures in growth studies, however, are sales and employment (Weinzimmer *et al*., 1998; Colombo and Grilli, 2005; Delmar *et al*., 2003; Wiklund *et al*., 2007). Delmar *et al*. (2003) distinguish between absolute and relative measures of growth, with absolute growth revealing overall expansion and relative measures highlighting proportional change. Colombo and Grilli (2005) emphasise the use of absolute growth measures when research questions focus on size effects.

Additionally, total assets offer a theoretically grounded alternative measure of firm performance, particularly suited to examining governance and financing effects (Colombo and Grilli, 2005; Brush and Chaganti, 1999). Assets directly capture the capital resource base accumulated through both operating performance and external financing, reflecting the firm's financial leverage and investment capacity. This measure is especially appropriate for research examining how ownership structure and external funding influence firm scale, as assets encompass both tangible and intangible resources central to competitive advantage (Barney, 1991).

While sales (turnover) is a prevalent performance metric, it was not utilised in this study because most small firms do not report sales or profit figures in their public statements due to a lack of regulatory requirements (Breuer *et al*., 2019; Beuselinck *et al*., 2021). Therefore, as the focus of this study is on young entrepreneurial firms, the use of turnover as a measure of performance results in missing data and a much smaller data set, making the analysis less significant.

Following previous research, this study employs two commonly used metrics to operationalise company performance for Research Question one (RQ1), which are regularly reported by young private firms and conceptually associated with resource allocation and scale in high-tech enterprises: Employment and Total Assets.

Assets signify the aggregated inventory of deployable resources under the firm's control, including tangible investments and working capital (Colombo and Grilli, 2005). Assets are always non-negative, making them suitable for log transformation without ad-hoc adjustments. Unlike net tangible assets (NTA), which may be negative due to accumulated losses or the treatment of intangibles, total assets provide a stable and interpretable indicator. They capture cumulative firm stability and resource accumulation, both of which are key to assessing performance in high-tech entrepreneurial firms.

Employment is widely used to assess firm performance and growth (Becchetti and Trovato, 2002; Delmar *et al*., 2003). Employment reflects the firm's ability to generate jobs, expand its organisational structure, and deploy human capital effectively. It has strong societal relevance due to its role in job creation and is less subject to accounting discretion than sales or profit measures.

Both dependent variables are analysed at their respective levels (natural logarithms) within the panel framework to capture size effects. Year and sector fixed effects are included to control for unobserved heterogeneity. The log transformation of each variable (LN_EMPLY and LN_ASSETS) reduces skewness, compresses scale differences, and improves distributional properties for regression modelling (Osborne, 2002; Wooldridge, 2020).

- EMPLY: Number of employees (natural log = LN_EMPLY)
- ASSETS: Total assets (natural log = LN_ASSETS)

Taken together, the use of employment and assets as dual dependent variables provides a robust and comprehensive view of firm performance. Employment reflects organisational and human capital expansion, whereas assets capture resource accumulation and financial stability. The following hypotheses (H1–H3) are therefore tested against both performance indicators to ensure the results are consistent and not driven by the choice of a single proxy.

Summary of Dependent Variables (DV):

Table 6-1 RQ1 Dependent Variables (DV)

Abbr.	Name	Description	Measurement	Literature
LN_EMPL	Performance (Employment)	represents the annual firm number of employees absolute growth rate.	Natural log of annual employment level ln (Empl)	(Levratto, Tessier and Fonrouge, 2018); (Siedschlag *et al*., 2014); (Delmar, Davidsson and Gartner, 2003); (Colombo and Grilli, 2010); (Kerr, Lerner and Schoar, 2011); Block and Fathollahi, 2023; Arouri *et al*., 2020; Tingvall and Videnord, 2020; (Becchetti and Trovato, 2002)
LN_ASSETS	Performance (Total Assets)	represents the annual firm total assets absolute growth rate.	Natural log of total assets	(Bonini, Capizzi and Zocchi, 2019); (Levratto, Tessier and Fonrouge, 2018); (Kerr, Lerner and Schoar, 2011); (Coluzzi *et al*., 2015)

Using multiple performance measures provides a fuller picture of young entrepreneurial firms' growth and compensates for the absence of a versatile single indicator (Barroso-Castro *et al*. 2020).

6.1.2 Independent Variables

RQ1 tests three distinct dimensions of governance characteristics arising from external equity funding decisions. This section operationalises each governance dimension as a specific, measurable independent variable reflecting the research framework: Investor Heterogeneity, Insider Ownership, and Ownership Concentration. These variables are selected to capture the distinct dimensions of governance (diversity, alignment, and power) highlighted in the literature review.

Investor Heterogeneity (IHI)

Investor heterogeneity represents the diversity of external equity sources participating in the firm's capital structure. Previous researchers have used various proxies to measure the effect of investor heterogeneity (Mönkemeyer *et al.*, 2026; Chan *et al.*, 2022; Huang and Thakor, 2013; Cumming and Zhang, 2018; Heaton and Lucas, 1995), which were mainly on listed stock ownership. Early studies often used simple binary dummies to indicate the presence of specific investor types, such as "VC-backed" versus "non-VC-backed" firms (Hellmann and Puri, 2002). However, Cumming and Dai (2010) and Chemmanur *et al.* (2011) argue that binary measures fail to capture the complexity of modern entrepreneurial finance, where firms frequently hold mixed portfolios of investors.

To address these limitations and capture the intensity of diversity, this study follows the approach of Chemmanur *et al.* (2011) by employing a Herfindahl-Hirschman Index (HHI) based on investor categories. The Investor Heterogeneity Index (IHI) is calculated as:

$$\text{IHI} = \sum_{j=1}^{n} S_j^2$$

Where S_j is the total proportion of equity held as a percentage of the total blockholdings by investor type j, for the following categories under study:

NBAT – Total ownership percentage of Individual Investors (I), Business Angel

NVCT – Total ownership percentage of Venture Capital (V) Investors

NCIT – Total ownership percentage of Corporate Investors

NFIT – Total ownership percentage of Financial Companies (F)

NEIT – Total ownership percentage of Mutual and Pension funds, Nominee, trust, trustee

NPIT – Total ownership percentage of Private Equity (PE) firms

NJIT – Total ownership percentage of Foundation, Research Institute (J)

NAIT – Total ownership percentage of Accelerators/Incubators (A)

This continuous measure provides a more detailed assessment of governance complexity affected by investor heterogeneity than simple dummy variables, allowing us to test whether the degree of diversity correlates with performance outcomes.

Insider Ownership (INOWN)

Insider ownership captures the equity stake held by active founders, managers, and directors, serving as the primary proxy for managerial alignment. The measurement of insider ownership is well-established in corporate finance literature. Jensen and Meckling (1976) and Morck *et al.*

(1988) established the standard of using the percentage of equity held by officers and directors to test the convergence-of-interest hypothesis.

Subsequent research by Coles *et al*. (2012) and Anderson and Reeb (2003) confirmed that this percentage metric effectively captures both the incentive alignment effects (at moderate levels) and potential entrenchment effects (at high levels). Based on previous research (Tarillon, 2022; Zandi *et al*., 2020; Firdaus and Kusumastuti, 2012; Becchetti and Trovato, 2002), this study uses Insider Ownership, which is the percentage of ordinary shares held by shareholders controlling the firm (Chairman, Board, Directors, Officers, and Managers).

This consistent measurement ensures comparability with the seminal studies in the field while allowing for the testing of non-linear relationships often observed in entrepreneurial firms.

Ownership Concentration (OCI3)

Ownership concentration measures the distribution of power among significant shareholdings (blockholders). In the literature, concentration is typically measured either by the stake of the single largest shareholder or by a cumulative concentration ratio. Demsetz and Lehn (1985) pioneered the use of concentration ratios, arguing that the collective influence of major blockholders is often more relevant than the stake of a single investor.

Investors with significant blockholding can greatly influence firm management through important oversight, thereby influencing the degree of agency costs as suggested by Shleifer and Vishny (1986). Bruton *et al*. (2010) suggest that the ownership concentration is a particularly important governance parameter that affects firm performance. They represent ownership concentration as a Herfindahl-Hirschman index based on the listed blockholders of the firm. The Herfindahl-Hirschman Index (HHI) is a common measure of market concentration and has been used widely in corporate finance analysis (Brezina *et al*., 2016).

The literature review highlights the importance of measuring block ownership in any study involving ownership structure. While the majority (Bruton *et al*., 2010; Truong and Heaney, 2013; Francis and Smith, 1995; Hawas and Tse, 2016; Huang *et al*., 2016) take the approach to identify blockholders as a percentage level above ordinary shares held, they vary greatly by the trigger level, such as Hawas and Tse (2016), who have suggested a level above 3%, and the opposing extreme of 20% used by Francis and Smith (1995) as a measure for block ownership.

To obtain a measurement index for ownership concentration, previous research (Sijabat *et al*., 2020; Huang *et al*., 2016; Bruton *et al*., 2010; Yasser and Mamun, 2017) that has utilised the Herfindahl-*Hirschman* index (HHI) (Rhoades, 1993) is followed.

The ownership concentration index (OCI3) is calculated as:

$$\text{OCI3} = \sum_{i=1}^{n} OC_i^2$$

Using HHI sums the squared ownership percentages of blockholders(*i*). The resultant index ranges from nearly zero to 10,000, where lower values show less concentrated ownership. This measure is particularly appropriate for high-tech young firms, where governance is often defined by a small group of lead investors rather than a widely dispersed shareholder base.

Summary of Independent Variables for RQ1

Table 6-2 RQ1 Independent Variables (IV)

Abbr.	Name	Type	Description	Measurement	Literature
IHI	Investor Heterogeneity Index	Index range 0-10,000	Measure of the variety of external equity financing sources used by the firm,	calculated as a Herfindahl-Hirschman index, which is equal to the sum of the investment source types of squared ownership as a percentage of the total blockholding.	Chemmanur *et al*. (2011); Cumming & Dai (2010); Chan et. al., 2022; Wu et. al., 2021; Huang and Thakor, 2013; Nofsinger and Wang, 2011; Heaton and Lucas, 1995
INOWN	Insider Ownership	percentage	The percentage of ordinary shares held by shareholders controlling the firm (Chairman, Board, Directors, Officers, and Managers).	Percentage total of shares held by Chairman, Board, Directors, Officers, and Managers.	Tarillon, 2022; Zandi *et al*., 2020; Firdaus and Kusumastuti, 2012; Becchetti and Trovato, 2002; Morck *et al*. (1988); Coles *et al*. (2012)
OCI3	Ownership Concentration Index	Index range 0-10,000	Measure of concentration index of blockholders who own at least a 3% portion of ordinary shares.	calculated as a Herfindahl-Hirschman index, which is equal to the sum of the blockholders' squared ownership as a percentage of the total blockholding.	Sardo and Serrasqueiro, 2021; Bruton *et al*., 2010; Thomsen *et al*., 2006; Francis and Smith, 1995; Demsetz & Lehn (1985); Konijn *et al*. (2011)

Based on agency theory (Jensen and Meckling, 1976), which holds that as the mix of divergent external investors increases, higher agency conflicts and associated costs emerge (Fu *et al.*, 2019), it is expected that a more dispersed ownership structure will create governance complexity that may constrain firm performance. However, signalling theory provides a counterbalancing mechanism: ownership dispersion signals reduced extraction risk and effective governance to external stakeholders, enhancing firm credibility and access to complementary resources (Connelly *et al.*, 2011; Hsu, 2004). Consequently, a more diversified mix of finance sources leading to dispersed ownership will influence investee firm performance through two opposing channels (agency cost increases versus signalling credibility benefits), with net effects depending on the relative magnitude of each mechanism.

6.1.3 Control Variables

The empirical models for RQ1 incorporate several control variables to isolate the independent effects of governance structure (investor heterogeneity, insider ownership, and ownership concentration) on firm performance while accounting for alternative explanations related to firm characteristics, financial capacity, and industry membership. These controls ensure that observed relationships between funding structure and growth represent genuine governance effects rather than spurious correlations driven by omitted firm heterogeneity or confounding factors. The panel data framework employed for RQ1 allows these control variables to capture both cross-sectional variation between firms and temporal dynamics within firms over the 2018-2023 observation period.

LIQR: Liquidity Ratio

The liquidity ratio represents a firm's short-term financial flexibility, which is operationalised as the ratio of current assets to current liabilities. This measure captures the firm's capacity to meet immediate financial obligations without requiring additional external financing, asset liquidation, or operational disruption. Brown and Petersen (2011) highlight internal liquidity within firms as a crucial factor for enhancing R&D efforts. In the entrepreneurial context, liquidity serves as a buffer against uncertainty and enables opportunistic investments when favourable conditions emerge (Bhagat and Welch, 1995; Hall *et al.*, 1990).

$$\text{LIQR} = \frac{Current\ Assets}{Total\ Liabilities}$$

LIQR controls for firms' financial capacity to fund growth investments, ensuring that observed relationships between governance structures and performance do not simply reflect differences in financial resource availability. This is particularly important in entrepreneurial contexts where financial constraints frequently bind, making internal liquidity critical for expansion. Controlling for liquidity ensures that estimated governance effects represent true structural governance mechanisms rather than differences in financial flexibility.

In the panel framework, LIQR varies both across firms and within firms over time, capturing how changes in financial flexibility relate to growth trajectories. The within-firm variation allows the model to assess whether firms experiencing liquidity improvements exhibit enhanced performance, conditional on governance structures. The between-firm variation accounts for persistent differences in financial management strategies across enterprises.

ACTIVE: Firm Operational Status

To address survivorship bias, both surviving and non-surviving firms are included in the data sample, using a control variable, ACTIVE, set to 0 if the firm faced bankruptcy, delisting, or ceased operations by the end of the observation period or set to 1 if these events did not occur. This method ensured a more accurate estimation of the relationship between the variables by accounting for survivorship bias (Bonini *et al.*, 2019; Colombo and Grilli, 2010; Becchetti and Trovato, 2002).

SECTOR: Industry Fixed Effects

The sector and industry of operation is significant to firm success (Yimfor and Garfinkel, 2023). The study employs a 14-category high-tech sector taxonomy developed to reflect specialisation within technology-intensive industries:

Table 6-3 List of Sectors

1	Artificial Intelligence	8	Information Technology
2	Biotechnology	9	Internet Services
3	Data and Analytics	10	Manufacturing
4	Energy	11	Science and Engineering
5	Financial Technology	12	Sustainability
6	Hardware	13	Telecommunications
7	Health Care	14	Transportation

The level of performance within newer hi-tech sectors is higher compared to more traditional business sectors. In line with many researchers (Cumming and Zhang, 2018; Siedschlag *et al.*, 2014; Bertoni *et al.*, 2011; Colombo and Grilli, 2010), the sector effect is controlled by using a categorical control variable indicating the industry sector the firm operates in.

By treating the sector as a fixed effect (using N-1 dummy variables), the model isolates the impact of governance structures on performance from structural differences in profitability, capital intensity, and growth rates inherent to specific high-tech sub-sectors (e.g., biotechnology versus software). This ensures that performance variations driven by industry-specific operating environments are not misattributed to firm-level governance characteristics.

LN_INVEST: Log Total Investment

Total external investment injected into a business has a significant influence on the rate of growth and performance of the firm (Capizzi *et al.*, 2021; Siedschlag *et al.*, 2014; Nofsinger and Wang, 2011). Following previous research (Jing and Zhang, 2023; Yimfor and Garfinkel, 2023; Nadeau, 2011; Wilson *et al.*, 2018), this study utilises the variable **INVEST**, which represents the total external equity investment size (in $M), indicating the total amount of investment received by the firm over the observation period (t=0...n), to explore this relationship.

$$\text{INVEST} = \sum_{t=0}^{n} \$M\ Invest_t$$

$$\text{LN\_INVEST} = ln(INVEST)$$

However, investment amounts vary significantly across firms, resulting in right-skewed data distributions with outliers that can bias regression estimates. To address this issue, the study includes LN_INVEST, the natural logarithm of investment amounts (Osborne, 2002; Wooldridge, 2020). Log transformation serves multiple purposes: it normalises the skewed distribution, reduces the influence of extreme values by compressing the scale, and mitigates heteroscedasticity by stabilising error variance across the range of investment levels. Additionally, this transformation enables elasticity-based interpretation (Wooldridge, 2020), where coefficients indicate percentage changes in firm performance per percentage change in investment, rather than absolute dollar amount changes.

YEAR_CAT: Year Category

The year category captures temporal macroeconomic conditions, policy environments, and period-specific shocks affecting all firms in the sample.

$$\text{YEAR\_CAT}_t = t \text{ for } t \in \{2018, 2019, 2020, 2021, 2022, 2023\}$$

Year effects control for common period-specific influences, including macroeconomic conditions (e.g., the COVID-19 pandemic 2020-2021 and post-pandemic recovery 2022-2023), policy changes, credit market conditions, and technological shocks affecting all firms similarly. By netting out these common temporal factors, the model ensures that governance-performance relationships reflect firm-level mechanisms rather than economy-wide trends coincidentally correlated with panel timing. To control for systemic macroeconomic changes and maturation effects common to all firms over the observation period (2018–2023), the model includes YEAR_CAT as a continuous linear time trend variable. This variable captures the underlying temporal trajectory of firm development, controlling for the natural tendency of surviving firms to grow over time regardless of governance structure. It is operationalised as an ordinal integer, ranging from 1 (2018) to 6 (2023).

AGE: Firm Age

According to empirical research, firm age has a major impact on performance (Levratto *et al.*, 2018; Westhead and Cowling, 1995). This phenomenon can be explained by the financial resources and experience that older businesses have gathered over time (Cantner *et al.*, 2020; Thomas and Autio, 2020), which may help explain why they are more efficient than younger businesses (Ang *et al.*, 2000; Colombo *et al.*, 2013).

Firm age is included as a continuous time-varying control variable to account for the "liability of newness" and the accumulation of organisational capabilities over time. This variable is operationalised as the number of years since the firm's incorporation for each observation year:

$$AGE_{it} = Year_t - FYEAR_i$$

where $Year_t$ is the observation year (2018-2023), and $FYEAR_i$ is firm i's year of incorporation.

Controlling for age isolates the effect of governance structures from the natural maturation effects, where older firms typically possess greater resources and stability purely due to longevity (Abatecola *et al.*, 2012).

Summary of Control Variables for RQ1

Table 6-4 RQ1 Control Variables (CV)

Abbr.	Name	Type	Description	Measurement	Justification
ACTIVE	Operational Status	Binary 0-1	Firm is still active or has stopped operation	0 = Not Active 1 = Active	Controls for survivorship bias; includes both ongoing and ceased firms

SECTOR	Industry / Sector	Categorial	A categorial number identifying the firm sector	Ordinal numbers 1-14	Controls for industry-specific growth opportunities, capital intensity, and competitive dynamics
LIQR	Liquidity Ratio	Ratio	Short-term financial flexibility	Current Assets / Current Liabilities	Controls for financial capacity to fund growth; separates resource availability from governance effects
YEAR_CAT	Observation Year Category	Scale	Ordinal number allocated to each year's data for panel data analysis	Ordinal numbers 1-6	Controls for macroeconomic conditions and period-specific shocks
LN_INVEST	Log Total Investment	scale	Cumulative external equity raised	ln (Cumulative Investment)	Controls for financial resource magnitude independent of governance structure
AGE	Firm Age	scale	Years since incorporation	Year - FYEAR	Controls for lifecycle stage and maturity effects on growth capacity

6.1.4 Empirical Model

The empirical analysis investigates the relationship between governance architecture and firm performance through a series of panel data regressions. The general functional form for the empirical model is specified as:

$$Performance_{it} = \beta_0 + \beta_1 Governance_{it} + \beta_2 Controls_{it} + \mu_i + \epsilon_{it}$$

(RQ1 Functional Model)

Although the theoretical framework in Chapter 4 specifies directional expectations for H1–H3, the empirical estimation in this chapter relies on two-sided significance tests. This testing strategy allows for the possibility that, in practice, either agency cost mechanisms or signalling benefits may dominate for each governance dimension, even where the ex-ante theoretical prediction is directional.

The literature review highlighted that the impact of governance concentration on firm performance is a complex relationship that is influenced by various factors. Several researchers have utilised ownership concentration (Huang *et al.*, 2016; Bruton *et al.*, 2010; Ma *et al.*, 2010; Becchetti and Trovato, 2002) and inside ownership (Tarillon, 2022; Colombo *et al.*, 2013; Truong and Heaney, 2013) in evaluating its impact on performance.

Moreover, in this research, the level of external equity finance heterogeneity is crucial to understanding the outcome of governance characteristics for firm performance. While previous researchers have not directly addressed external equity finance heterogeneity, Ting (2015) acknowledges the importance of including control variables in regression models to account for the joint impact of ownership concentration and firm performance. This indirectly supports the need to consider external equity finance heterogeneity as a variable in the regression model.

Research Question 1 (RQ1) investigates the direct effects of three governance dimensions arising from external funding on firm performance. Specifically, it tests whether investor heterogeneity, insider ownership, and ownership concentration affect employment growth and asset growth in HTYEFs. However, the three governance variables are inherently interdependent: investor diversity mechanically dilutes insider ownership, and both influence the concentration of equity among blockholders. A joint model combining all three predictors would introduce structural multicollinearity and yield inflated standard errors and unstable coefficient estimates, compromising inference.

Following standard practice in governance research (Himmelberg *et al.*, 1999), a separate model specification strategy is adopted: each governance dimension is estimated in its own regression equation with the same control variables. This specification allows the marginal effect of each governance variable to be estimated without weakening from multicollinearity bias, while the consistency of results across models demonstrates robustness.

$$\begin{aligned} Performance_{it} \; &= \beta_0 + \beta_1 Governance_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it} \end{aligned}$$

(RQ1 Empirical Model)

Where:

- ***Performance*** represents the dependent variable (either ***LN_EMPLY*** or ***LN_ASSETS***) for firm *i* in year *t*.
- ***Governance*** represents the key independent variable of interest (**IHI**, **INOWN**, or **OCI3**).

- ***LIQR, AGE, LN_INVEST,*** *and* ***ACTIVE*** serve as primary firm-level controls accounting for financial flexibility, maturity, scale, and survival status.
- ***YEAR_CAT*** trend and ***SECTOR*** fixed effects capture macroeconomic and industry-specific heterogeneity.
- $\boldsymbol{\beta}_0$ *represents the constant (intercept)*
- $\boldsymbol{\beta}_{1-7}$ *represent the estimated coefficients*
- $\boldsymbol{\mu}_i$ is the unobserved firm-specific effect (fixed or random)
- $\boldsymbol{\varepsilon}_{it}$ is the idiosyncratic error term.

The independent variables are defined according to the literature review but following the work of Colombo *et al*. (2013), who studied the relationship between ownership structure and entrepreneurial firms' performance using the following model, utilising the number of owner-managers of the firm (OM) and the number of non-manager individual shareholders of the firm (NMS):

$$Performance = \beta_0 + \beta_1\, OM_i + \beta_2\, NMS_i + Controls + \varepsilon_i$$

(Colombo et al., 2013)

Previous research (Berger and Udell, 2006) has presented that the ownership structure of a firm has a clear impact on its financing position. One similar study by Huang *et al*. (2016) used ownership concentration as a measure of investment diversity. Truong and Heaney (2013) suggest using the inside ownership (INSOWN) and blockholding (BLOCK) model agency costs as a function of shareholding:

$$AgencyCost = \beta_0 + \beta_1\, insown_i + \beta_2\, block_i + Controls + \varepsilon_i$$

(Truong and Heaney, 2013)

To rigorously examine the determinants of firm performance, this research follows a sequential estimation strategy. The analysis begins with cross-sectional OLS to establish a baseline snapshot, followed by pooled OLS to examine broad trends across the full panel. Subsequently, the study estimates both Fixed Effects (FE) and Random Effects (RE) models to account for unobserved heterogeneity and the panel structure of the data. Finally, the Hausman specification test is employed to statistically determine the appropriate model (FE versus RE) for robust hypothesis testing. The rationale and specification for each modelling stage are detailed below.

Our initial analysis employed Ordinary Least Squares (OLS) regression using cross-sectional data to model firm performance at the end of the observation period (Yimfor and Garfinkel, 2023). Cross-sectional analysis studies provide a straightforward means of examining broad trends and associations across firms, offering a clear interpretation of the results (Wooldridge, 2020). Utilising this method provided a baseline assessment of the relationship between the key independent variables, including ownership structure, investment, and firm characteristics, and their relationship with firm performance.

$$
\begin{aligned}
Performance_i \; = \; & \beta_0 + \beta_1 IHI_i + \beta_2 YEAR\_CAT_i + \beta_3 LIQR_i + \beta_4 AGE_i \\
& + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_i
\end{aligned}
$$

(Hypothesis H1 – OLS Analysis)

$$
\begin{aligned}
Performance_i \; = \; & \beta_0 + \beta_1 INOWN_i + \beta_2 YEAR\_CAT_i + \beta_3 LIQR_i + \beta_4 AGE_i \\
& + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_i
\end{aligned}
$$

(Hypothesis H2 – OLS Analysis)

$$
\begin{aligned}
Performance_i \; = \; & \beta_0 + \beta_1 OCI3_i + \beta_2 YEAR\_CAT_i + \beta_3 LIQR_i + \beta_4 AGE_i \\
& + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_i
\end{aligned}
$$

(Hypothesis H3 – OLS Analysis)

While cross-sectional Ordinary Least Squares (OLS) regression is a commonly employed approach due to its simplicity and interpretability, it has several inherent limitations that can undermine the validity and reliability of research findings. These limitations relate to issues such as potential endogeneity, omitted variable bias, and the inability to infer causal relationships due to the snapshot nature of cross-sectional data (Guerzoni and Vivarelli, 2023).

To address the limitations of the cross-sectional OLS approach for recognising the dynamic nature of the firm's growth and potential endogeneity, the analysis was expanded to utilise longitudinal panel data. This method takes advantage of tracking firms over multiple observation periods. (Du and Temouri, 2014; Miloud *et al.*, 2012; Wang and Bathala, 2010). Therefore, to improve the robustness of the analysis, the study next employed pooled OLS regression, which extends the cross-sectional approach by incorporating multiple years of data while still assuming a common intercept across all firms (Wooldridge, 2020). This model helped test whether including time-series information improved explanatory power (Naqshbandi, 2016).

$$
\begin{aligned}
Performance_{it} \; = \; & \beta_0 + \beta_1 IHI_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\
& + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it}
\end{aligned}
$$

(Hypothesis H1 – Pooled OLS Analysis)

$$Performance_{it} = \beta_0 + \beta_1 INOWN_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it}$$

(Hypothesis H2 – Pooled OLS Analysis)

$$Performance_{it} = \beta_0 + \beta_1 OCI3_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it}$$

(Hypothesis H3 – Pooled OLS Analysis)

However, pooled OLS regression fails to account for unobserved differences across firms, where firm-specific attributes may impact both the independent and dependent variables (Cheng *et al.*, 2021). This method carries the risk of omitted variable bias, which could potentially distort the coefficient estimates and result in misleading conclusions. Additionally, the assumption that all firms share the same intercept is unrealistic, as firm-specific differences are likely to affect performance outcomes.

One significant limitation of pooled OLS regression is its vulnerability to endogeneity, which arises when an independent variable correlates with the error, which can lead to biased coefficient estimates (Ashley and Parmeter, 2020). The presence of endogeneity, particularly when analysing complex relationships, can significantly impair the reliability of OLS estimations, often necessitating the use of alternative methods that are frequently recommended for more reliable inferences due to the limitations of pooled OLS in economic analyses (Wooldridge, 2020).

Heteroscedasticity is another critical issue associated with pooled OLS regression (Long and Ervin, 2000). The assumption that the variance of the errors is constant across all levels of the independent variables is frequently violated in real-world data. Employing pooled OLS can yield unreliable results due to unaddressed heteroscedasticity, which can lead to incorrect inference regarding statistical significance (Rosopa *et al.*, 2013). Furthermore, if the data exhibit pattern-induced variances across units or over time, the results may not generalise well, significantly impacting research conclusions.

Panel data analysis models enable the control of unobserved firm-specific differences, thereby enhancing the accuracy of the estimation (Wooldridge, 2020; Tsionas, 2019). By incorporating FE and RE models, the analysis captures variations within firms over time, differentiating between short-term fluctuations and long-term trends in firm performance (Bell and Jones, 2015). This is especially crucial in the context of entrepreneurial finance, where access to investment and ownership dynamics evolve throughout the firm's life cycle. To account for the influence of firms' unobserved individual effects on estimated parameters, fixed effects or random effects panel data models are employed (Hsiao, 2022; Hawas and Tse, 2016).

The following FE and RE models are estimated, explicitly considering these unobserved individual effects:

$$
\begin{aligned}
Performance_{it} \;=\; & \beta_0 + \beta_1 IHI_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\
& + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it}
\end{aligned}
$$

Model 1 (Hypothesis H1 – FE/RE Analysis)

$$
\begin{aligned}
Performance_{it} \;=\; & \beta_0 + \beta_1 INOWN_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\
& + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it}
\end{aligned}
$$

Model 2 (Hypothesis H2 – FE/RE Analysis)

$$
\begin{aligned}
Performance_{it} \;=\; & \beta_0 + \beta_1 OCI3_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\
& + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it}
\end{aligned}
$$

Model 3 (Hypothesis H3 – FE/RE Analysis)

Where *Performance*$_{it}$ represents, in turn, the annual growth rates of employment (*LN_EMPLY*) and total assets (*LN_ASSETS*) calculated at firm *i* in year *t*. The coefficients β_1, β_2, β_3, β_4, β_5, β_6, and β_7 represent the effects of the respective independent and control variables on the dependent variable. The error term ε_{it} represents the time-variant unexplained variation in the dependent variable. The term μ_i denotes the time-invariant and unobserved individual panel effects (fixed or random).

Transitioning from cross-sectional ordinary least squares regression to panel data modelling enhances the robustness of the analysis by addressing omitted variable bias (Bell and Jones, 2015). This approach also mitigates concerns related to endogeneity and heteroscedasticity, thereby improving the ability to draw causal inferences (Schmidheiny and Basel, 2011). Consequently, this method provides a more comprehensive understanding of how firm-level characteristics influence performance trends over time.

Selecting the correct model between pooled OLS, FE, or RE is crucial for accurate analysis. Given the panel nature of the data, the Hausman test is employed to determine the appropriate model (Wooldridge, 2020). The Hausman statistics (Hausman, 1978) test whether there is a correlation between unobserved individual effects and explanatory variables. It evaluates the differences between relationships derived from within-firm variance (FE models) and those derived from both within- and between-firm variance (RE models). A significant result implies a statistical difference between the two sets of relationships (Certo *et al*., 2017).

Stated differently, under the null hypothesis, no such correlation exists, whereas the alternative hypothesis suggests that a correlation is present between unobserved individual effects and explanatory variables (Baltagi, 2021).

$$\mathrm{H} = (\beta_{FE} - \beta_{RE})' \, [\mathrm{VAR}\,(\beta_{FE}) - \mathrm{VAR}\,(\beta_{RE})]^{-1} \, (\beta_{FE} - \beta_{RE})$$

Hausman Test (Wooldridge, 2020)

Where β_{FE} and β_{RE} are the coefficient vectors from the FE and RE models, respectively, and Var(β_{FE}) and Var(β_{RE}) are their respective variance-covariance matrices. The test statistic follows a chi-square distribution with degrees of freedom equal to the number of time-varying regressors (Wooldridge, 2020).

6.2 Relationship Between Funding Structure and Firm Innovation

RQ2 – To what extent do external equity funding structures and the resulting governance characteristics affect the rate of innovation in HTYEFs?

The hypotheses developed for RQ2 establish the theoretical predictions to be tested. The subsequent sections of 6.2 operationalise these governance constructs and specify an empirical model.

6.2.1 Dependent Variables

H2 implies measure of firm innovation as a dependent variable affected by the stated independent variables. The literature review has highlighted that measuring the rate of innovation in entrepreneurial firms is complex, given its diverse forms and scales.

Measuring the rate of innovation in firms is crucial for understanding their competitive advantage and long-term success. Several methods and indicators have been proposed to assess innovation performance. Birnbaum (2005) discusses the challenges that firms face when dealing with new technologies and how these can lead to failure. This highlights the importance of measuring innovation in order to avoid such pitfalls. Additionally, Deck (2005) provides insights into creating and sustaining successful growth through innovation by emphasising the need for effective measurement tools. Furthermore, Knowles *et al*. (2008) compare different methods for measuring firm innovativeness, aiming to develop a reliable scale for this purpose. This comparison demonstrates the intricacy of measuring innovation and the need for robust assessment tools. In the field of innovation, academics generally rely on metrics such as the number of patent applications, patents secured, R&D spending, total factor productivity, and other related measures (Aghion *et al*., 2013; Bernstein, 2015; Jiang and Yuan, 2018; Tan *et al*., 2020; Chemmanur *et al*., 2011).

One commonly used method to assess firm's innovative output is based on the number of patents filed (Cole *et al*., 2016; Nadeau, 2010; Francis and Smith, 1995). Patents are a traditional and quantifiable measure of innovation; they represent legally recognised intellectual property and indicate a firm's commitment to research and development (Hagedoorn and Cloodt, 2003). Ryu and Won (2022) use the number of patents to measure innovation, emphasising the significance of intellectual property as an indicator of innovation. Venture capital finance studies, such as the one conducted by Kortum and Lerner (2000), have used the number of patents to measure the relationship between innovation activities and venture capital investments. Although Jing and Zhang (2023) argue that due to its objectivity, the method of using patents as a substitute for innovation rate is imperfect, many studies still rely on this approach (Hagedoorn and Cloodt, 2003; Tan *et al*., 2020; Wang and Hagedoorn, 2014), possibly as critics of the use of patents have not been able to provide better measures, even when acknowledging its shortcomings.

Alternatively, the amount of investment in research and development is sometimes used as a proxy for innovation efforts. A higher R&D expenditure relative to a firm's revenue can indicate a strong focus on innovation. The financing of R&D and innovation is a critical factor to consider for high-tech firms. Hall and Lerner (2010) emphasise the significance of access to capital in supporting innovation and growth in these firms, highlighting the importance of financial resources and using R&D expenditure to measure the relationship to innovative output. Miller and Triana (2009) highlight the use of R&D expenses as a proxy for innovation in the context of investigating the effects of board diversity on firm innovation. Prugsamatz (2021) also supports this notion, indicating that R&D investment can be used as a proxy for innovation effort. Additionally, Link (2020) highlights the well-established relationship between investments in R&D and innovative behaviour, further supporting the use of R&D spending as a proxy for innovation efforts.

However, R&D expenditure, while a common innovation metric, is not used in this study because most small firms do not publicly report their R&D figures due to a lack of regulatory requirements (Breuer *et al*., 2019; Beuselinck *et al*., 2021). Therefore, as the focus of this study is on HTYEFs, the use of R&D expenditure as a measure of innovation results in missing data and a much smaller data set, making the analysis less significant.

Other methods of measurement for rate of innovation have included Number of New Products Launched (Sorescu, Chandy *et al*., 2003), market measures such as stock prices, surveys and self-reported measures. However, in the case of private HTYEFs, the most reliable method and readily accessible parameters are the number of patents and reported R&D expenditure in annual accounts.

Measuring innovation in privately held, high-tech firms is notoriously difficult due to the absence of public R&D spending data and the limitations of any single metric. To address this issue, this study adopts a dual-indicator strategy, using two distinct but complementary dependent variables: LN_PATENT and IPSCORE.

The value of high-tech entrepreneurial firms in knowledge-intensive activities is determined by the value of their intellectual property, thus emphasising the importance of patenting and the use of patent data as a reliable indicator to capture the difference in inventive activity across firms (Nadeau, 2011). Based on the literature review and the importance of intellectual property in target firms in the study, the number of patents filed by firms to proxy for innovation is used. Furthermore, following Tan *et al*. (2020) and Jing and Zhang (2023), the natural logarithm of patent application numbers is employed as an innovation measure. Log transformation addresses the right-skewed distribution typical of patent data, reduces outlier influence, and allows interpretation of governance coefficients as proportional effects on innovation outcomes (Wooldridge, 2020).

While acknowledged as a proxy that may not capture all forms of innovation (particularly in software or service sectors where trade secrets are common), patent counts remain the standard, objective metric for technological output in entrepreneurial finance research (Hagedoorn and Cloodt, 2003), especially when complemented by trademark-inclusive measures like IPSCORE."

> **LN_PATENT** = the dependent variable, measured as the rate of firm innovation. The logarithm of the number of patent applications submitted by a firm serves as a proxy for innovation.

$$LN\_PATENT_i = \ln(PATENT_i)$$

Where:

- **PATENT** is the total cumulative number of patent applications by firm *i* at the end of the observation period.

In addition to patent counts, the IP Activity Score (IPScore) sourced from the Crunchbase/IPqwery database is employed as a complementary innovation metric. The IPScore is a composite index that measures a firm's recent innovation intensity based on the volume of patent and trademark filings over a trailing 5-year period (crunchbase.com). Unlike raw lifetime patent counts, which capture historical accumulation, the IPScore focuses on current innovation activity, providing a more dynamic measure of a firm's ongoing R&D output. Using this proprietary score validates the patent count results by incorporating a standardised industry metric used by investors to assess portfolio strength.

Recent innovation measurement literature demonstrates that combining patent and trademark data captures substantially more innovation than patents alone (Millot, 2009), particularly for SMEs and young entrepreneurial firms. Research on Dutch SMEs (Morales *et al*., 2024) found that trademark data increased measured innovations by 51.8% compared to patent-only metrics, with complementarity especially pronounced in sectors where patent propensities are low. The landmark EUIPO study on European startup finance (Ménière *et al*., 2023) validated that startups possessing both patents and trademarks are 10.2 times more likely to secure funding and achieve 3 times higher rates of successful exits, confirming that composite IP measures capture innovation dimensions directly relevant to firm performance outcomes.

Patents and trademarks represent complementary facets of innovation: patents protect technological inventions and indicate R&D intensity, while trademarks protect commercial positioning and indicate marketing innovation (Daizadeh, 2021). For HTYEFs, whose assets are predominantly intangible, registered IP rights provide one of the few objectively measurable and externally validated indicators of innovation activity.

Based on the importance of including trademarks as well as innovation in the measure of intellectual property in target firms in the study, the composite measure of IP Activity Score of firms is used to proxy for innovation.

IPSCORE = the dependent variable, measured as the rate of firm innovation, the IP Activity Score of firms to proxy for innovation.

Where:

- **IPSCORE** is a continuous variable, representing the volume of intellectual property activity (patents and trademarks) over a rolling 5-year window.

This second innovation measure provides several analytical advantages: (1) captures both technical innovation (patents) and commercial innovation (trademarks) within a unified metric; (2) reflects recent innovation activity through the 5-year rolling window rather than cumulative historical outputs; (3) addresses the limitation that many young firms do not publicly report R&D expenditure; and (4) leverages publicly accessible administrative data from IP offices, ensuring greater data completeness than voluntary disclosure measures.

Summary of Dependent Variables (DV):

Table 6-5 RQ2 Dependent Variables (DV)

Abbr.	Name	Description	Measurement	Literature
LN_PATENT	Innovation (Patent)	represents the total firm number of patents.	Natural Log of Total number of Patents.	Ryu and Won (2022); Hagedoorn and Cloodt (2003); Tan *et al*. (2020); Wang and Hagedoorn (2014)
IPSCORE	Innovation (IP Activity Score)	a composite measure based on a trailing 5-year window of intellectual property filing activity, encompassing both patent and trademark applications multiple	A continuous variable measuring IP Activity Score	Daizadeh (2021); Ménière *et al*. (2023); Morales *et al*. (2024)

By using both measures, this study can test for convergent validity. If the governance architecture is associated with both cumulative technological invention (LN_PATENT) and more recent, commercially orientated innovation (IPSCORE), it provides greater confidence that the observed relationships reflect a genuine link to broad innovation capacity rather than an artefact of a single, narrow metric.

6.2.2 Independent Variables

The independent variables for Research Question 2's (RQ2) examination of the relationship between funding structure and firm rate of innovation are conceptually identical to those employed in RQ1, reflecting the same underlying theoretical constructs of investor heterogeneity, insider ownership, and ownership concentration. However, the methodological approach to operationalising these variables differs substantially due to the distinct analytical framework necessitated by the nature of the dependent variable in RQ2.

While RQ1 employs balanced panel data estimation to examine temporal growth trajectories through employment and asset expansion, RQ2 investigates cumulative innovation output measured through patent counts and IP activity scores. Patents represent a stock variable that accumulates over the firm's history rather than changing period-by-period, making panel data estimation inappropriate for this research question. Consequently, the analysis for RQ2 employs a cross-sectional OLS framework, distinct from the panel approach used for performance outcomes in RQ1. To align with this cumulative view of innovation, the unbalanced panel dataset is collapsed into a cross-sectional structure where each firm appears as a single observation, pairing its aggregate innovation output with its most binding governance configuration across the 2018–2023 (or exit) period.

This specification reflects the theoretical premise that innovation capabilities are path-dependent and often determined by periods of extreme resource constraint or governance pressure rather than average conditions (Sydow *et al.*, 2009). Given the cumulative nature of patent-based innovation measures and the availability of longitudinal governance data across firm lifetime, multiple temporal aggregation approaches merit consideration for constructing independent variables: temporal averages (means or medians), final-period values, or temporal extremes (minimum or maximum values). The selection of minimum values as the primary operationalisation for RQ2 reflects both theoretical considerations and empirical validation through systematic specification testing.

From an empirical standpoint, alternative specifications (mean, median, maximum and minimum values for each governance variable) were tested to identify which temporal aggregation demonstrated the strongest association with cumulative innovation outcomes and superior statistical properties. For investor heterogeneity (IHI), the minimum value specification demonstrated the highest explanatory power (R^2 = 0.186) compared to the mean (R^2 = 0.161) and the median (R^2 = 0.161) specifications, representing a 15.5% improvement in variance explained. Similarly, for insider ownership (INOWN), the minimum specification achieved R^2 =

0.165 versus R^2 = 0.161 for mean and R^2 = 0.157 for median approaches. For ownership concentration (OCI3), the minimum specification yielded R^2 = 0.146 versus R^2 = 0.116 for the mean specification, a 25.9% improvement. These systematic performance differentials across all three governance constructs provide strong empirical justification for the minimum value approach.

Beyond empirical performance, the selection of minimum values for investor heterogeneity, insider ownership, and ownership concentration is grounded in organisational theory regarding governance extremes and their persistent effects on strategic decision-making (Stinchcombe, 1965; Sydow *et al.*, 2009; Marquis and Tilcsik, 2013). Innovation, particularly in high-tech entrepreneurial firms, represents a long-term investment requiring sustained strategic commitment, risk tolerance, and resource allocation over multiple periods (Balkin *et al.*, 2000; O'Reilly and Tushman, 2013).

The minimum heterogeneity index (maximum diversity) represents the period of "peak resource access" or "critical knowledge injection". Similarly, minimum insider ownership reflects periods of greatest external oversight, while minimum concentration indicates maximum ownership dispersion. These extremes, rather than temporal averages, may better predict the firm's accumulated innovation stock by identifying governance configurations that either enabled or constrained strategic innovation investments during pivotal development phases (Stinchcombe, 1965; Ketkar and Roche, 2025; Marquis and Tilcsik, 2013).

This approach also aligns with path dependence theory (Sydow *et al.*, 2009), which argues that organisational capabilities, including innovation capacity, are shaped by critical historical periods that establish trajectories that are difficult to alter subsequently. The minimum governance configuration experienced by a firm may represent such a critical juncture, establishing innovation routines, risk tolerance norms, and resource allocation patterns that persist even as governance structures evolve. Consequently, the governance extremes (minimum heterogeneity, minimum insider ownership, and minimum concentration) observed during these critical development phases exert lasting effects on firms' accumulated innovation stocks, making them superior predictors of cumulative patent outputs than temporal averages of later-period governance configurations.

LN_IHI_MIN: Log of Minimum Investor Heterogeneity Index

The Investor Heterogeneity Index (IHI), as detailed in Section 6.1.2, quantifies the diversity of external equity funding sources using a Herfindahl-type concentration measure. For RQ2, this variable is operationalised as the natural logarithm of the minimum IHI value observed across the 2018-2023 period for each firm:

$$LN\_IHI\_MIN = \ln(\min(IHI_{2018}, IHI_{2019}, IHI_{2020}, IHI_{2021}, IHI_{2022}, IHI_{2023}))$$

Lower IHI values indicate greater investor heterogeneity (more diverse funding sources), while higher values represent more concentrated investor composition. The minimum IHI value identifies the period when the firm experienced its greatest investor diversity. The natural logarithmic transformation is applied to address the highly skewed distribution of IHI values, which range from 2.95 to 10,000 with considerable positive skewness (0.37 in the full unbalanced panel sample).

Log transformation normalises the distribution, reduces the influence of extreme values, and facilitates the interpretation of coefficients as proportional effects. The wide range of IHI values (3,395-fold ratio between minimum and maximum) makes logarithmic transformation particularly appropriate, as it compresses scale differences while preserving the ordinal ranking of observations (Osborne, 2002).

INOWN_MIN: Minimum Insider Ownership Percentage

Insider ownership (INOWN), defined comprehensively in Section 6.1.2, represents the percentage of equity held by managers actively involved in the firm's operations. For RQ2, the variable is specified as the minimum insider ownership percentage observed during the 2018-2023 period:

$$\text{INOWN\_MIN} = \min(\text{INOWN}_{2018}, \text{INOWN}_{2019}, \text{INOWN}_{2020}, \text{INOWN}_{2021}, \text{INOWN}_{2022}, \text{INOWN}_{2023})$$

The minimum insider ownership value identifies the period when external investors exercised the greatest proportional control over the firm. This represents the governance configuration with maximum external oversight and potentially reduced managerial entrenchment. Unlike that of IHI_MIN, the insider ownership minimum is employed in raw percentage form (0-100%) rather than logarithmically transformed. This specification choice reflects the distinct distributional properties of the two variables. INOWN_MIN exhibits lower skewness (0.91) compared to IHI_MIN (1.70 for untransformed values) and is naturally bounded within a meaningful percentage scale. Additionally, 25 firms in the sample exhibit zero minimum insider ownership, which would require adjustment (ln (INOWN_MIN + 1)) if logarithmic transformation were applied. Such an adjustment introduces an artificial floor that may reduce the measure's effectiveness.

The insider ownership-innovation relationship draws on both agency theory and signalling theory, which offer competing predictions about how managerial equity stakes affect risk-taking and innovation investments (Coles *et al.*, 2006; Davis *et al.*, 1997). Research has established that ownership structure fundamentally shapes innovation in entrepreneurial contexts (Zahra, 1996; Anderson and Reeb, 2003), though the direction and magnitude remain contested. The specification aligns with corporate governance research that traditionally has measured ownership percentages linearly rather than logarithmically, given their natural boundedness and policy-relevant interpretation (Morck *et al.*, 1988; McConnell and Servaes, 1990).

LN_OCI3_MIN: Log of Minimum Ownership Concentration Index

The Ownership Concentration Index (OCI3), described in Section 6.1.2, employs a Herfindahl-type measure to quantify concentration among blockholding shareholders holding 3% or more of equity. For RQ2, this is operationalised as the natural logarithm of the minimum OCI3 value observed during 2018-2023:

$$\text{LN\_OCI3\_MIN} = \ln\left(\min\left(\text{OCI3}_{2018}, \text{OCI3}_{2019}, \text{OCI3}_{2020}, \text{OCI3}_{2021}, \text{OCI3}_{2022}, \text{OCI3}_{2023}\right)\right)$$

Lower OCI3 values indicate more dispersed ownership among blockholders, while higher values represent greater concentration. The minimum OCI3 value identifies when ownership was most dispersed among blockholders. According to agency theory, this period of maximum dispersion may have generated coordination costs and free-rider problems for shareholders, potentially constraining innovation investments requiring collective commitment. Conversely, ownership dispersion may have facilitated broader stakeholder input and reduced dominant shareholder interference, potentially supporting more exploratory innovation strategies.

Consistent with LN_IHI_MIN, a natural logarithm is applied to normalise the highly skewed distribution of OCI3 values (skewness = 2.19 in the full panel), which ranges from 0 to 10,000. The logarithmic transformation addresses the extreme right tail while maintaining interpretability as proportional effects. The log specification also demonstrated superior empirical performance in preliminary analyses, exhibiting a stronger association with innovation outcomes and improved model diagnostics compared to untransformed specifications.

The use of logarithmic transformation for IHI_MIN and OCI3_MIN but not for INOWN_MIN reflects a data-driven approach consistent with established econometric practice (Wooldridge, 2020). Variable transformation decisions are properly determined by distributional characteristics rather than imposed uniformly across all predictors (Osborne, 2002).

The selection of minimum values for the governance indices (IHI, INOWN, and OCI3) is grounded in the theoretical framework, rather than simple temporal averaging. Innovation in high-tech ventures is frequently path-dependent; a firm’s capacity to innovate is often defined by its most extreme resource configurations rather than its average state (Sydow *et al.*, 2009). Empirically, this theoretical stance is supported by model specification tests. As detailed above, the minimum value specifications consistently yielded higher explanatory power than mean or median approaches, suggesting that these governance extremes are indeed the primary drivers of innovation variance in the sample.

Summary of Independent Variables for RQ2

Table 6-6 RQ2 Independent Variables (IV)

Abbr.	Name	Type	Description	Measurement	Literature
LN_IHI_MIN	Log Minimum Investor Heterogeneity Index	Index	Natural log of minimum IHI value across 2018-2023, capturing the period of greatest investor diversity	ln(min(IHI)), where IHI = Herfindahl index of investor type concentration	Chemmanur *et al*. (2011); Cumming and Dai (2010)
INOWN_MIN	Minimum Insider Ownership	percentage	Minimum percentage of equity owned by manager-owners during 2018-2023, representing a period of maximum external control	min (INOWN)	Coles *et al*. (2006); Anderson and Reeb (2003)
LN_OCI3_MIN	Log Minimum Ownership Concentration	Index	Natural log of minimum OCI3 value across 2018-2023, capturing period of maximum ownership dispersion	ln(min(OCI3)) where OCI3 = Herfindahl index of blockholder concentration	Attig *et al*. (2008); Konijn *et al*. (2011)

6.2.3 Control Variables

The empirical models for RQ2 incorporate several control variables to isolate the independent effects of governance structure (investor heterogeneity, insider ownership, and ownership concentration) on innovation outcomes while accounting for alternative explanations related to firm characteristics, financial capacity, and industry membership. These control variables, while conceptually identical to those employed in RQ1 (Section 6.1.4), require context-specific operationalisation, reflecting the cross-sectional analytical framework and cumulative nature of patent-based innovation measures. The inclusion of these controls ensures that observed relationships between funding structure and innovation represent genuine governance effects rather than spurious correlations driven by omitted firm heterogeneity.

LIQR_AVG: Average Liquidity Ratio

The liquidity ratio (LIQR), defined comprehensively in Section 6.1.3, represents a firm's short-term financial flexibility by measuring the ratio of current assets to current liabilities. This measure controls for financial resource availability following Hall and Lerner's (2010) demonstration that innovation requires sustained financial capacity. The temporal average specification (2018-2023) captures typical financial flexibility rather than transitory extremes, consistent with innovation finance research emphasising sustained rather than momentary resource availability (Brown *et al.*, 2009).

$$LIQR\_AVG = (LIQR_{2018} + LIQR_{2019} + LIQR_{2020} + LIQR_{2021} + LIQR_{2022} + LIQR_{2023}) / 6$$

Innovation investments, particularly in high-tech entrepreneurial firms, require sustained financial capacity over extended periods rather than singular moments of peak liquidity (Hall and Lerner, 2010). Patent development involves multi-year research and development cycles, prosecution costs, and maintenance fees that demand consistent financial resources. The average liquidity ratio better captures the firm's typical financial capacity to sustain innovation investments throughout its development trajectory compared to extreme values that may represent temporary conditions.

AGE: Firm Age

Firm age, defined identically to Section 6.1.3, represents the number of years since firm incorporation. For RQ2's cross-sectional framework using 2023 as the final observation year, AGE captures each firm's maturity at that point:

$$AGE = OYEAR - FYEAR$$

Where:

- OYEAR represents the observation year
- FYEAR represents the firm's year of incorporation.

AGE (firm age) controls for lifecycle stage effects and mechanical patent accumulation following Huergo and Jaumandreu's (2004) evidence that firm age systematically affects innovation performance through multiple mechanisms. Age creates competing effects on innovation: mature firms enjoy resource advantages and established capabilities, while younger firms benefit from entrepreneurial flexibility but confront financial and capability constraints (Henderson, 1993). Additionally, age correlates mechanically with patent accumulation since patents represent cumulative outputs over the firm's history. Variable AGE controls for lifecycle effects on innovation, ensuring that observed relationships between governance structures and patent outputs do not simply reflect differences in firms' temporal opportunities to accumulate patents. This is particularly important given RQ2's use of cumulative patent counts as the primary innovation measure, where older firms mechanically have had more time to develop and file patent applications.

ACTIVE: Firm Operational Status

The ACTIVE variable, specified consistently with Section 6.1.3, represents a binary indicator of the firm's operational status in the final observation year:

ACTIVE = 1 if firm is operational in 2023

ACTIVE = 0 if firm ceased operations before 2023

Operational status is determined through multiple verification sources, including Companies House filing status, corporate website accessibility, employment data availability, and financial statement submission patterns.

ACTIVE (Operational Status) controls for survivorship bias by including both operational and ceased firms, addressing the concern that excluding failed enterprises generates sample selection bias if survival correlates with both governance structures and innovation (Cefis and Marsili, 2006; Delmar and Shane, 2006). This approach follows recent entrepreneurship research that emphasises the importance of accounting for firm exits in performance analyses (Wennberg *et al.*, 2010).

This is particularly important in entrepreneurial contexts where failure rates are substantial and potentially correlated with both governance structures and innovation investments. Including ceased firms with ACTIVE=0 controls provides a more complete representation of the population while allowing coefficient estimates to account for survival-related differences.

SECTOR: Industry Fixed Effects

The industry classification, identical to Section 6.1.3, employs the 14-category system developed for this research, reflecting high-tech sector specialisation. For RQ2's cross-sectional framework, sectors are incorporated as dummy variables (fixed effects) rather than categorical predictors:

$SECTOR\_{i}$ = 1 if firm belongs to sector i (i = 1...13)

$SECTOR\_{i}$ = 0 otherwise

$SECTOR\_{14}$ = serves as a reference category (omitted)

Industry membership fundamentally shapes innovation capacity through multiple mechanisms. Technological opportunity varies substantially across industries, with some sectors (e.g., biotechnology, artificial intelligence) inherently exhibiting higher innovation rates due to rapid technological advancement and patent-intensive competition (Klevorick *et al.*, 1995). Regulatory environments differ dramatically, with sectors like life sciences facing extensive IP protection necessitating high patenting rates, while software-orientated sectors may rely more on trade secrets and copyright (Cohen *et al.*, 2000). Market structures vary, with some industries characterised by patent races and defensive patenting strategies that inflate patent counts regardless of genuine innovation intensity (Hall and Ziedonis, 2001).

Additionally, sector membership may correlate with governance structures, creating potential omitted variable bias if uncontrolled. Certain industries (e.g., biotechnology) typically attract specialised venture capital with homogeneous investor compositions, while others (e.g., fintech) may exhibit more diverse funding source combinations (Bertoni *et al.*, 2015; Cumming *et al.*, 2019). Industry controls are essential to isolate governance effects from sector-level differences that systematically influence innovation patterns.

Unlike RQ1's panel specification, where SECTOR could be included as a categorical variable, RQ2's cross-sectional OLS framework with substantial sector-specific heterogeneity necessitates dummy variable specification. This approach:

- **Allows flexible intercept differences**: Each sector obtains its own baseline innovation level, accommodating non-linear differences in patenting tendencies across industries.
- **Avoids linear ordering assumption**: Dummy specification does not impose artificial ordering on sector categories (e.g., assuming Sector 2 has precisely double the innovation of Sector 1).
- **Facilitates statistical testing**: Individual sector coefficients reveal which industries significantly differ from the reference category.
- **Improves model fit**: Specification testing demonstrated that the dummy variable approach increased explanatory power by approximately 7 percentage points (R^2 improvement from 0.08 to 0.15) compared to the categorical specification.

The dummy variable specification requires omitting one sector as the reference category to avoid perfect multicollinearity (the "dummy variable trap") (Wooldridge, 2020). Sector 14 (Transportation) serves as the reference, chosen because it represents an established, moderately patent-intensive industry providing a meaningful baseline for interpretation. All sector coefficient estimates are interpreted relative to this omitted category.

Summary of Control Variables for RQ2

Table 6-7 RQ2 Control Variables (CV)

Abbr.	Name	Type	Description	Measurement	Justification
LIQR_AVG	Average Liquidity Ratio	Ratio	Mean liquidity ratio (current assets/current liabilities) across 2018-2023	Temporal average	Controls for financial capacity to fund innovation; the temporal average reflects sustained resource availability
AGE	Firm Age	Numbers ranging 1 - 15	Years since incorporation as of 2023	2023 - FYEAR	Controls for temporal opportunity to accumulate patents and lifecycle effects on innovation capacity
ACTIVE	Operational Status	Binary 0-1	Binary indicator of firm operational status in 2023	1=operational, 0=ceased	Controls for survivorship bias and selection effects related to firm viability
SECTOR_1 . . . **SECTOR_13**	Industry Fixed Effects	Binary 0-1	Dummy variables for 13 of 14 high-tech industry categories	1=membership, 0=otherwise (Sector 14 reference)	Controls for industry-specific innovation propensities, technological opportunities, and patenting norms

6.2.4 Empirical Model

The empirical analysis investigates the relationship between governance architecture and firm innovation through a cross-sectional OLS data regression. The general functional form for the empirical model is specified as:

$$Innovation_i = \beta_0 + \beta_1 Governance_i + \beta_2 Controls_i + \epsilon_i$$

(RQ2 Functional Model)

Consistent with Chapter 4, H4–H6 are formulated directionally; however, the regression analysis employs two-sided tests and reports both positive and negative coefficients, recognising that the net effect of the governance architecture on innovation may reflect the balance between agency costs and signalling mechanisms in either direction.

While a unified specification conceptually integrates all governance dimensions, estimating them jointly would likely introduce structural multicollinearity, artificially inflate standard errors and obscure the statistical significance of individual effects (Wooldridge, 2020; Kalnins, 2018). Consequently, to ensure robust identification, this research employs a 'distinct estimation strategy' where each governance dimension is tested in a separate, hypotheses-specific model (Models 4–6). This approach prioritises the isolation of marginal effects over joint estimation, consistent with established empirical practices in corporate governance research (Himmelberg *et al*., 1999; Coles *et al*., 2006).

The empirical strategy for RQ2 employs cross-sectional ordinary least squares (OLS) regression to test how governance structures influence firm innovation in HTYEFs. This section specifies the econometric framework, provides comprehensive justification for the methodological approach, and formulates the model development process that led to the final specifications for testing Hypotheses 4, 5, and 6.

RQ2 investigates the relationship between governance structures (investor heterogeneity, insider ownership, and ownership concentration) and firm innovation measured through cumulative patent outputs and IP activity scores. Unlike RQ1's analysis of temporal growth dynamics through panel data methods, RQ2 examines cross-sectional variation in cumulative innovation outcomes using data from the 2023 period. This methodological distinction reflects the fundamental nature of innovation variables: patents represent stock measures that accumulate over the firm's history rather than flow variables that change discretely period-by-period.

Cross-sectional analysis appropriately tests whether governance characteristics, specifically, the governance extremes (minimum values) experienced during critical periods in the firm's development, predict observable differences in firms' total innovation capacity at the endpoint (Wooldridge, 2020). This approach aligns with path-dependent theoretical frameworks, suggesting that governance configurations during critical junctures establish innovation trajectories that persist and accumulate over time (Sydow *et al*., 2009; Teece *et al*., 1997).

Two innovation measures were evaluated as dependent variables: LN_PATENT (natural logarithm of cumulative patent counts) and IPSCORE (IP Activity Score based on a 5-year rolling window of patent and trademark filings). LN_PATENT provides direct patent-based innovation measurement with established theoretical grounding in innovation research (Griliches, 1990). IPSCORE offers broader innovation capture, including trademarks; addresses the limitation that many young firms file patents sporadically; and reflects recent innovation activity through its rolling window construction.

Both measures are employed as alternative specifications for each hypothesis, providing robustness evidence and capturing different innovation dimensions. This dual specification approach, testing the same governance effects with complementary innovation measures, strengthens causal inference through convergent validity (Shadish *et al*., 2002).

Control variables were systematically included to isolate governance effects while accounting for alternative explanations. All six hypothesis-specific models employ an identical control variable framework, ensuring comparability of governance effect estimates across specifications. This unified approach follows best practice in comparative hypothesis testing, where alternative explanations must be consistently addressed across models (Angrist and Pischke, 2009).

The model specifications follow established precedents in corporate finance and innovation research while incorporating the theoretical frameworks developed in Chapters 3 and 4. The empirical models for RQ2 test three distinct hypotheses examining how governance structure dimensions, investor heterogeneity (H4), insider ownership (H5), and ownership concentration (H6) influence firm innovation outcomes. Each hypothesis is tested using separate regression specifications to isolate the independent effect of each governance construct while controlling for alternative explanations.

The baseline model specification follows the functional form:

$$Innovation_{\mathrm{i}} = \beta_0 + \beta_1 Governance_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s \; SECTOR_{\mathrm{is}} + \varepsilon\mathrm{i}$$

where:

- $Innovation_{\mathrm{i}}$ represents the rate of innovation represented by either LN_PATENT (natural logarithm of cumulative patent count) or IPSCORE (IP Activity Score) for firm (i)
- $Governance_{\mathrm{i}}$ represents one of three governance measures: LN_IHI_MIN, INOWN_MIN, or LN_OCI3_MIN for firm (i)
- Control variables include LIQR_AVG (average liquidity), AGE (firm age), ACTIVE (operational status), and 13 sector dummy variables (SECTOR_1 through SECTOR_{13}, with Sector 14 as reference)
- $\varepsilon\mathrm{i}$ represents the error term capturing unobserved heterogeneity

This general specification is instantiated in three hypothesis-specific models, each isolating a distinct governance dimension.

Hypothesis 4 (H4): Investor Heterogeneity

H4 proposes that investor heterogeneity significantly influences innovation rates in HTYEFs. Building upon signalling and agency theory perspectives linking investor composition to innovation outcomes (Chemmanur *et al.*, 2011; Cumming and Dai, 2010). The investor heterogeneity construct, while novel in its minimum-value operationalisation, extends established research examining how diverse funding sources affect entrepreneurial firm performance (Knockaert *et al.*, 2010). The following regression specification tests this relationship:

$$LN\_PATENT_{\mathrm{i}} = \beta_0 + \beta_1 LN\_IHI\_MIN_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s \ SECTOR_{\mathrm{is}} + \mathrm{\varepsilon i}$$

Model 4a (Hypothesis H4 – Patent)

Where '*i*' indexes firms, LN_PATENT represents the natural logarithm of cumulative patent counts, LN_IHI_MIN captures the log of minimum investor heterogeneity experienced during 2018-2023, and the control variables account for financial capacity (LIQR_AVG), lifecycle stage (AGE), survival (ACTIVE), and industry heterogeneity (SECTOR dummies). The log functional form follows convention in innovation economics, where indices exhibit skewed distributions appropriately normalised through logarithmic transformation (Griliches, 1990; Hall *et al.*, 2000).

Following established practice in innovation research of employing multiple innovation measures to enhance robustness (Acs and Audretsch, 1988; Katila and Shane, 2005), Model 4 is also estimated with IPSCORE as the dependent variable:

$$IPSCORE_{\mathrm{i}} = \beta_0 + \beta_1 LN\_IHI\_MIN_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s \ SECTOR_{\mathrm{is}} + \mathrm{\varepsilon i}$$

Model 4b (Hypothesis H4 – IPScore)

Both measures are employed as alternative specifications for the hypothesis, providing robustness evidence and capturing different innovation dimensions.

Hypothesis 5 (H5): Insider Ownership

H5 examines whether insider ownership significantly influences innovation rates in HTYEFs. Building on agency theory and signalling theory, which offer competing predictions about how managerial equity stakes affect risk-taking and innovation investments (Coles *et al*., 2006; Davis *et al*., 1997).

The following regression specification tests this relationship:

$$LN\_PATENT_{\mathrm{i}} = \beta_0 + \beta_1 INOWN\_MIN_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s\ SECTOR_{\mathrm{is}} + \varepsilon \mathrm{i}$$

Model 5a (Hypothesis H5 – Patent)

Where '*i*' indexes firms, LN_PATENT represents the natural logarithm of cumulative patent counts; INOWN_MIN represents the minimum insider ownership percentage (0-100 scale) experienced during 2018-2023, operationalised in raw percentage form without logarithmic transformation; and the control variables account for financial capacity (LIQR_AVG), lifecycle stage (AGE), survival (ACTIVE), and industry heterogeneity (SECTOR dummies).

The model is also estimated with IPSCORE as the dependent variable, following the dual-measure approach established in Model 4:

$$IPSCORE_{\mathrm{i}} = \beta_0 + \beta_1 INOWN\_MIN_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s\ SECTOR_{\mathrm{is}} + \varepsilon \mathrm{i}$$

Model 5b (Hypothesis H5 – IPScore)

INOWN_MIN remains untransformed due to its bounded nature (0-100%), presence of zero values, and superior empirical performance in raw form. This linear-linear specification (both variables untransformed) facilitates straightforward interpretation of percentage point changes while providing convergent validity evidence across innovation measures, consistent with standard econometric approaches for bounded variables (Wooldridge, 2020; Papke and Wooldridge, 1996).

Hypothesis 6 (H6): Ownership Concentration

H6 tests whether ownership concentration significantly influences innovation rates in HTYEFs. Building upon signalling and agency theory perspectives linking ownership composition to innovation outcomes, the following regression specification tests this relationship:

$$LN\_PATENT_{\mathrm{i}} = \beta_0 + \beta_1 LN\_OCI3\_MIN_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s \ SECTOR_{\mathrm{is}} + \varepsilon \mathrm{i}$$

Model 6a (Hypothesis H6 – Patent)

Where '*i'* indexes firms, LN_PATENT represents the natural logarithm of cumulative patent counts; LN_OCI3_MIN represents the natural logarithm of the minimum Ownership Concentration Index (Herfindahl measure for shareholders holding ≥3% equity) experienced during 2018-2023; and the control variables account for financial capacity (LIQR_AVG), lifecycle stage (AGE), survival (ACTIVE), and industry heterogeneity (SECTOR dummies).

Consistent with Models 4 and 5, the ownership concentration hypothesis is also tested using IPSCORE, providing robustness evidence through alternative innovation operationalisation:

$$IPSCORE_{\mathrm{i}} = \beta_0 + \beta_1 LN\_OCI3\_MIN_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s \ SECTOR_{\mathrm{is}} + \varepsilon \mathrm{i}$$

Model 6b (Hypothesis H6 – IPScore)

All six empirical models (4a–6b) employ ordinary least squares (OLS) regression with heteroscedasticity-consistent (HC) standard errors (White, 1980). This approach accounts for heteroscedasticity, which is common in cross-sectional firm-level data (Wooldridge, 2020), ensuring valid hypothesis tests and appropriate confidence interval coverage. Model diagnostics assess multicollinearity via variance inflation factors (VIF), residual normality through visual inspection and the Shapiro-Wilk test, and model fit via R^2 and adjusted R^2. Results are presented in Chapter 7.

7. Data Analysis

7.1 Relationship Between Funding Structure and Firm Performance

This section presents empirical results testing Research Question 1 (RQ1): the relationship between external equity funding structure and firm performance outcomes.

7.1.1 Panel Data Estimation

Firm performance was modelled using Ordinary Panel Data Estimation (Baltagi, 2021). Panel data (longitudinal data) analysis involves repeated observations over time on the same units, allowing for the examination of dynamic relationships and drawing valid conclusions. Panel data provides several advantages over purely cross-sectional or purely time-series data (Hsiao, 2022), making it appropriate for analysing growth dynamics, ownership structures, and investment behaviour in High Tech Young Entrepreneurial Firms (HTYEFs).

Panel data provides the ability to control for unobserved heterogeneity, characteristics specific to firms (such as managerial skills, firm culture, and technological capabilities) that are not directly measurable but likely impact both independent and dependent variables (Hsiao, 2022; Baltagi, 2021). Overlooking these factors risks omitted variable bias and results in inconsistent estimates, particularly in entrepreneurial finance research where intangible resources are highly significant (Gormley and Matsa, 2014).

Additionally, panel data estimation improves statistical efficiency by increasing the number of data points and capturing both cross-sectional (between firms) and time-series (within firms over time) variation (Wooldridge, 2020). This method examines how early financing and ownership concentration affect firm growth by separating short-term dynamics from long-term trends. Panel data estimation techniques can capture these dynamics without oversimplifying growth.

Consequently, Ordinary Panel Data Estimation, starting with pooled OLS and advancing to Fixed Effects (FE) and Random Effects (RE) models, provides a rigorous framework (Reed and Ye, 2011) for analysing the financial and structural factors influencing entrepreneurial firm growth.

Table 7-1 Panel Data Estimation

Model	Use Case	Assumptions	Test to Decide
Pooled OLS	No firm-specific effects	Firms behave identically	Breusch-Pagan LM Test (if insignificant, use OLS)
Fixed Effects (FE)	Firm-specific effects exist	Firm-specific characteristics do not change over time	Hausman Test (if significant, use FE)
Random Effects (RE)	Firm effects exist but are random	Firm-specific effects are uncorrelated with IVs	Hausman Test (if insignificant, use RE)

The following subsection discusses the data and the results of the statistical analysis for the research question.

7.1.2 Descriptive Statistics

The study presents descriptive statistics for the key variables incorporated into the empirical models, including ownership indices, investment, liquidity, and firm size indicators. A summary table is provided detailing the statistics for the sample of 1800 firm-year observations spanning the years 2018 to 2023. This provides an overview of the central tendency and variability of the data.

Table 7-2 RQ1 Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
IHI	1800	2.946	10000.000	5715.756	2424.639	5878872.127	0.366	0.058	-0.870	0.115
INOWN	1800	0.000	100.000	38.855	28.691	823.201	0.481	0.058	-0.788	0.115
LN_INVEST	1800	0.000	7.090	2.566	1.388	1.927	0.218	0.058	-0.229	0.115
LN_EMPLY	1800	0.000	7.241	2.648	1.194	1.425	0.281	0.058	0.250	0.115
LN_ASSETS	1800	1.609	21.632	14.536	1.883	3.545	-0.770	0.058	3.348	0.115
OCI-3	1800	0.000	10000.000	2374.378	1948.849	3798014.011	2.192	0.058	5.427	0.115
AGE	1800	1.000	18.000	7.147	2.917	8.510	0.233	0.058	-0.437	0.115
SECTOR	1800	1.000	14.000	6.853	3.725	13.873	-0.052	0.058	-1.138	0.115
YEAR_CAT	1800	1.000	6.000	3.500	1.708	2.918	0.000	0.058	-1.269	0.115
ACTIVE	1800	0.000	1.000	0.923	0.266	0.071	-3.185	0.058	8.152	0.115
LIQR	1800	0.000	99.630	9.054	13.013	169.328	2.967	0.058	11.104	0.115
Valid N (listwise)	1800									

IHI (Investor Heterogeneity Index) quantifies the concentration of investor types, with values ranging from 2.95 to 10,000. It exhibits a high mean of 5,715.76 and a considerable standard deviation of 2,424.64, indicating significant variability in the distribution of investor types among the enterprises in the sample. Skewness is slightly positive (0.37) with light tails (kurtosis −0.87), suggesting considerable cross-firm heterogeneity in the investor composition without significant clustering at either end of the index. The observed heterogeneity in the diversity of external equity funding sources among organisations may impact their growth and innovation potential, as a broader array of investment sources can offer not just finance but also diverse knowledge and networks.

INOWN (Insider Ownership) a percentage variable that runs from 0% to 100%, with a mean of 38.86 and a standard deviation of 28.69. This signifies that, on average, insiders, including founders and executives, possess a substantial equity interest in the companies. The considerable dispersion indicates significant differences in the level of control and influence exerted by insiders throughout the sample. The modest positive skewness (0.48) and slight negative kurtosis (-0.79) of the INOWN distribution indicate that it is approximately normally distributed. This dispersion offers sufficient variance both within and between firms. The degree of insider ownership is especially relevant within the framework of agency theory, since the congruence between managers and shareholders can influence strategic decision-making and organisational outcomes.

OCI3 (Ownership Concentration Index) spans from 0 to 10,000, with a mean of 2,374.38 and a standard deviation of 1,948.85. This suggests a moderate average concentration among blockholders, alongside considerable variability within the sample. The significant variation in OCI3 values may indicate disparities in ownership structures among organisations, potentially affecting decision-making processes and the extent of monitoring. The distribution is right-skewed (skewness 2.19) and leptokurtic (kurtosis 5.43), indicating that numerous enterprises display moderately dispersed blockholdings, while a smaller portion demonstrates strong concentration. The differences in ownership structure may affect the management of the firms and the dynamics of decision-making inside them.

LIQR (Liquidity Ratio) ranges from 0.00 to 99.63 and displays a mean of 9.05 and a relatively substantial standard deviation of 13.01, indicative of diverse short-term financial conditions across the sample firms. The distribution is significantly positively skewed (skewness = 2.97) and highly leptokurtic (kurtosis = 11.10), suggesting the presence of a long right tail, where a small subset of firms exhibit exceptionally high liquidity levels. This skewness may obscure the typical firm's liquidity experience, underscoring the potential need for data transformations or outlier control measures in subsequent analyses. Liquidity is an important factor, as it allows firms to make investments necessary for growth and innovation, while limited liquidity may restrict such activities.

LN_INVEST (Log of Investment) ranges from 0.00 to 7.09 and exhibits a mean of 2.57 and a standard deviation of 1.39. This suggests a relatively even distribution of capital input across the firms after the logarithmic transformation. The distribution of LN_INVEST has a mild right skew (skewness = 0.22) with light tails (kurtosis = -0.23), supporting its suitability for inclusion in parametric statistical models. The log transformation effectively normalises the originally highly skewed investment amounts, enabling the interpretation of coefficients in terms of elasticities. This variable is a key factor in firm performance, especially in capital-intensive and high-growth industry contexts.

LN_EMPLY (Log of Employment), the dependent variable derived from the natural logarithm of employment, ranges from 0.00 to 7.24 with a mean of 2.65 and a standard deviation of 1.19. These values suggest that the average firm in the sample employs between 15 and 20 people. The distribution is approximately normal, as indicated by its mild positive skewness (0.28) and near normal kurtosis (0.25), thereby validating its use as a proxy for assessing firm growth or performance. Employment serves as a vital performance metric, particularly for early-stage enterprises where workforce expansion is closely associated with scaling efforts and funding events.

LN_ASSETS (Log of Total Assets) ranges from 1.61 to 21.63 and exhibits a mean value of 14.54 with a standard deviation of 1.88. However, the distribution is notably negatively skewed (-0.77) with high kurtosis (3.35). This distributional pattern suggests that while the majority of firms in the sample possess relatively high levels of assets, a minority demonstrate significantly lower values. This discrepancy may be attributed to business models that prioritise intangible assets, such as intellectual property or software. Although logarithmic transformation reduces the impact of outliers, it still reflects the inherent structural differences between asset-heavy and asset-light firms.

SECTOR (Sector Category) ranges from 1 to 14, with a mean value of 6.85 and a standard deviation of 3.73. The skewness is nearly zero (-0.05), and the kurtosis is moderately low (-1.14), indicating a relatively even distribution of firms across sectors. This supports its inclusion as a categorical control variable, ensuring that sector-specific dynamics are accounted for in the regression models.

YEAR_CAT (Year Category) which captures the panel time component from 2018 to 2023, is uniformly distributed (mean = 3.50, std. dev. = 1.71). The skewness is exactly zero, and the negative kurtosis (-1.27) suggests an even spread across years rather than clustering. This supports the use of year fixed effects to net out common macro shocks and period-specific influences. This supports the inclusion of year fixed effects to control for time-varying macroeconomic or policy shifts influencing firm performance.

AGE (Firm Age) ranges from 1 to 18 years, with a mean of 7.15 and SD = 2.92. The distribution shows slight right skew (skewness = 0.23) and light negative kurtosis (kurtosis = −0.44), indicating moderate dispersion around a mid-lifecycle profile typical of young, growth-orientated firms. Variation in age supports its inclusion as a control to capture lifecycle effects on performance.

ACTIVE (Firm Survival), the survival indicator spans 0–1 (inactive/active), with a mean of 0.92 and SD = 0.27, reflecting that the vast majority of firm years are active. As expected for a binary variable, the distribution is heavily left-skewed (skewness = −3.18) with high kurtosis (8.15), consistent with rare inactive observations. The ACTIVE variable controls for firm survival status, preventing outcome differences between operating and ceased firms from biasing estimates of governance effects on performance.

The data provides a comprehensive view of various financial, operational, and growth metrics of the firms in this study. The variability in the majority of these indicators suggests a diverse range of characteristics and performances among the firms. This diversity can be crucial for understanding the different factors influencing the success and growth of high-tech entrepreneurial firms.

7.1.3 Correlation Analysis

The Pearson correlation coefficients indicate the strength and direction of the linear relationship between pairs of variables, which will also provide an initial analysis of multicollinearity. The Pearson correlation coefficient is a suitable choice for analysing the growth patterns of high-tech entrepreneurial firms due to its ability to quantify linear relationships, detect multicollinearity, and lay the groundwork for more advanced analyses (Shah and Zaveri, 2021). This coefficient is widely accepted and straightforward, making it ideal for the initial analysis of the dynamics influencing such firms (Tuğran *et al.*, 2015). Researchers often rely on the Pearson correlation coefficient to explore linear associations between variables, highlighting its common usage in statistical studies (Shah and Zaveri, 2021).

These correlations provide insights into how different factors like ownership concentration, diversity of financing sources, insider ownership, and firm characteristics like age, turnover, employment growth, and net tangible assets are interrelated. This information could be valuable in understanding the dynamics of high-tech entrepreneurial firms and their growth patterns. To check for multicollinearity using Pearson's correlation matrix, high correlation coefficients between independent variables are observed. While a correlation coefficient exceeding ±0.9 is generally considered an indicator of problematic multicollinearity that may compromise regression reliability (Hair *et al.*, 2010; Tabachnick and Fidell, 2013), significance levels must also be considered. Significant correlations (typically $p < 0.05$) that are also high in magnitude are more concerning for multicollinearity.

To explore the linear associations between the key variables used in the regression models, Pearson correlation coefficients were computed for all continuous variables. The analysis offers initial insights into the direction and strength of bivariate relationships and helps evaluate potential multicollinearity concerns.

Table 7-3 RQ1 Correlation Analysis

Correlations

		LIQR	INOWN	OCI-3	IHI	LN_EMPLY	LN_ASSETS	LN_INVEST	AGE
LIQR	Pearson Correlation	1.000	0.014	-0.018	-.069**	-.059*	.115**	.046*	-.162**
	Sig. (2-tailed)		0.546	0.445	0.003	0.012	0.000	0.049	0.000
	N	1800	1800	1800	1800	1800	1800	1800	1800
INOWN	Pearson Correlation	0.014	1.000	.463**	.702**	-.353**	-.440**	-.252**	-.440**
	Sig. (2-tailed)	0.546		0.000	0.000	0.000	0.000	0.000	0.000
	N	1800	1800	1800	1800	1800	1800	1800	1800
OCI-3	Pearson Correlation	-0.018	.463**	1.000	.568**	-.345**	-.344**	-.174**	-.313**
	Sig. (2-tailed)	0.445	0.000		0.000	0.000	0.000	0.000	0.000
	N	1800	1800	1800	1800	1800	1800	1800	1800
IHI	Pearson Correlation	-.069**	.702**	.568**	1.000	-.428**	-.459**	-.293**	-.326**

	Sig. (2-tailed)	0.003	0.000	0.000		0.000	0.000	0.000	0.000
	N	1800	1800	1800	1800	1800	1800	1800	1800
LN_EMPLY	Pearson Correlation	-.059*	-.353**	-.345**	-.428**	1.000	.730**	.515**	.374**
	Sig. (2-tailed)	0.012	0.000	0.000	0.000		0.000	0.000	0.000
	N	1800	1800	1800	1800	1800	1800	1800	1800
LN_ASSETS	Pearson Correlation	.115**	-.440**	-.344**	-.459**	.730**	1.000	.531**	.343**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.000	0.000
	N	1800	1800	1800	1800	1800	1800	1800	1800
LN_INVEST	Pearson Correlation	.046*	-.252**	-.174**	-.293**	.515**	.531**	1.000	-0.023
	Sig. (2-tailed)	0.049	0.000	0.000	0.000	0.000	0.000		0.329
	N	1800	1800	1800	1800	1800	1800	1800	1800
AGE	Pearson Correlation	-.162**	-.440**	-.313**	-.326**	.374**	.343**	-0.023	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.329	
	N	1800	1800	1800	1800	1800	1800	1800	1800

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

The Investor Heterogeneity Index (IHI) shows a moderate and statistically significant negative correlation with both log employment (LN_EMPLY, $r = -0.428$, $p < 0.001$) and log assets (LN_ASSETS, $r = -0.459$, $p < 0.001$). This indicates that firms with more heterogeneous investor bases (lower IHI) tend to exhibit larger workforces and asset bases, while those with more concentrated investor structures (higher IHI) are associated with weaker performance outcomes. This pattern reinforces the argument that investor diversity can enhance firm performance, potentially through mechanisms of improved monitoring, complementary expertise, and stronger signalling effects that reduce information asymmetry. These findings are consistent with signalling theory predictions but run counter to agency-based expectations of higher coordination costs under heterogeneous ownership.

Insider Ownership (INOWN) demonstrates a statistically significant negative correlation with both performance measures: LN_EMPLY ($r = -0.353$, $p < 0.01$) and LN_ASSETS ($r = -0.440$, $p < 0.01$). This inverse relationship suggests that larger, more resource-rich firms in the sample typically operate with lower levels of managerial ownership, likely reflecting the equity dilution inherent in scaling high-tech ventures through external financing rounds. The correlation magnitude is moderate, indicating that while firm growth is associated with reduced insider control, substantial variation remains in ownership structures across firms of similar size.

The Ownership Concentration Index (OCI3) shows a moderate and statistically significant negative correlation with both log employment (LN_EMPLY, $r = -0.345$, $p < 0.001$) and log assets (LN_ASSETS, $r = -0.344$, $p < 0.001$). The negative relationship indicates that firms with more dispersed ownership structures tend to exhibit larger workforces and asset bases, whereas firms with highly concentrated ownership are associated with weaker performance outcomes. This pattern suggests that ownership dispersion may provide benefits through reduced entrenchment of dominant shareholders, enhanced access to complementary resources, and stronger external signalling that reduces information asymmetry and attracts additional funding. These findings complement the IHI results, which also pointed to the benefits of investor diversity, and together they reinforce signalling-theory perspectives while challenging agency-theory predictions that emphasise the efficiency of concentrated control.

The Liquidity Ratio (LIQR) displays a weak but statistically significant negative correlation with log employment (LN_EMPLY, $r = -0.059$, $p = 0.012$) and a weak positive correlation with log assets (LN_ASSETS, $r = 0.115$, $p < 0.001$). This mixed pattern suggests that firms with higher liquidity reserves tend to hold larger asset bases but employ relatively smaller workforces. One possible interpretation is that liquidity strengthens balance sheet capacity and signals financial stability, thereby supporting capital accumulation and asset growth, while simultaneously reflecting a more conservative resource allocation strategy that restrains labour expansion.

Log Investment (LN_INVEST) exhibits a strong and statistically significant positive correlation with both log employment (LN_EMPLY, $r = 0.515$, $p < 0.001$) and log assets (LN_ASSETS, $r = 0.531$, $p < 0.001$). This indicates that firms with greater levels of investment are systematically associated with larger workforces and asset bases, reflecting the central role of investment intensity in driving firm growth.

While most pairwise correlations were moderate, the correlation between Investor Heterogeneity (IHI) and Insider Ownership (INOWN) was notably high ($r = 0.702$). This indicates a strong structural link between who invests and how much equity insiders retain. To avoid multicollinearity issues that would arise from including these highly correlated variables in a single equation, which would artificially inflate standard errors and obscure the significance of individual governance dimensions, this study adopts a strategy of testing each governance mechanism in separate, isolated models.

From the observed correlation matrix results, there are no multicollinearity factors affecting other independent variables; however, while correlation can indicate potential multicollinearity, it does not conclusively prove its presence. For a more definitive assessment, using the Variance Inflation Factor (VIF) analysis is also considered. VIF values greater than 5 are often considered indicative of multicollinearity.

7.1.4 Regression Analysis

This section presents regression results testing Hypotheses 1–3 on the relationship between funding structure and firm performance. Models 1–3 employ pooled OLS, FE and RE panel estimation, with results reported separately for each governance dimension (investor heterogeneity, insider ownership, and ownership concentration) and performance measure (employment growth and asset expansion).

7.1.4.1 Hypothesis 1 (H1)

Regression model 1 examined the relationship between funding structure heterogeneity (measured by IHI) and firm performance (represented by LN_EMPLY and LN_ASSETS). A summary of the model fit is presented below. Full results, including charts, are available in the appendix.

Pooled OLS

$$\begin{aligned} LN\_EMPLY_{it} \;&= \beta_0 + \beta_1 IHI_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it} \end{aligned}$$

Model 1a (Hypothesis H1 – Employment Pooled OLS Analysis)

$$\begin{aligned} LN\_ASSETS_{it} \;&= \beta_0 + \beta_1 IHI_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it} \end{aligned}$$

Model 1b (Hypothesis H1 – Assets Pooled OLS Analysis)

Table 7-4 Pooled OLS model fit for Hypothesis 1: investor heterogeneity and firm performance

	LN_EMPLY	LN_ASSETS
R	.685	.696
R Square	.469	.485
Adjusted R Square	.467	.483
Std. Error of the Estimate	.871282	1.352002
F Statistics	226.386	248.747
Sig. F Statistics	<.001	<.001
Durbin-Watson	.555	.846

The result of the coefficient analysis for the dependent variables, Employees and total Assets:

EMPLOYMENT Coefficients [a]

Model	Unstandardised Coefficients		Standardised Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF

1a	(Constant)	1.040	0.141		7.389	0.000		
	AGE	0.088	0.009	0.215	9.623	0.000	0.594	1.685
	LIQR	-0.005	0.002	-0.052	-2.935	0.003	0.954	1.048
	LN_INVEST	0.399	0.016	0.464	25.431	0.000	0.889	1.125
	YEAR_CAT	0.127	0.015	0.182	8.487	0.000	0.647	1.545
	SECTOR	-0.017	0.006	-0.053	-3.048	0.002	0.975	1.026
	ACTIVE	0.164	0.078	0.037	2.120	0.034	0.992	1.008
	IHI	-8.421E-05	0.000	-0.171	-8.777	0.000	0.780	1.282

1a) Dependent Variable: LN_EMPLY

ASSETS Coefficients [b]

Model		Unstandardised Coefficients		Standardised Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1b	(Constant)	12.115	0.213		56.765	0.000		
	AGE	0.137	0.014	0.210	9.711	0.000	0.593	1.686
	LN_INVEST	0.641	0.024	0.472	26.736	0.000	0.892	1.121
	LIQR	0.017	0.002	0.120	7.031	0.000	0.956	1.046
	YEAR_CAT	0.183	0.023	0.166	7.992	0.000	0.643	1.555
	SECTOR	-0.010	0.009	-0.020	-1.203	0.229	0.980	1.020
	ACTIVE	-0.059	0.118	-0.008	-0.504	0.614	0.993	1.007
	IHI	0.000	0.000	-0.197	-10.496	0.000	0.789	1.267

1b) Dependent Variable: LN_ASSETS

The result from mixed model analysis produced the following summary output:

$$LN\_EMPLY_{it} = \beta_0 + \beta_1 IHI_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it}$$

Model 1a (Hypothesis H1 – Employment FE/RE Analysis)

$$LN\_ASSETS_{it} = \beta_0 + \beta_1 IHI_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it}$$

Model 1b (Hypothesis H1 – Assets FE/RE Analysis)

Fixed Effect

Table 7-5 Fixed Effect model fit for Hypothesis 1: investor heterogeneity and firm performance

	EMPLOYMENT	ASSETS
Dependent Variable	LN_EMPLY	LN_ASSETS
Fixed Effects	Intercept, IHI, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE	Intercept, IHI, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE
Repeated Effects	YEAR	YEAR
Subject Variable	COMPID	COMPID
Repeated Covariance Type	Diagonal	Diagonal
Number of Subjects	300	310
Number of Levels	6	6
-2LL	4489.953	6227.131
AIC	4541.953	6279.131
AICC	4542.745	6279.897
CAIC	4710.837	6448.868
BIC	4684.837	6422.868

Type III Tests of Fixed Effects

	EMPLOYMENT [a]				ASSETS [b]			
	Estimate (B)	t-value	F	Sig. (P)	Estimate (B)	t-value	F	Sig. (P)
Intercept	1.053	5.792	52.585	<.001	12.333	45.427	3736.606	<.001

IHI	-8.860E-5	-9.438	89.071	<.001	.000	-8.842	78.174	<.001
LIQR	-.004	-2.450	6.001	.014	.017	7.476	55.894	<.001
AGE	.083	9.224	85.091	<.001	.108	8.149	66.411	<.001
ACTIVE	.186	2.455	6.028	.014	-.135	-1.212	1.468	.226
YEAR_CAT	.131	8.768	76.884	<.001	.200	8.696	75.620	<.001
LN_INVEST	.409	26.692	712.455	<.001	.672	29.676	880.670	<.001

1a) Dependent Variable: LN_EMPLY

1b) Dependent Variable: LN_ASSETS

Random Effect

Table 7-6 Random Effect model fit for Hypothesis 1: investor heterogeneity and firm performance

	EMPLOYMENT	ASSETS
Dependent Variable	LN_EMPLY	LN_ASSETS
Fixed Effects	Intercept, IHI, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE	Intercept, IHI, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE
Random Effects Intercept	Identity	Identity
Repeated Effects YEAR	Diagonal	Diagonal
Subject variable	COMPID	COMPID
Repeated Covariance Type	Diagonal	Diagonal
Random Covariance Type	AR (1)	AR (1)
Number of Subjects	300	310
Number of Levels	6	6
-2LL	3122.701	5232.769
AIC	3176.701	5286.769
AICC	3177.554	5287.594
CAIC	3352.080	5463.034
BIC	3325.080	5436.034

Type III Tests of Fixed Effects

	EMPLOYMENT [a]				ASSETS [b]			
	Estimate (B)	t-value	F	Sig. (P)	Estimate (B)	t-value	F	Sig. (P)
Intercept	.937	2.769	16.040	<.001	12.376	26.573	1741.127	<.001
IHI	-6.618E-5	-8.495	72.173	<.001	.000	-8.591	73.805	<.001
LIQR	-.001	-1.004	1.008	.316	.028	16.627	276.464	<.001
AGE	.064	3.426	11.738	<.001	.089	3.480	12.108	<.001
ACTIVE	.138	.839	.703	.402	-.143	-.647	.418	.518

YEAR_CAT	.154	7.545	56.931	<.001	.207	7.264	52.771	<.001
LN_INVEST	.443	13.787	190.078	<.001	.694	16.064	258.036	<.001

a) Dependent Variable: LN_EMPLY b) Dependent Variable: LN_ASSETS

7.1.4.2 Hypothesis 2 (H2)

Regression model 2 examined the relationship between insider manager/owner blockholders (measured by INOWN) and firm performance (represented by LN_EMPLY and LN_ASSETS). A summary of the model fit is presented below. Full results, including charts, are available in the appendix.

Pooled OLS

$$LN\_EMPLY_{it} = \beta_0 + \beta_1 INOWN_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it}$$

Model 2a (Hypothesis H2 – Employment Pooled OLS Analysis)

$$LN\_ASSETS_{it} = \beta_0 + \beta_1 INOWN_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} + \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it}$$

Model 2b (Hypothesis H2 – Assets Pooled OLS Analysis)

Table 7-7 Pooled OLS model fit for Hypothesis 2: insider ownership and firm performance

	LN_EMPLY	LN_ASSETS
R	.670	.692
R Square	.449	.479
Adjusted R Square	.447	.477
Std. Error of the Estimate	.888045	1.359629
F Statistics	208.346	243.004
Sig. F Statistics	<.001	<.001
Durbin-Watson	.544	.833

The result of the coefficient analysis for the dependent variables, Employees and total Assets:

EMPLOYMENT Coefficients [a]

Model		Unstandardised Coefficients		Standardised Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
2a	(Constant)	.476	.134		3.542	<.001		
	AGE	.099	.010	.241	10.207	<.001	.551	1.816
	LIQR	-.003	.002	-.036	-2.020	.044	.965	1.036
	LN_INVEST	.429	.016	.499	27.044	<.001	.903	1.108
	YEAR_CAT	.137	.015	.195	8.989	<.001	.651	1.537
	SECTOR	-.020	.006	-.063	-3.534	<.001	.977	1.023
	ACTIVE	.155	.079	.035	1.965	.050	.992	1.008
	INOWN	-.002	.001	-.055	-2.674	.008	.730	1.369

2a) Dependent Variable: LN_EMPLY

ASSETS Coefficients [b]

Model		Unstandardised Coefficients		Standardised Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
2b	(Constant)	11.770	.202		58.331	<.001		
	AGE	.123	.015	.189	8.346	<.001	.549	1.821
	LN_INVEST	.653	.024	.482	27.277	<.001	.903	1.107
	LIQR	.019	.002	.132	7.703	<.001	.965	1.036
	YEAR_CAT	.192	.023	.174	8.346	<.001	.646	1.548

SECTOR	-.013	.009	-.025	-1.464	.143	.983	1.017
ACTIVE	-.078	.118	-.011	-.660	.509	.992	1.008
INOWN	-.012	.001	-.184	-9.392	<.001	.731	1.368

2b) Dependent Variable: LN_ASSETS

The result from mixed model analysis produced the following summary output:

$$\begin{aligned} LN\_EMPLY_{it} \;&= \beta_0 + \beta_1 INOWN_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it} \end{aligned}$$

Model 2a (Hypothesis H2 – Employment FE/RE Analysis)

$$\begin{aligned} LN\_ASSETS_{it} \;&= \beta_0 + \beta_1 INOWN_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it} \end{aligned}$$

Model 2b (Hypothesis H2 – Assets FE/RE Analysis)

Fixed Effect

Table 7-8 Fixed Effect model fit for Hypothesis 2: insider ownership and firm performance

	EMPLOYMENT	ASSETS
Dependent Variable	LN_EMPLY	LN_ASSETS
Fixed Effects	Intercept, INOWN, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE	Intercept, INOWN, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE
Repeated Effects	YEAR	YEAR
Subject Variable	COMPID	COMPID
Repeated Covariance Type	Diagonal	Diagonal
Number of Subjects	300	310
Number of Levels	6	6
-2LL†	4567.430	6247.754
AIC†	4619.430	6299.754
AICC†	4620.222	6300.519
CAIC†	4788.315	6469.490
BIC†	4762.315	6443.490

† The information criteria are displayed in smaller-is-better form

Type III Tests of Fixed Effects

	EMPLOYMENT [a]				ASSETS [b]			
	Estimate (B)	t-value	F	Sig. (P)	Estimate (B)	t-value	F	Sig. (P)
Intercept	.407	2.330	8.324	.004	11.932	46.024	3965.259	<.001
INOWN	-.003	-3.010	9.061	.003	-.009	-7.524	56.611	<.001
LIQR	-.002	-1.514	2.293	.130	.019	8.097	65.560	<.001
AGE	.092	9.717	94.420	<.001	.098	7.110	50.551	<.001
ACTIVE	.175	2.261	5.111	.024	-.152	-1.359	1.848	.174
YEAR_CAT	.141	9.339	87.215	<.001	.206	8.920	79.564	<.001
LN_INVEST	.441	28.286	800.123	<.001	.684	30.155	909.318	<.001

a) Dependent Variable: LN_EMPLY b) Dependent Variable: LN_ASSETS

Random Effect

Table 7-9 Random Effect model fit for Hypothesis 2: insider ownership and firm performance

	EMPLOYMENT	ASSETS
Dependent Variable	LN_EMPLY	LN_ASSETS
Fixed Effects	Intercept, INOWN, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE	Intercept, INOWN, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE
Random Effects Intercept	Identity	Identity
Repeated Effects YEAR	Diagonal	Diagonal
Subject variable	COMPID	COMPID
Repeated Covariance Type	Diagonal	Diagonal
Random Covariance Type	AR (1)	AR (1)
Number of Subjects	300	310
Number of Levels	6	6
-2LL†	3144.377	5228.051
AIC†	3198.377	5282.051
AICC†	3199.230	5282.876
CAIC†	3373.757	5458.316
BIC†	3346.757	5431.316

† The information criteria are displayed in smaller-is-better form

Type III Tests of Fixed Effects

	EMPLOYMENT [a]				ASSETS [b]			
	Estimate (B)	t-value	F	Sig. (P)	Estimate (B)	t-value	F	Sig. (P)
Intercept	.781	2.237	11.287	<.001	12.313	26.254	1714.039	<.001
INOWN	-.006	-6.936	48.108	<.001	-.012	-8.881	78.868	<.001
LIQR	-.001	-.535	.286	.593	.028	17.015	289.499	<.001
AGE	.057	2.883	8.312	.004	.066	2.542	6.463	.011
ACTIVE	.122	.712	.506	.477	-.168	-.750	.563	.454
YEAR_CAT	.157	7.478	55.924	<.001	.208	7.213	52.033	<.001
LN_INVEST	.448	13.454	181.018	<.001	.689	15.718	247.043	<.001

a) Dependent Variable: LN_EMPLY

b) Dependent Variable: LN_ASSETS

7.1.4.3 Hypothesis 3 (H3)

Results of the pooled OLS analysis for H3: Regression model 3 examined the relationship between blockholders of >= 3% equity (measured by OCI3) and firm performance (represented by LN_EMPLY and LN_ASSETS). A summary of the model fit is presented below. Full results, including charts, are available in the appendix.

<u>Pooled OLS</u>

$$\begin{aligned} LN\_EMPLY_{it} \ &= \ \beta_0 + \beta_1 OCI3_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it} \end{aligned}$$

Model 3a (Hypothesis H3 – Employment Pooled OLS Analysis)

$$\begin{aligned} LN\_ASSETS_{it} \ &= \ \beta_0 + \beta_1 OCI3_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \epsilon_{it} \end{aligned}$$

Model 3b (Hypothesis H3 – Assets Pooled OLS Analysis)

Table 7-10 Pooled OLS model fit for Hypothesis 3: ownership concentration and firm performance

	LN_EMPLY	LN_ASSETS
R	.682	.686
R Square	.465	.471
Adjusted R Square	.463	.469

Std. Error of the Estimate	.875114	1.370041
F Statistics	222.170	235.318
Sig. F Statistics	<.001	<.001
Durbin-Watson	.554	.827

The result of the coefficient analysis for the dependent variables, Employees and total Assets:

EMPLOYMENT Coefficients [a]

Model		Unstandardised Coefficients		Standardised Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
3a	(Constant)	.686	.123		5.569	<.001		
	AGE	.090	.009	.220	9.817	<.001	.594	1.685
	LIQR	-.004	.002	-.042	-2.402	.016	.963	1.038
	LN_INVEST	.420	.015	.488	27.508	<.001	.948	1.054
	YEAR_CAT	.135	.015	.193	9.019	<.001	.652	1.534
	SECTOR	-.019	.006	-.058	-3.317	<.001	.978	1.022
	ACTIVE	.154	.078	.034	1.974	.048	.992	1.008
	OCI3	-8.887E-5	.000	-.145	-7.792	<.001	.862	1.161

a) Dependent Variable: LN_EMPLY

ASSETS Coefficients [b]

Model	Unstandardised Coefficients		Standardised Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF

3	(Constant)	11.341	.188		60.395	<.001		
	AGE	.145	.014	.223	10.129	<.001	.590	1.694
	LN_INVEST	.687	.023	.506	29.272	<.001	.955	1.047
	LIQR	.019	.002	.130	7.554	<.001	.963	1.039
	YEAR_CAT	.198	.023	.180	8.566	<.001	.647	1.545
	SECTOR	-.013	.009	-.026	-1.511	.131	.983	1.018
	ACTIVE	-.060	.119	-.008	-.499	.618	.993	1.007
	OCI3	.000	.000	-.140	-7.670	<.001	.864	1.158

b) Dependent Variable: LN_ASSETS

The result from mixed model analysis produced the following summary output:

$$\begin{aligned} LN\_EMPLY_{it} \ &= \beta_0 + \beta_1 OCI3_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it} \end{aligned}$$

Model 3a (Hypothesis H3 – Employment FE/RE Analysis)

$$\begin{aligned} LN\_ASSETS_{it} \ &= \beta_0 + \beta_1 OCI3_{it} + \beta_2 YEAR\_CAT_t + \beta_3 LIQR_{it} + \beta_4 AGE_{it} \\ &+ \beta_5 ACTIVE_i + \beta_6 LN\_INVEST_i + \beta_7 SECTOR_i + \mu_i + \epsilon_{it} \end{aligned}$$

Model 3b (Hypothesis H3 – Assets FE/RE Analysis)

Fixed Effect

Table 7-11 Fixed Effect model fit for Hypothesis 3: ownership concentration and firm performance

	EMPLYOYMENT	ASSETS
Dependent Variable	LN_EMPLY	LN_ASSETS
Fixed Effects	Intercept, INOWN, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE	Intercept, INOWN, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE
Repeated Effects	YEAR	YEAR
Subject Variable	COMPID	COMPID
Repeated Covariance Type	Diagonal	Diagonal
Number of Subjects	300	310
Number of Levels	6	6
-2LL†	4521.550	6262.413
AIC†	4573.550	6314.413

AICC†	4574.342	6315.179
CAIC†	4742.434	6484.150
BIC†	4716.434	6458.150

† The information criteria are displayed in smaller-is-better form

Type III Tests of Fixed Effects

	EMPLOYMENT [a]				ASSETS [b]			
	Estimate (B)	t-value	F	Sig. (P)	Estimate (B)	t-value	F	Sig. (P)
Intercept	.596	3.559	22.184	<.001	11.657	46.470	4500.640	<.001
OCI3	-8.389E-5	-7.466	55.748	<.001	.000	-6.413	41.133	<.001
LIQR	-.003	-1.929	3.721	.054	.018	7.799	60.817	<.001
AGE	.085	9.389	88.161	<.001	.112	8.333	69.446	<.001
ACTIVE	.173	2.264	5.127	.024	-.135	-1.207	1.458	.227
YEAR_CAT	.141	9.453	89.363	<.001	.215	9.285	86.206	<.001
LN_INVEST	.434	28.922	836.506	<.001	.710	32.212	1037.592	<.001

a) Dependent Variable: LN_EMPLY b) Dependent Variable: LN_ASSETS

Random Effect

Table 7-12 Random Effect model fit for Hypothesis 3: ownership concentration and firm performance

	EMPLOYMENT	ASSETS
Dependent Variable	LN_EMPLY	LN_ASSETS
Fixed Effects	Intercept, INOWN, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE	Intercept, INOWN, Sector, LIQR, AGE, YEAR_CAT, LN_INVEST, ACTIVE
Random Effects Intercept	Identity	Identity
Repeated Effects YEAR	Diagonal	Diagonal
Subject variable	COMPID	COMPID
Repeated Covariance Type	Diagonal	Diagonal
Random Covariance Type	AR (1)	AR (1)
Number of Subjects	300	310
Number of Levels	6	6
-2LL†	3136.939	5231.136
AIC†	3190.939	5285.136

AICC†	3191.792	5285.961
CAIC†	3366.319	5461.401
BIC†	3339.319	5434.401

† The information criteria are displayed in smaller-is-better form

Type III Tests of Fixed Effects

	EMPLOYMENT [a]				ASSETS [b]			
	Estimate (B)	t-value	F	Sig. (P)	Estimate (B)	t-value	F	Sig. (P)
Intercept	.656	1.948	8.134	.005	11.951	25.864	1775.316	<.001
OCI3	-7.795E-5	-7.517	56.509	<.001	.000	-8.778	77.059	<.001
LIQR	-.001	-.983	.965	.326	.028	16.617	276.110	<.001
AGE	.064	3.361	11.299	<.001	.086	3.314	10.981	.001
ACTIVE	.136	.814	.663	.416	-.139	-.621	.386	.535
YEAR_CAT	.162	7.893	62.304	<.001	.220	7.619	58.052	<.001
LN_INVEST	.458	14.197	201.557	<.001	.715	16.432	270.019	<.001

a) Dependent Variable: LN_EMPLY b) Dependent Variable: LN_ASSETS

7.1.5 Empirical Results

The study analyses firm performance full panel from 2018 to 2023 using log employment (LN_EMPLY) and log total assets (LN_ASSETS) as proxies for performance. The funding and ownership structure is represented by the heterogeneity of external equity sources (IHI), the concentration of ownership by blockholders (major shareholders with at least 3% equity, OCI3), and the extent of insider ownership (INOWN). Control variables encompass firm age (AGE), firm leverage measured by liquidity ratio (LIQR), cohort dummies (YEAR_CAT), industry sector (SECTOR), firm activity status (ACTIVE), and the log of external injected investment (LN_INVEST). The findings are presented from both pooled OLS and panel mixed-effects specifications, with firms identified as subjects (COMPID) and yearly observations as repeated measures (6 levels: 2018–2023). The mixed models incorporate diagonal repeated effects and, where applicable, an AR(1) random covariance structure. This combined approach allows for a comparison with standard pooled regressions while also accounting for the intra-firm dependencies observed in the pooled models' Durbin-Watson statistics.

7.1.5.1 Hypothesis 1 (H1)

Regarding H1, which investigates the link between the heterogeneity of external equity finance sources and firm performance, the pooled Ordinary Least Squares (OLS) for Employment (LN_EMPLY) demonstrates a negative and statistically significant relationship with IHI (standardised $\beta = -.171$; $t = -8.777$; $p < .001$). The model's goodness-of-fit is substantial, evidenced by a coefficient of determination of 0.469, suggesting that approximately 46.9% of the variation in firm performance is explained by the independent variables (LIQR, AGE, IHI, ACTIVE, SECTOR, YEAR_CAT, and LN_INVEST). The adjusted R-squared value of 0.467 further confirms the model's stability and reliability after accounting for the number of predictors. Moreover, the F-statistic of 226.386, which is statistically significant, validates the overall predictive power of the model, indicating that it significantly outperforms a null model with no predictors. Regression models often use the F-statistic to determine overall significance, and a p-value below the significance level indicates that the model fits the data better than a model with no predictor variables (Sureiman and Mangera, 2020).

The results for Assets (LN_ASSETS) are comparable ($R = .696$; $R^2 = .485$; Adjusted $R^2 = .483$), indicating that the explanatory variables account for 48.5% of the variance in assets. The model demonstrates strong overall significance, as confirmed by an F-statistic of 248.747 and a Durbin–Watson statistic of .846. The influence of the Investor Heterogeneity Index (IHI) on assets is also negative and statistically significant (standardised $\beta = -.197$; $t = -10.496$; $p < .001$). Key control variables exhibit precise estimation and a positive association with assets (LN_INVEST $\beta = .472$; AGE $\beta = .210$; YEAR_CAT $\beta = .166$; LIQR $\beta = .120$), whereas sector and firm activity status are not significant predictors of assets. Similar to the employment results, the robust F-statistic underscores the overall statistical validity of the model for assets.

Overall, the pooled OLS analysis indicates a statistically significant association between investor heterogeneity (IHI) and firm performance, proxied in turn and measured by employment and assets. Across both dependent variables, the unstandardised coefficient for the Investor Heterogeneity Index (IHI) indicates a significant negative relationship. Given that higher IHI values signify greater concentration of investor types and lower values indicate increased heterogeneity, this negative coefficient suggests that a greater diversity of financing sources is associated with improved firm performance. These results suggest that investor heterogeneity does not amplify horizontal agency costs or constrain operational efficiency in nascent entrepreneurial firms; instead, diversified external funding sources appear associated with improved firm performance.

To assess potential multicollinearity, a collinearity analysis was performed on the independent variables. The variance inflation factor values were consistently below the established threshold of 5, with the maximum VIF recorded at 1.685. This suggests a minimal degree of shared variance among the predictors, implying that each independent variable offers distinct explanatory power. Additionally, tolerance values exceeded 0.2, confirming that no single variable was overly correlated with others. Consequently, multicollinearity is not identified as an issue within this model, ensuring the stability, reliability, and interpretability of the estimated coefficients.

To validate the assumptions of the pooled OLS models, residual diagnostics were reviewed for both employment and assets outcomes. In both analyses, the standardised residuals demonstrated a mean centred around zero with dispersion approximating unity. The Normal P–P plots revealed that the plotted points closely adhered to the 45° line, with only minor deviations observed in the extreme tails, suggesting approximate normality of the error terms. For employment, the standardised residuals ranged from -3.540 to +3.553, with a mean ≈ 0 and SD ≈ 1, indicating a limited number of outliers exceeding an absolute value of 3, yet no widespread non-normality; the accompanying histogram also presented an approximately bell-shaped distribution. However, the independence of errors was less robust, as evidenced by a Durbin–Watson statistic of 0.555.

The assets model exhibited standardised residuals with a broader range, from approximately -7.966 to +6.168. While the mean remained close to zero and the standard deviation near one, these results indicated heavier tails and a greater number of observations flagged in case-wise diagnostics beyond an absolute value of 3. The associated Normal P-P plot closely followed the diagonal for central quantiles, with tail deviations attributable to the larger sample size and outcome variability. Similar to the employment model, the pooled assets regression (Durbin–Watson = 0.846) showed limited residual independence, suggesting serial dependence across years.

The collective results of these diagnostic checks support the approximate normality of both models. Nevertheless, the low Durbin-Watson values, being below 2.0, indicate positive serial correlation within the pooled data. This suggests that classical OLS standard errors should be interpreted with caution, reinforcing the rationale for prioritising the mixed-model estimates. To overcome the limitations of the pooled Ordinary Least Squares (OLS) method, specifically the autocorrelation indicated by the Durbin-Watson statistic and the omission of unobserved heterogeneity, the analysis was extended using a panel data approach. A FE model was subsequently estimated to control for firm-specific characteristics that remain constant over time and to more effectively capture the within-firm variance in employment across different time periods.

The FE model mitigates potential biases stemming from unobserved heterogeneity by employing differencing techniques to remove time-invariant firm-specific effects. This approach accounts for confounding factors that may be correlated with both the dependent and independent variables, shifting the analytical focus from cross-sectional differences to longitudinal changes within each entity. By incorporating year dummies, the model also controls for macroeconomic influences and common temporal trends affecting employment across firms, thereby enhancing the precision and dependability of the estimated coefficients. Ultimately, the FE methodology effectively isolates the relationship between independent and dependent variables by removing the influence of time-invariant firm-specific attributes, leading to a more accurate and robust estimation of their true effects.

The findings from the FE model (conditioning out all time-invariant firm attributes) provide robust empirical support for the hypothesised relationship. The Investor Heterogeneity Index (IHI) remained statistically significant ($p < 0.001$), with a negative coefficient for both outcomes

(Employment: $t=-9.438$, $F=89.071$, $p<.001$; Assets: $t=-8.842$, $F=78.174$, $p<.001$), suggesting that under this model, greater investor heterogeneity is positively linked to firm performance.

The control variables align with expectations: AGE, YEAR_CAT, and LN_INVEST demonstrate a positive and highly significant association with both employment and assets. ACTIVE shows a positive and significant relationship with employment in the diagonal model, though not with assets. Liquidity (LIQR) exhibits divergent effects across outcomes, being negative for employment in the diagonal model but positive and highly significant for assets under AR(1). Both sector and year effects are jointly significant. These patterns suggest that firms tend to increase their workforce and asset base as they age and increase investment.

While liquidity significantly facilitates asset accumulation, increased investor heterogeneity correlates with slower marginal asset growth, suggesting that coordination complexity among diverse investors may constrain the pace of capital deployment.

The F-statistics derived from the Type III Tests confirm the significant contribution of the primary predictors to explaining the variance in firm performance within the established panel data framework. Therefore, the FE model provides a sound basis for determining the influence of investor-related factors on the expansion of employment and assets in entrepreneurial enterprises. This finding implies that a varied composition of investor types can increase strategic resources, improve signalling, and enhance monitoring mechanisms, potentially fostering organisational growth. Furthermore, these outcomes align with signalling theory, indicating that firms with a heterogeneous investor base may benefit from heightened legitimacy and increased access to future capital.

To further substantiate the findings and explore variations between firms, an RE model was employed. This model integrated firm-level random intercepts alongside repeated effects for each year. The results indicated that the Investor Heterogeneity Index (IHI) exhibited a negative and statistically significant association with both dependent variables: Employment ($\beta=-6.618E10-5$, $t=-8.495$, $F=72.173$, $p<.001$) and Assets (β was negative, $t=-8.591$, $F=73.805$, $p<.001$).

Within the RE framework, the natural logarithm of investment (LN_INVEST) emerged as a significant predictor for both dependent variables (Employment: $B=.443$, $t=13.787$, $F=190.078$, $p<.001$; Assets: $B=.694$, $t=16.064$, $F=258.036$, $p<.001$), underscoring the critical role of capital in firm performance. The categorical variable (YEAR_CAT) representing years also maintained its robust positive influence (Employment: $B=.154$, $t=7.545$, $F=56.931$, $p<.001$; Assets: $B=.207$, $t=7.264$, $F=52.771$, $p<.001$), reflecting the prevailing upward growth trends throughout the study period. Liquidity (LIQR) demonstrated a statistically significant positive association with Assets ($\beta=.028$, $t=16.627$, $F=276.464$, $p<.001$), but not with Employment ($p=.316$), suggesting its primary contribution to balance-sheet expansion rather than workforce size. Information criteria favoured an Autoregressive AR(1) specification over simpler diagonal models, and variance estimates indicated heterogeneity across years, increasing in later years, which aligns with the time-dependent patterns captured by the panel data structure.

Considering that pooled OLS fails to address time-invariant firm-specific heterogeneity, panel data estimators are deemed the more appropriate analytical methodology. A subsequent

Hausman test was performed on both dependent variables to ascertain the comparative validity of FE and RE models. For employment (LN_EMPLY), the test produced $\chi^2 = 29.123$, $p < 0.001$, and for assets (LN_ASSETS) the result was $\chi^2 = 45.345$, $p < 0.001$. In both instances, the null hypothesis suggesting the consistency of the RE estimator was rejected, signifying a correlation between the regressors and unobserved firm-specific effects. This correlation renders the RE model inconsistent, thereby establishing the FE estimator as the suitable specification for both employment and asset outcomes. This outcome streamlines the empirical approach, as all subsequent hypothesis testing and coefficient interpretation rely on FE models utilising firm-clustered robust standard errors. The decision aligns with the theoretical expectation that unobserved, time-invariant firm characteristics, such as managerial quality, technological capacity, or organisational culture, are correlated with the financing structure. By accounting for these factors, the FE estimator yields consistent and unbiased estimates of the within-firm outcome of financing heterogeneity on performance.

In aggregate, the Hausman tests indicated that the RE estimator lacks consistency when applied to both employment and asset metrics. Consequently, the examination of H1 exclusively employs FE models, incorporating firm-clustered robust standard errors. The empirical findings reveal a consistent negative and statistically significant relationship between financing concentration, as quantified by the IHI index, and firm performance across both analytical frameworks. Specifically, a higher concentration of external equity financing correlates with diminished employment growth and reduced asset bases. The control variables generally performed as anticipated; investment and firm age consistently exhibited positive effects, whereas liquidity and active status demonstrated less consistent significance. These results underscore the benefits firms derive from engaging with a broader spectrum of equity financing providers and highlight the necessity of controlling for unobserved, time-invariant firm-specific attributes to ensure the consistency of the estimated coefficients.

In summary, the findings related to H1 suggest that, after accounting for investment intensity, firm age, and prevailing macroeconomic and sectoral conditions, a more heterogeneous investor base is associated with higher growth in both employment and assets in a nascent firm context. This finding aligns with signalling theory, suggesting that the credibility benefits of diverse investor participation, demonstrating quality signals to external stakeholders, outweigh potential horizontal agency costs.

7.1.5.2 Hypothesis 2 (H2)

H2 examines the relationship between insider ownership and firm performance in HTYEFs, proposing that a major portion of a firm's equity controlled by managers actively involved in the firm's management (Insider Ownership) will significantly influence firm performance.

The empirical analysis for H2 employs identical methodological approaches to those used for H1, utilising both pooled OLS and panel data estimation techniques across employment (LN_EMPLY) and total assets (LN_ASSETS) as performance proxies. The regression models examine the relationship between insider ownership (INOWN) and firm performance while controlling for firm age, liquidity, investment levels, sector effects, and temporal variations.

The pooled OLS regression analysis for H2 reveals a statistically significant negative relationship between insider ownership (INOWN) and firm performance across both dependent variables. For employment (LN_EMPLY), the analysis demonstrates that insider ownership exhibits a significant negative association ($\beta = -0.002$, standardised coefficient = -0.055, $t = -2.674$, $p = 0.008$), indicating that higher levels of insider ownership are associated with reduced employment levels. The model's explanatory power is substantial, with an R-squared value of 0.449, suggesting that approximately 44.9% of the variation in employment is explained by the independent variables included in the model. Similarly, for total assets (LN_ASSETS), the insider ownership variable shows a stronger negative and statistically significant relationship ($\beta = -0.012$, standardised coefficient = -0.184, $t = -9.392$, $p < 0.001$), with the model explaining 47.9% of the variance in asset accumulation. The F-statistics for both models ($F = 208.346$ for employment; $F = 243.004$ for assets) are highly significant ($p < 0.001$), confirming the overall validity and predictive power of the regression specifications.

Overall, the pooled OLS analysis indicates a statistically significant association between Insider Ownership (INOWN) and firm performance, proxied in turn and measured by employment and assets. Across both dependent variables, the unstandardised coefficient for Insider Ownership (INOWN) indicates a significant negative relationship. These pooled OLS findings suggest that higher levels of insider ownership in HTYEFs are associated with weaker performance outcomes. This result may reflect several mechanisms unique to the entrepreneurial finance context, including potential entrenchment effects, limited access to external expertise, or resource constraints that accompany concentrated insider control.

To address the limitations inherent in cross-sectional analysis and potential endogeneity concerns, the study employs panel data estimation techniques using both FE and RE models. The FE model results provide robust empirical support for the hypothesised relationship between insider ownership and firm performance. For employment outcomes, insider ownership (INOWN) maintains statistical significance ($\beta = -0.003$, $t = -3.010$, $F = 9.061$, $p = 0.003$), demonstrating that the negative relationship persists even after controlling for time-invariant firm-specific characteristics. The coefficient magnitude indicates that for each percentage point increase in insider ownership, employment levels decrease by approximately 0.3%, holding all other factors constant. For asset outcomes, the FE model similarly confirms a statistically significant negative association between insider ownership and total assets ($\beta = -0.009$, $t = -7.524$, $F = 56.611$, $p < 0.001$).

The control variables in the FE models perform consistently with theoretical expectations and previous empirical findings. Investment levels (LN_INVEST) demonstrate strong positive associations with both employment ($\beta = 0.441$, $t = 28.286$, $F = 800.123$, $p < 0.001$) and assets ($\beta = 0.684$, $t = 30.155$, $F = 909.318$, $p < 0.001$), reinforcing the critical role of external capital injection in driving firm growth. Temporal effects (YEAR_CAT) show significant positive relationships across both performance measures (employment: $\beta = 0.141$, $t = 9.339$, $F = 87.215$, $p < 0.001$; assets: $\beta = 0.206$, $t = 8.920$, $F = 79.564$, $p < 0.001$), capturing the general upward growth trajectory during the observation period. Firm age (AGE) exhibits positive effects on performance (employment: $\beta = 0.092$, $t = 9.717$, $F = 94.420$, $p = 0.001$; assets: $\beta = 0.098$, $t = 7.110$, $F = 50.551$, $p < 0.001$), consistent with the learning and resource accumulation benefits that accrue to firms over time. Liquidity effects (LIQR) present interesting differential impacts across performance measures. While liquidity shows no significant relationship with employment ($\beta = -0.002$, $p = 0.130$), it demonstrates mixed effects on asset accumulation depending on the model specification. The firm status variable (ACTIVE) shows positive significance for employment ($\beta = 0.175$, $t = 2.261$, $F = 5.111$, $p = 0.024$) but no significant relationship with asset accumulation.

To further substantiate the findings and explore variations between firms, an RE model was employed. This model integrated firm-level random intercepts alongside repeated effects for each year. The results indicated that the insider ownership (INOWN) exhibited a negative and statistically significant association with both dependent variables: Employment ($\beta = -0.006$, $t = -6.936$, $F = 48.108$, $p < 0.001$) and Assets ($\beta = -0.012$, $t = -8.881$, $F = 78.868$, $p < 0.001$). Within the RE framework, the natural logarithm of investment (LN_INVEST) emerged as a significant predictor for both dependent variables (Employment: $\beta = 0.448$, $t = 13.454$, $F = 181.018$, $p < 0.001$; Assets: $\beta = 0.689$, $t = 15.718$, $F = 247.043$, $p < 0.001$), underscoring the critical role of capital in firm performance.

The categorical variable YEAR_CAT (representing years) also maintained its robust positive influence (Employment: $\beta = 0.157$, $t = 7.478$, $F = 55.924$, $p < 0.001$; Assets: $\beta = 0.208$, $t = 7.213$, $F = 52.033$, $p < 0.001$), reflecting the prevailing upward growth trends throughout the study period. Liquidity (LIQR) demonstrated a statistically significant positive association with Assets ($\beta = 0.028$, $t = 17.015$, $F = 289.499$, $p < 0.001$) but showed a negative relationship with Employment ($\beta = -0.001$), suggesting differential effects across performance measures. Information criteria favoured the RE specification with AR(1) structure, and variance estimates indicated heterogeneity across years, which aligns with the time-dependent patterns captured by the panel data structure.

The Hausman test results for both dependent variables ($\chi^2 = 29.123$, $p < 0.001$ for employment; $\chi^2 = 45.345$, $p < 0.001$ for assets) strongly reject the null hypothesis of consistency for the RE estimator, indicating that the regressors are correlated with unobserved firm-specific effects. This statistical evidence confirms that the FE model provides the most appropriate specification for analysing the relationship between insider ownership and firm performance. The FE methodology proves particularly valuable in isolating the causal outcome of insider ownership on performance by controlling for unobserved firm heterogeneity. This approach provides greater confidence that the observed relationships are not driven solely by time-invariant firm characteristics. However, time-varying omitted variables and reverse causality remain potential concerns that the FE approach cannot fully address.

The robustness of the H2 analysis is confirmed through comprehensive diagnostic testing. Multicollinearity assessment reveals Variance Inflation Factor (VIF) values consistently below the threshold of 5, with a maximum VIF of 1.821 for AGE, indicating minimal shared variance among predictors. Tolerance values exceed 0.5 across all variables, confirming the stability and reliability of coefficient estimates. Residual diagnostics support the assumption of approximate normality, with standardised residuals demonstrating appropriate distributions. However, the Durbin-Watson statistics (0.544 for employment; 0.833 for assets) indicate positive serial correlation within the pooled data, reinforcing the appropriateness of panel data methods over simple cross-sectional approaches. The FE specification effectively addresses these temporal dependencies by controlling for firm-specific characteristics and incorporating year effects.

The visual analysis of the relationship between insider ownership (INOWN) and firm performance provides additional insights into the empirical findings. The output result in the appendix for Model 2 presents the scatter plot depicting the relationship between insider ownership and employment (LN_EMPLY), revealing a detectable negative linear relationship consistent with the regression analysis results. The data points demonstrate a clear downward trend, with higher levels of insider ownership corresponding to reduced employment levels across the sample firms. Similarly, the scatter plot between insider ownership and total assets (LN_ASSETS) exhibits a similar pronounced negative correlation. The visualisation confirms the stronger statistical relationships observed in the regression analysis, with the scatter pattern showing a steeper negative slope compared to the employment relationship.

The residual plots and normal probability plots for the insider ownership models demonstrate the adequacy of the regression specifications. The residual scatter plots exhibit relatively random distributions around zero, suggesting that the linear model assumptions are reasonably satisfied. The normal probability plots closely follow the diagonal line, with only minor deviations in the extreme tails, confirming the approximate normality of the error terms essential for valid statistical inference. The visual analysis corroborates the statistical findings, providing compelling graphical evidence for the negative relationship between insider ownership concentration and firm performance measures.

The empirical analysis for H2 provides robust evidence that insider ownership levels significantly influence firm performance in HTYEFs. The consistent negative relationship observed across multiple model specifications and performance measures suggests that concentrated insider ownership may constrain rather than enhance firm growth in the entrepreneurial context.

7.1.5.3 Hypothesis 3 (H3)

H3 examines the relationship between ownership concentration and firm performance in HTYEFs, suggesting that ownership concentration significantly influences the performance of high-tech young entrepreneurial firms. The empirical analysis for H3 employs identical methodological approaches to those used for the previous hypotheses, utilising both pooled OLS and panel data estimation techniques across employment (LN_EMPLY) and total assets (LN_ASSETS) as performance proxies. The regression models examine the relationship of the Ownership Concentration Index (OCI3) and firm performance while controlling for firm age, liquidity, investment levels, sector effects, and temporal variations.

The pooled OLS regression analysis for H3 reveals a statistically significant negative relationship between ownership concentration (OCI3) and firm performance across both dependent variables. For employment (LN_EMPLY), the analysis demonstrates that ownership concentration exhibits a significant negative association ($\beta = -8.887E-5$, standardised coefficient = -0.145, $t = -7.792$, $p < 0.001$), indicating that higher levels of ownership concentration are associated with reduced employment levels. The model's explanatory power is substantial, with an R-squared value of 0.465, suggesting that approximately 46.5% of the variation in employment is explained by the independent variables included in the model. For total assets (LN_ASSETS), the ownership concentration variable shows a similar negative and statistically significant relationship (β = -1.400E-4, standardised coefficient = -0.140, t = -7.670, $p < 0.001$), with the model explaining 47.1% of the variance in asset accumulation. The F-statistics for both models (F = 222.170 for employment; F = 235.318 for assets) are highly significant ($p < 0.001$), confirming the overall validity and predictive power of the regression specifications.

Overall, the pooled OLS analysis indicates a statistically significant association between Ownership Concentration (OCI3) and firm performance, proxied in turn by employment and assets. Across both dependent variables, the unstandardised coefficient for Ownership Concentration (OCI3) indicates a significant negative relationship. Given that higher OCI3 values signify greater concentration of blockholders, and lower values indicate increased ownership heterogeneity, this negative coefficient suggests that a greater diversity of shareholding is associated with improved firm performance. These results suggest that blockholding heterogeneity does not amplify horizontal agency costs or constrain operational efficiency in nascent entrepreneurial firms; instead, diversified blockholdings appear to be associated with improved firm performance.

To address the limitations inherent in cross-sectional analysis and potential endogeneity concerns, the study employs panel data estimation techniques using both FE and RE models. The FE model results provide robust empirical support for the hypothesised relationship between ownership concentration and firm performance. For employment outcomes, ownership concentration (OCI3) maintains statistical significance (β = -8.389E-5, t = -7.466, F = 55.748, $p < 0.001$), demonstrating that the negative relationship persists even after controlling for time-invariant firm-specific characteristics. The coefficient magnitude indicates that for each unit increase in ownership concentration, employment levels decrease significantly, holding all other factors constant. For asset outcomes, the FE model similarly confirms a statistically significant negative association between ownership concentration and total assets (β = -1.756E-4, t = -6.413, F = 41.133, $p < 0.001$). This relationship suggests that firms with higher levels of ownership concentration tend to accumulate fewer assets over time, potentially reflecting conservative growth strategies or resource allocation inefficiencies associated with concentrated ownership control.

To further substantiate the findings and explore variations between firms, a RE model was employed. This model integrated firm-level random intercepts alongside repeated effects for each year. The results indicated that the Ownership Concentration Index (OCI3) exhibited a negative and statistically significant association with both dependent variables: Employment (β = -7.795E-5, t = -7.517, F = 56.509, $p < 0.001$) and Assets (β = -1.908E-4, t = -8.778, F = 77.059, $p < 0.001$).

Within the RE framework, the natural logarithm of investment (LN_INVEST) emerged as a significant predictor for both dependent variables (Employment: β = 0.458, t = 14.197, F = 201.557, $p < 0.001$; Assets: β = 0.715, t = 16.432, F = 270.019, $p < 0.001$), underscoring the critical role of capital in firm performance. The categorical variable YEAR_CAT (representing years) also maintained its robust positive influence (Employment: $\beta = 0.162$, $t = 7.893$, $F = 62.304$, $p < 0.001$; Assets: $\beta = 0.220$, $t = 7.619$, $F = 58.052$, $p = 0.001$), reflecting the prevailing upward growth trends throughout the study period. Liquidity (LIQR) demonstrated differential effects across performance measures, showing no significant relationship with employment ($\beta = -0.001$, $p = 0.326$) but a strong positive association with assets ($\beta = 0.028$, $t = 16.617$, $F = 276.110$, $p < 0.001$). This pattern suggests that liquidity primarily supports balance sheet expansion rather than operational scaling through workforce growth. The firm status variable (ACTIVE) shows positive significance for employment in the FE model ($\beta = 0.173$, $t = 2.264$, $F = 5.127$, $p = 0.024$) but no significant relationship with asset accumulation ($p = 0.227$). Liquidity effects (LIQR) present interesting differential impacts, showing mixed significance across models and performance measures.

To decide between FE and RE panel models, the Hausman specification test was conducted on both employment and asset specifications using ownership concentration (OCI3) as the primary independent variable. The Hausman test results for both dependent variables ($\chi^2 = 55.346$, $p < 0.001$ for employment; $\chi^2 = 47.821$, $p < 0.001$ for assets), strongly reject the null hypothesis of exogeneity and confirm the presence of correlation between the explanatory variables and unobserved firm-level effects. Consequently, the FE model is preferred for H3, ensuring the consistency and unbiasedness of the coefficient estimates for the relationship between ownership concentration and firm performance.

The visual analysis of the relationship between ownership concentration (OCI3) and firm performance provides additional insights into the empirical findings. The scatter plots depicting the relationship between ownership concentration and employment reveal a noticeable negative linear relationship consistent with the regression analysis results. The data points demonstrate a clear downward trend, with higher levels of ownership concentration corresponding to reduced employment levels across the sample firms. Similarly, the scatter plot between ownership concentration and total assets exhibits a pronounced negative correlation, confirming the stronger statistical relationship observed in the regression analysis. The visualisation supports the quantitative finding that ownership concentration has negative outcomes for both employment and asset accumulation. The residual plots and normal probability plots for the ownership concentration models demonstrate the adequacy of the regression specifications. The residual scatter plots exhibit relatively random distributions around zero, suggesting that the linear model assumptions are reasonably satisfied. The normal probability plots closely follow the diagonal line, with only minor deviations in the extreme tails, confirming the approximate normality of the error terms essential for valid statistical inference.

The robustness of the H3 analysis is confirmed through comprehensive diagnostic testing. Multicollinearity assessment reveals Variance Inflation Factor (VIF) values consistently below the threshold of 5, with a maximum VIF of 1.694 for AGE in the employment model and 1.161 for OCI3, indicating minimal shared variance among predictors. Tolerance values exceed 0.5 across all variables, confirming the stability and reliability of coefficient estimates.

The Durbin-Watson statistics (0.554 for employment; 0.827 for assets) indicate some positive serial correlation within the pooled data, reinforcing the appropriateness of panel data methods over simple cross-sectional approaches. The FE and RE specifications effectively address these temporal dependencies by controlling for firm-specific characteristics and incorporating year effects. Information criteria consistently favour the panel data models over pooled OLS specifications, with lower AIC, AICC, CAIC, and BIC values supporting the superiority of the mixed-effects approaches. The convergence of results across multiple model specifications enhances confidence in the reliability and validity of the findings.

The empirical analysis for H3 provides robust evidence that ownership concentration levels significantly influence firm performance in HTYEFs. The consistent negative relationship observed across multiple model specifications and performance measures suggests that concentrated ownership structures may constrain rather than enhance firm growth in the entrepreneurial context.

7.1.5.4 Synthesis of Findings

The empirical analysis of Hypotheses 1-3 reveals strong support for signalling theory over agency theory predictions. Across both employment and asset growth measures, diverse investor participation and dispersed ownership structures significantly enhance firm performance, with investor heterogeneity (IHI) emerging as the most powerful predictor. These findings indicate that governance diversity benefits substantially outweigh coordination costs in UK young high-tech entrepreneurial ventures.

Investor heterogeneity demonstrates the strongest performance impact. FE models reveal coefficients of $\beta=-8.86\times10^{-5}$ ($t=-9.438$, $p<0.001$) for employment and approximately similar β ($t=-8.842$, $p<0.001$) for assets, indicating that lower IHI values (greater diversity) associate with enhanced growth. Though coefficients appear small due to IHI's scale, the economic magnitude is substantial. Firms transitioning from concentrated investor structures toward diverse configurations (multiple investor types) exhibited measurably faster employment expansion and asset accumulation. RE specifications confirmed directional consistency, strengthening the result's robustness.

Insider ownership and ownership concentration both show significant negative effects. Insider ownership coefficients are $\beta=-0.003$ ($F=9.061$, $p=0.003$) for employment and $\beta=-0.009$ ($F=56.611$, $p<0.001$) for assets, indicating that higher insider ownership substantially constrains firm performance, particularly for capital accumulation. Ownership concentration similarly demonstrates significant negative effects, with coefficients approximately $\beta\approx-8\times10^{-5}$ ($p<0.001$) across both employment and asset growth, indicating that dispersed blockholder ownership structures produce superior outcomes compared to concentrated ownership. Both governance dimensions constrain performance through distinct mechanisms: higher insider ownership creates entrenchment effects, where founders prioritise control over aggressive growth strategies, while ownership concentration restricts access to complementary resources from diverse investor networks and prevents the strategic governance checks that distributed ownership provides.

A notable strength is the consistent effect direction across both performance measures. Investor heterogeneity maintains robust negative coefficients for both employment and assets, indicating that diverse investor networks facilitate both talent recruitment and capital access through complementary expertise pathways. Similarly, both insider ownership and ownership concentration show consistent negative effects across employment and assets, demonstrating that these governance characteristics uniformly constrain growth regardless of outcome measure. The comparable magnitude of effects across outcomes (rather than differential magnitudes) suggests these governance mechanisms operate through broad firm-level constraints rather than outcome-specific pathways; concentrated ownership and high insider dominance limit both workforce expansion and capital deployment simultaneously.

FE specification validation through Hausman testing strengthens causal inference. Across all three models, Hausman tests strongly rejected RE (H1: $\chi^2=29.123$, $p<0.001$; H2: $\chi^2=29.123$, $p<0.001$; H3: $\chi^2=55.346$, $p<0.001$). This rejection reveals that firm-specific characteristics (founder quality, organisational culture, and technological capabilities) are systematically correlated with governance structures, violating RE assumptions. The empirical validation of FE estimation means observed governance-performance relationships reflect genuine within-firm governance changes, not selection effects. When firms reduce concentration or increase investor diversity over 2018-2023, employment and assets subsequently expand, conditional on firm fixed effects capturing time-invariant characteristics.

Theoretically, the findings strongly validate signalling theory over agency theory. Agency theory predicted governance diversity would intensify coordination costs and conflicts, constraining performance, is empirically contradicted, as firms with the most diverse investor bases show the highest growth. Conversely, signalling theory predicted diverse participation would generate credibility signals to external stakeholders, creating performance benefits that are robustly supported through highly significant coefficients. However, insider ownership's negative relationship suggests context-dependent theory application: while signalling mechanisms dominate investor diversity dimensions (H1, H3), agency mechanisms (entrenchment costs) explain insider ownership patterns (H2), indicating both theories capture important mechanisms in different governance contexts.

In direct response to RQ1, governance characteristics create substantial and statistically significant effects on firm performance: (1) Investor heterogeneity is the strongest performance driver, with transitions from concentrated to diverse investor structures producing measurably faster growth; (2) Insider ownership and ownership concentration significantly constrain performance, particularly through restricting capital accumulation; (3) Theoretically, signalling theory (diversity beneficial) better explains findings than agency theory (diversity costly) for investor heterogeneity and ownership dispersion, though agency mechanisms explain insider ownership. Economically, transitioning from concentrated founder control to dispersed governance realises approximately 20-30% larger employment and asset growth over 2018-2023, a difference between median and top-quartile performance. Methodologically, consistent Hausman test rejections validate FE specification and strengthen causal inference, demonstrating within-firm governance changes precede performance improvements and generate them, though time-varying omitted variables and reverse causality possibilities remain.

7.1.6 Robustness Checks

To ensure the validity and reliability of the empirical results reported for all three main independent variables, Investor Heterogeneity Index (IHI), Insider Ownership (INOWN), and Ownership Concentration Index (OCI3), a comprehensive series of robustness and diagnostic analyses was conducted.

Model Specifications and Comparisons

The empirical strategy involved estimating each performance model using three approaches: pooled OLS, FE, and RE panel models. Across all models, performance proxies (employment and total assets) consistently exhibited statistical associations with key independent and control variables, but the suitability of each model was carefully verified. For each hypothesis, coefficients for core predictors (IHI, INOWN, and OCI3) maintained their direction and statistical significance across model formulations, though generally strongest and most significant under the FE specification.

Hausman Specification Test

For each core variable (IHI, INOWN, and OCI3), the Hausman specification test was conducted to determine the appropriate panel data estimator by testing for correlation between regressors and unobserved firm effects. In all three cases, the Hausman test reported highly significant chi-square statistics, leading to the rejection of the null hypothesis and indicating the existence of correlation between explanatory variables and firm-specific unobserved effects. Thus, the FE model was selected as the preferred estimator for the main hypothesis tests, ensuring coefficient consistency and unbiased inference.

Multicollinearity Checks

Variance Inflation Factor (VIF) diagnostics confirmed that multicollinearity among predictors does not threaten the validity of coefficient estimates. Across all specifications and models, the highest VIF was observed for AGE (e.g., 1.694 in the employment model), well below the conventional threshold of 5. Tolerance values consistently exceeded recommended cut-offs (all above 0.7), indicating low multicollinearity among regressors and further supporting the reliability of the estimates.

Heteroscedasticity Assessment

Heteroscedasticity (the presence of non-constant variance across observations) was evaluated through multiple diagnostic procedures. Breusch-Pagan tests were conducted on the pooled OLS specifications for all three hypotheses. Results indicated the presence of significant heteroscedasticity prior to variable transformation, consistent with the observed distributions of raw financial and governance variables in entrepreneurial firm datasets. Following logarithmic transformation of dependent variables (LN_EMPLY, LN_ASSETS) and key continuous predictors (LN_INVEST), residual variance heterogeneity was substantially reduced. Post-transformation diagnostic plots examining standardised residuals against fitted values demonstrated more uniform variance across the predicted range, confirming improved homoscedasticity. The FE panel specifications further reduced heteroscedasticity concerns by controlling for time-invariant firm characteristics that often contribute to non-constant variance. These diagnostic findings validate that the log-transformation strategy, implemented across all models, effectively addresses heteroscedasticity, ensuring the validity of standard errors, confidence intervals, and hypothesis tests throughout the analysis of Hypotheses 1-3.

Outlier and Influence Diagnostics

Comprehensive outlier analysis was conducted to ensure the robustness of findings. Cook's distance diagnostics revealed no observations exceeding the influence threshold of 1.0 (Cook and Weisberg, 1982), with maximum values well below 0.2 across all models. Leverage statistics identified a small proportion of high-leverage observations consistent with expected frequencies in large samples. Casewise diagnostics showed that less than 2% of observations exhibited standardised residuals exceeding ±3.0 standard deviations, aligning with normal distribution expectations.

Sensitivity analysis excluding high-influence observations and extreme residuals revealed that governance variable coefficients (IHI, INOWN, and OCI3) remained stable in magnitude and statistical significance, confirming that results are not driven by influential cases.

Residual and Model Diagnostics

Residual analysis included normal probability plots, residual histograms, and Durbin-Watson statistics. In all models, standardised residuals clustered around a mean of zero and a standard deviation near one, with only minor tail deviations as expected in large samples. Normal probability plots exhibited close adherence to the 45° line. However, the Durbin-Watson statistics for pooled OLS were below 2.0 (e.g., 0.554–0.846), indicating some serial correlation, which was addressed in the panel data models using random intercepts and repeated effects for year.

Alternative Specifications

The robustness of the analysis was further evaluated by considering alternative dependent variables, including employment growth (LN_EMPLY) and total assets (LN_ASSETS). While the models utilising LN_EMPLY exhibited weaker fit and lower statistical significance, the results employing LN_EMPLY as the dependent variable demonstrated greater stability and stronger theoretical justification as a proxy for firm performance. Additionally, the exploration of interaction terms and lagged effects (e.g., lag IHI) did not materially alter the findings or improve model fit, suggesting that the current model specification adequately captures the primary effects of interest.

Model Information Criteria

Panel model information criteria (AIC, BIC, and CAIC) consistently favoured the Mixed Effects and FE specifications over simple pooled OLS, validating the use of panel techniques in capturing both within- and between-firm variations over time.

Variable Transformations

To address issues of skewness and heteroscedasticity, selected variables were subjected to logarithmic transformations prior to model estimation. Specifically, both dependent variables were converted to their natural logarithms (LN_EMPLY and LN_ASSETS), while investment was represented as LN_INVEST. These transformations served to normalise the variable distributions and mitigate heteroscedasticity, thereby enhancing the accuracy and interpretability of the empirical models. As confirmed through formal diagnostic testing, these transformations effectively addressed variance heterogeneity concerns.

Endogeneity Considerations

While FE panel estimation addresses time-invariant unobserved heterogeneity, three residual endogeneity concerns warrant acknowledgement: (1) coexistent reverse causality, where performance changes influence concurrent governance adjustments; (2) time-varying omitted variables that jointly affect governance and performance; and (3) selection into governance structures based on unobserved time-varying characteristics.

The panel structure establishes temporal ordering, comprehensive controls capture key confounders, and findings exhibit theoretical coherence with signalling theory predictions, collectively strengthening causal inference. However, as detailed in Section 8.1.1, findings should be interpreted as robust associations consistent with causal relationships rather than definitive causal proof. Future research employing instrumental variables, difference-in-differences designs, or propensity score matching would further address these identification challenges.

Taken together, these robustness checks confirm the consistency and reliability of all empirical findings reported in section 7.1.5. The FE panel estimator is confirmed as the most appropriate for hypothesis testing, with core ownership and investor diversity variables maintaining significance and direction across model variants. These diagnostic procedures reinforce the empirical validity of the link between ownership/financing structure and firm performance in HTYEFs, offering strong support for the study's theoretical framework and conclusions.

7.2 Relationship Between Funding Structure and Firm Innovation

This section presents empirical results testing Research Question 2 (RQ2): the relationship between external equity funding structure and firm innovation outcomes.

7.2.1 Descriptive Statistics

This section presents descriptive statistics for all variables employed in the RQ2 analysis, examining relationships between governance structures and firm innovation. The following table summarises the distributions of dependent variables (innovation measures), independent variables (governance structures), and control variables for the cross-sectional sample of HTYEFs observed in 2023. The descriptive analysis provides a foundational understanding of variable characteristics, distributional properties, and cross-sectional variation that inform subsequent regression analyses.

Table 7-13 RQ2 Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
LN_PATENT	396	0.000	5.808	1.901	0.889	0.791	0.596	0.123	0.301	0.245
IPSCORE	396	0.400	2.900	1.414	0.459	0.211	-0.023	0.123	-0.239	0.245
LN_IHI_MIN	396	0.901	9.210	8.129	0.868	0.754	-4.400	0.123	29.350	0.245
INOWN_MIN	396	0.000	100.000	21.290	22.129	489.698	0.995	0.123	0.238	0.245
LN_OCI3_MIN	371	3.609	9.210	7.023	0.753	0.568	-0.605	0.127	1.650	0.253
LIQR_AVG	387	0.086	44.152	9.952	8.061	64.978	1.187	0.124	1.162	0.247
AGE	396	2.000	17.000	7.806	2.780	7.727	0.194	0.123	-0.588	0.245
ACTIVE	396	0.000	1.000	0.899	0.302	0.091	-2.658	0.123	5.092	0.245
Valid N (listwise)	362									

The analytical sample comprises 396 firms with complete data on the primary dependent variable (LN_PATENT), representing HTYEFs that received external equity financing between the year of foundation and 2023. The valid listwise N of 362 observations indicates that approximately 91.4% of firms possess complete data across all model variables, with the primary source of missingness attributed to LN_OCI3_MIN (371 observations, or 93.7% completeness).

Table 7-14 RQ2 Sector Statistics

SECTOR					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	39	9.8	9.8	9.8
	2	43	10.9	10.9	20.7
	3	28	7.1	7.1	27.8
	4	24	6.1	6.1	33.8
	5	20	5.1	5.1	38.9
	6	27	6.8	6.8	45.7
	7	43	10.9	10.9	56.6
	8	41	10.4	10.4	66.9
	9	15	3.8	3.8	70.7
	10	35	8.8	8.8	79.5
	11	39	9.8	9.8	89.4
	12	28	7.1	7.1	96.5
	13	6	1.5	1.5	98
	14	8	2	2	100
	Total	396	100	100	

The table above presents the sectoral composition of the sample, revealing substantial representation across the 14 high-tech industry classifications. Biotechnology constitutes the largest category (Sector=2, 10.9%, n=43), followed by Artificial Intelligence (Sector=1, 9.8%, n=39), Data and Analytics (Sector=3, 7.1%, n=28), and Sustainability (Sector=12, 7.1%, n=28). This sectoral diversity provides meaningful variation for industry fixed effects estimation while ensuring sufficient observations per sector (minimum n=6 for Telecommunications) to support stable coefficient estimation.

The primary innovation measure, **LN_PATENT** (natural logarithm of cumulative patent counts through 2023), exhibits a mean of 1.901 (SD = 0.889), ranging from 0.336 to 5.808. This corresponds to a geometric mean of approximately 6.7 patents per firm in the untransformed scale (exp(1.901) ≈ 6.69), indicating moderate patenting activity consistent with young entrepreneurial firms still establishing intellectual property portfolios. The substantial range, from exp(0.000) ≈ 1 patent to exp(5.808) ≈ 333 patents, demonstrates considerable cross-sectional heterogeneity in innovation output, with the maximum value representing CMR Surgical, a medical robotics firm whose exceptional patent portfolio (333 patents, 47.6 times the median) constitutes a legitimate outlier reflecting genuine innovation intensity rather than data error. The logarithmic transformation effectively normalises the highly skewed distribution of raw patent counts (which would exhibit extreme positive skewness), yielding moderate positive skewness of 0.596 and modest kurtosis of 0.301 in the transformed variable, indicating an approximately symmetric distribution with a flatter peak than expected for a normal distribution, suggesting values are spread more evenly across the range. This satisfies OLS regression assumptions more appropriately than untransformed counts would, supporting the log specification employed in the regression models (Wooldridge, 2020). The observed skewness remains positive even after transformation, indicating that while most firms accumulate modest patent portfolios (median ≈ 7 patents), a subset of highly innovative firms drives the right tail of the distribution, consistent with power-law patterns highlighted in innovation research (Griliches, 1990).

The alternative innovation measure, **IPSCORE** (IP Activity Score based on a 5-year rolling window of patent and trademark filings), demonstrates a mean of 1.414 (SD = 0.459), ranging from 0.400 to 2.900. Unlike LN_PATENT, IPSCORE exhibits near-zero skewness (-0.023) and slightly negative kurtosis (-0.239), indicating an approximately normal distribution with minimal tail behaviour. This distributional regularity reflects IPSCORE's construction as a composite measure aggregating multiple IP activities (patents, trademarks, and designs) over a rolling 5-year window, which inherently smooths the intermittent, lumpy pattern of individual patent filings (Daizadeh, 2021). The lower mean and narrower range of IPSCORE relative to LN_PATENT (coefficient of variation = STDEV/MEAN: 0.325 vs 0.468) suggest that this measure captures more consistent, baseline innovation activity rather than exceptional breakthroughs, complementing the patent-based measure's emphasis on technical innovation. Firms with high cumulative patent counts may exhibit lower recent IP Activity Scores if their patenting occurred primarily in earlier years, while firms with elevated IPSCORE values demonstrate sustained recent innovation activity regardless of historical patent accumulation. This divergence validates the dual-measure robustness strategy, where convergent findings across both dependent variables strengthen causal inference (Shadish *et al.*, 2002).

Among the three governance constructs, **LN_IHI_MIN** (natural logarithm of minimum Investor Heterogeneity Index experienced during 2018-2022) demonstrates a mean of 8.129 (SD = 0.868), ranging from 0.901 to 9.210. The pronounced negative skewness (-4.400) and exceptionally high kurtosis (29.350) indicate a heavily left-skewed distribution with a long-left tail and sharp central peak. This pattern reflects that most firms experienced minimum IHI values near the upper range (indicating relatively concentrated investor compositions during their periods of minimum heterogeneity), while a smaller subset encountered genuinely diverse investor portfolios (lower IHI values, corresponding to higher heterogeneity) at some point in their development. Exponentiating the logarithmic values reveals that the typical firm's minimum IHI approximates exp(8.129) ≈ 3,395, while the range spans from exp(0.901) ≈ 2.46 to exp(9.210) ≈ 10,000. The theoretical IHI range of 0-10,000 (Herfindahl index, where 10,000 represents complete concentration in one investor type and approaching 0 indicates perfect dispersion across all types) suggests that even during periods of maximum heterogeneity (minimum IHI), most sample firms maintained moderate-to-high investor concentration.

INOWN_MIN (minimum insider ownership percentage experienced during 2018-2023) exhibits a mean of 21.29% (SD = 22.13%), ranging from 0% to 100%. This substantial variability indicates considerable cross-sectional heterogeneity in the extent to which firms maintained periods of low insider control. The near-unit skewness (0.995) and near-zero kurtosis (0.238) suggest a moderately right-skewed, approximately normal distribution with 25 firms (6.3%) exhibiting zero minimum insider ownership at some point, indicating complete external ownership during at least one observation year. The mean of 21.29% implies that the typical firm experienced at least one period where insiders held only one-fifth of equity, suggesting substantial external investor involvement during critical development phases. The standard deviation of 22.13% (exceeding 100% of the mean) reflects extreme dispersion, with some firms maintaining consistently low insider ownership (minima near 0%) while others retained substantial insider stakes throughout the observation period (minima approaching 100%). This variance provides sufficient statistical power to detect insider ownership effects on innovation, assuming such relationships exist.

LN_OCI3_MIN (natural logarithm of minimum Ownership Concentration Index for shareholders holding ≥3% equity) demonstrates a mean of 7.023 (SD = 0.753), ranging from 3.609 to 9.210, with 371 firms (93.7%) reporting valid data. The moderate negative skewness (-0.605) and modest kurtosis (1.650) indicate a slightly left-skewed distribution approaching normality. Exponentiating yields typical minimum OCI3 values of exp(7.023) ≈ 1,123, ranging from exp(3.609) ≈ 37 to exp(9.210) ≈ 10,000. These values suggest most firms experienced periods of moderate-to-high ownership concentration among blockholders, with few achieving highly dispersed block ownership structures (low OCI3).

LIQR_AVG (average liquidity ratio across 2018-2022) exhibits a mean of 9.95 (SD = 8.06), ranging from 0.086 to 44.152. The positive skewness (1.187) and positive kurtosis (1.162) indicate a right-skewed distribution with occasional extreme high-liquidity observations, likely representing firms with exceptionally strong cash positions relative to current liabilities. The high standard deviation (81% of the mean) reflects substantial heterogeneity in financial management strategies, with some firms operating on thin liquidity buffers while others maintain substantial cash reserves. This variation provides meaningful statistical leverage for isolating liquidity effects on innovation, controlling for the hypothesis that observed governance-innovation relationships might simply reflect differences in financial capacity to fund R&D and patent prosecution.

AGE (firm age in years as of 2022) ranges from 2 to 17 years, with a mean of 7.81 years (SD = 2.78). The slight positive skewness (0.194) and moderate negative kurtosis (-0.588) indicate an approximately symmetric, flatter-peaked distribution with lighter tails than a normal distribution. The mean age of 7.81 years confirms the sample's focus on young entrepreneurial firms, consistent with the study's emphasis on ventures in early-to-mid development stages (Mason and Brown, 2013). All firms fall within the 2–17-year range, ensuring the "young entrepreneurial" classification remains valid while providing sufficient age variation (coefficient of variation = 0.36) to detect lifecycle effects on innovation capacity.

ACTIVE (binary indicator of operational status in 2023) demonstrates that 89.9% of firms (n=356) remained operational while 10.1% (n=40) had ceased operations by the observation year. The mean of 0.899 (SD = 0.302) reflects this 9:1 ratio of surviving-to-failed firms. The extreme negative skewness (-2.658) and high positive kurtosis (5.092) are artefacts of the binary distribution, which is heavily concentrated at ACTIVE=1, indicating the sample comprises predominantly surviving firms with a non-trivial minority of ceased ventures. The inclusion of 40 ceased firms addresses survivorship bias concerns, ensuring coefficient estimates account for firms that failed to sustain operations through 2023. The 10.1% exit rate appears modest compared to typical entrepreneurial failure rates (approximately 20-30% annual failures for young ventures; Wennberg *et al.*, 2010), potentially reflecting the sample's focus on funded firms (which exhibit higher survival due to resource advantages).

The descriptive statistics reveal substantial cross-sectional heterogeneity across all key variables, providing sufficient statistical variance to detect governance-innovation relationships if they exist. The next sections proceed with correlation analysis, building upon this descriptive foundation to rigorously test whether investor heterogeneity, insider ownership, and ownership concentration significantly influence innovation outcomes in HTYEFs.

7.2.2 Correlation Analysis

This section presents a bivariate correlation analysis examining relationships among all variables employed in the RQ2 models. Pearson correlation coefficients quantify linear associations between continuous variables, providing preliminary evidence regarding governance-innovation relationships while assessing potential multicollinearity concerns among independent variables. Table 7.2.2 presents the correlation matrix for the cross-sectional sample of firms observed in 2023, with significance levels indicated for each bivariate relationship.

Table 7-15 RQ2 Correlation Analysis

Correlations

		LN_PATENT	IPSCORE	LN_IHI_MIN	INOWN_MIN	LN_OCI3_MIN	LIQR_AVG	AGE	ACTIVE
LN_PATENT	Pearson Correlation	1	.738**	-.278**	-.237**	-.210**	0.097	.197**	0.074
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.055	0.000	0.142
	N	396	396	396	396	371	387	396	396
IPSCORE	Pearson Correlation	.738**	1	-.229**	-.173**	-.167**	.109*	-0.059	.151**
	Sig. (2-tailed)	0.000		0.000	0.001	0.001	0.032	0.245	0.003
	N	396	396	396	396	371	387	396	396
LN_IHI_MIN	Pearson Correlation	-.278**	-.229**	1	.414**	.651**	-0.055	-.182**	0.084

	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.277	0.000	0.097
	N	396	396	396	396	371	387	396	396
INOWN_MIN	Pearson Correlation	-.237**	-.173**	.414**	1	.476**	-0.048	-.229**	0.063
	Sig. (2-tailed)	0.000	0.001	0.000		0.000	0.351	0.000	0.208
	N	396	396	396	396	371	387	396	396
LN_OCI3_MIN	Pearson Correlation	-.210**	-.167**	.651**	.476**	1	-0.029	-.241**	0.052
	Sig. (2-tailed)	0.000	0.001	0.000	0.000		0.581	0.000	0.319
	N	371	371	371	371	371	362	371	371
LIQR_AVG	Pearson Correlation	0.097	.109*	-0.055	-0.048	-0.029	1	-.284**	0.015
	Sig. (2-tailed)	0.055	0.032	0.277	0.351	0.581		0.000	0.769
	N	387	387	387	387	362	387	387	387
AGE	Pearson Correlation	.197**	-0.059	-.182**	-.229**	-.241**	-.284**	1	-.102*
	Sig. (2-tailed)	0.000	0.245	0.000	0.000	0.000	0.000		0.043
	N	396	396	396	396	371	387	396	396
ACTIVE	Pearson Correlation	0.074	.151**	0.084	0.063	0.052	0.015	-.102*	1
	Sig. (2-tailed)	0.142	0.003	0.097	0.208	0.319	0.769	0.043	
	N	396	396	396	396	371	387	396	396

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

The two innovation measures**, LN_PATENT** and **IPSCORE**, demonstrate a strong positive correlation ($r = 0.738$, $p < 0.001$), indicating substantial shared variance between patent-based and IP activity-based innovation metrics. This robust positive association suggests that firms accumulating higher cumulative patent counts also tend to exhibit elevated recent IP activity levels, providing convergent validity evidence that both measures capture genuine innovation capacity rather than measurement artefacts. The magnitude of this correlation ($r^2 \approx 0.54$, implying 54% shared variance) confirms these measures tap related but partially distinct innovation dimensions, sufficiently correlated to validate the innovation construct, yet sufficiently independent to warrant separate analysis as complementary outcome measures (Hair *et al.*, 2010). However, this correlation also suggests that multivariate models employing both measures simultaneously would encounter collinearity issues, justifying the separate-equation approach adopted for hypothesis testing.

LN_IHI_MIN (log of minimum Investor Heterogeneity Index) exhibits significant negative correlations with both innovation measures: $r = -0.278$ with LN_PATENT ($p < 0.001$) and r = -

0.229 with IPSCORE ($p < 0.001$). These moderate negative associations provide preliminary evidence consistent with H4, suggesting that firms experiencing periods of greater investor diversity (lower IHI values, corresponding to negative correlations when IHI is log-transformed) demonstrate higher cumulative patent output and elevated IP activity. The correlation magnitude ($r \approx -0.25$) implies approximately 6-7% shared variance between investor composition and innovation outcomes, representing economically meaningful associations, though leaving substantial innovation variance attributable to other factors. The consistency of correlation signs across both dependent variables (both negative, both significant at $p < 0.001$) strengthens preliminary evidence, suggesting the investor heterogeneity-innovation relationship generalises across patent-based and IP activity-based innovation measures rather than reflecting idiosyncrasies of specific operationalisations.

INOWN_MIN (minimum insider ownership percentage) demonstrates significant negative correlations with both innovation measures: $r = -0.237$ with LN_PATENT ($p < 0.001$) and $r = -0.173$ with IPSCORE ($p < 0.001$). These negative associations provide preliminary support for the hypothesis that external oversight (reflected in lower insider ownership minima) facilitates innovation. The correlation magnitude ($r \approx -0.20$) indicates modest shared variance (approximately 4%), consistent with insider ownership representing one among multiple governance dimensions influencing innovation. The weaker association with IPSCORE ($r = -0.173$) compared to LN_PATENT ($r = -0.237$) may reflect that insider ownership effects manifest more strongly in cumulative patent accumulation than in recent IP activity, though both relationships achieve statistical significance.

LN_OCI3_MIN (log of minimum Ownership Concentration Index) exhibits significant negative correlations with both innovation measures: $r = -0.210$ with LN_PATENT ($p < 0.001$) and $r = -0.167$ with IPSCORE ($p < 0.001$). These moderate negative associations suggest that firms experiencing periods of greater ownership dispersion among blockholders (lower OCI3 values) demonstrate higher innovation outputs, providing preliminary evidence regarding ownership structure effects. The correlation magnitudes ($r \approx -0.19$) imply approximately 3-4% shared variance between ownership concentration and innovation, representing meaningful but modest associations. The slightly stronger relationship with LN_PATENT versus IPSCORE mirrors the pattern observed for INOWN_MIN, suggesting governance effects may influence long-term patent accumulation more substantially than recent IP activity.

AGE demonstrates a significant positive correlation with LN_PATENT ($r = 0.197$, $p < 0.001$) but a non-significant association with IPSCORE ($r = -0.059$, $p = 0.245$). The positive age-patent relationship confirms expected mechanical accumulation: older firms have had greater temporal opportunity to file patents, creating a baseline positive association independent of governance quality. The absence of age-IPSCORE correlation suggests that recent IP activity (measured via a 5-year rolling window) does not systematically vary with firm maturity, potentially because IPSCORE captures contemporary rather than cumulative innovation. AGE exhibits significant negative correlations with all three governance variables: $r = -0.182$ with LN_IHI_MIN ($p < 0.001$), $r = -0.229$ with INOWN_MIN ($p < 0.001$), and $r = -0.241$ with LN_OCI3_MIN ($p < 0.001$). These age-governance correlations underscore the importance of controlling for lifecycle stages in regression models to avoid confounding governance effects with maturation dynamics.

LIQR_AVG demonstrates a marginally non-significant correlation with LN_PATENT ($r = 0.097$, $p = 0.055$) and a weakly significant positive correlation with IPSCORE ($r = 0.109$, $p = 0.032$). These weak associations suggest that financial liquidity bears a limited direct bivariate relationship with innovation outcomes, though the near-significant positive trends hint that higher liquidity may modestly facilitate patent activity. The weak liquidity-innovation correlations support including LIQR_AVG as a control variable to isolate governance effects from financial capacity differences, though they suggest financial slack exerts less influence on innovation than governance structures do. LIQR_AVG exhibits weak non-significant correlations with all governance variables ($|r| < 0.06$, all $p > 0.27$), indicating financial management strategies and ownership structures vary largely independently. This independence ensures that controlling for liquidity in multivariate models isolates governance effects without introducing substantial collinearity.

ACTIVE demonstrates a non-significant correlation with LN_PATENT ($r = 0.074$, $p = 0.142$) but a significant positive correlation with IPSCORE ($r = 0.151$, $p = 0.003$). The absence of ACTIVE-LN_PATENT correlation indicates that cumulative patent portfolios do not systematically differ between operational and ceased firms, suggesting historical innovation success does not strongly predict survival in this sample. Conversely, the positive ACTIVE-IPSCORE correlation indicates operational firms that exhibit higher recent IP activity, consistent with surviving enterprises maintaining concurrent innovation efforts while failing firms reduce IP investments prior to cessation. ACTIVE exhibits weak, non-significant correlations with all governance variables ($|r| < 0.09$, all $p > 0.09$), indicating operational status varies largely independently of ownership structures. This independence validates including ACTIVE as a control variable without introducing substantial multicollinearity while addressing potential survivorship bias.

A critical diagnostic concern in multiple regression involves multicollinearity, excessive correlation among independent variables that compromises coefficient estimation precision and interpretability. The governance variable intercorrelations merit careful examination:

LN_IHI_MIN ↔ LN_OCI3_MIN: The strongest governance variable intercorrelation ($r = 0.651$, $p < 0.001$) indicates substantial shared variance ($r^2 \approx 0.42$) between investor heterogeneity and ownership concentration indices. This moderately high correlation reflects conceptual overlap: both measures quantify aspects of ownership structure concentration, with IHI capturing investor type diversity and OCI3 measuring blockholder dispersion. While this correlation falls below the conventional $r > 0.85$ threshold, indicating severe multicollinearity (Kutner *et al.*, 2005), it suggests these constructs tap partially overlapping governance dimensions. The moderate correlation justifies testing IHI and OCI3 in separate regression specifications (Models 4 and 6) rather than simultaneously, avoiding coefficient instability and inflated standard errors.

INOWN_MIN ↔ LN_OCI3_MIN: Moderate positive correlation ($r = 0.476$, $p < 0.001$) indicates that firms with lower minimum insider ownership tend also to exhibit lower ownership concentration among blockholders. This relationship ($r^2 \approx 0.23$) suggests some systematic association between management control and blockholder dispersion, potentially reflecting that external equity infusions simultaneously dilute insider stakes and disperse ownership among multiple investors. However, the correlation magnitude remains well below multicollinearity concern thresholds.

LN_IHI_MIN ↔ INOWN_MIN: Moderate positive correlation ($r = 0.414$, $p < 0.001$) indicates firms with more homogeneous investor compositions (higher IHI) tend to maintain higher minimum insider ownership levels. This pattern ($r^2 \approx 0.17$) may reflect that founder-controlled firms attract less diverse external financing, while firms securing varied investor types experience greater insider dilution. The correlation strength remains acceptable for multivariate analysis.

All governance variable intercorrelations fall below $r = 0.70$, satisfying conventional thresholds for acceptable multicollinearity levels in regression analysis (Hair *et al.*, 2010). The strongest correlation (LN_IHI_MIN ↔ LN_OCI3_MIN, $r = 0.651$) approaches but does not exceed concerning levels, justifying their inclusion in separate rather than simultaneous specifications. The separate-equation approach employed for hypothesis testing (one governance variable per model) further mitigates multicollinearity concerns.

The observed correlation patterns establish foundational expectations for multivariate regression results: negative governance-innovation relationships should persist after controlling for confounders, assuming bivariate associations reflect associations consistent with causal relationships rather than omitted variable confounding. The subsequent sections test these relationships rigorously through OLS regression, assessing whether preliminary correlation evidence withstands multivariate scrutiny incorporating controls and diagnostic testing.

7.2.3 Model Diagnostics and Assumptions

This section evaluates the validity of the ordinary least squares regression models through comprehensive diagnostic testing of fundamental regression assumptions. Valid OLS inference requires satisfying several conditions: linearity, independence of observations, homoscedasticity (constant error variance), normality of residuals, and absence of problematic multicollinearity. This section systematically addresses each assumption, presents diagnostic results from the SPSS regression output, and discusses implications for model validity and the robustness of coefficient estimates.

Multicollinearity Assessment

Multicollinearity, excessive correlation among independent variables, does not bias OLS coefficient estimates but inflates standard errors, reducing statistical power and producing unreliable confidence intervals (Kutner *et al.*, 2005). Variance Inflation Factor (VIF) statistics quantify the extent to which each independent variable's variance is inflated by correlations with other predictors, with VIF = 1 indicating no correlation and VIF > 5 conventionally signalling problematic multicollinearity.

Across all six RQ2 model specifications (three governance dimensions × two dependent variables), VIF values remained well below concerning thresholds, confirming minimal multicollinearity among regressors:

- Model 4 (Investor Heterogeneity): Maximum VIF = 1.100 (LN_IHI_MIN)
- Model 5 (Insider Ownership): Maximum VIF = 1.145 (INOWN_MIN)
- Model 6 (Ownership Concentration): Maximum VIF = 1.121 (LN_OCI3_MIN)

The governance variables exhibited minimal VIF values (all < 1.15), indicating their log and percentage transformations successfully reduced distributional correlations with other predictors. Control variables demonstrated similarly low VIF values across all models: AGE exhibited the highest VIF (ranging from 1.219 to 1.271 across models), LIQR_AVG maintained consistent VIF values (1.155-1.160), and ACTIVE demonstrated minimal collinearity (1.037-1.049).

Sector dummy variables, while inherently exhibiting within-group multicollinearity due to their categorical structure, maintained acceptable VIF ranges across models. Across the 14 sector categories included in each model, individual sector VIF values ranged from 1.700 to 5.959, with the maximum values observed for SECTOR 2 across all three governance variable specifications. While SECTOR2's VIF of 5.959 approaches the conventional threshold of 5.0, this represents acceptable multicollinearity for categorical variables (Hair *et al.*, 2010), particularly when the goal is controlling for sectoral heterogeneity rather than precisely estimating sector effects. The inclusion of all 14 sector dummies ensures comprehensive industry controls without arbitrary aggregation that would mask genuine sectoral variation.

Complementing VIF analysis, tolerance values (reciprocals of VIF, with tolerance = 1/VIF) provide an alternative multicollinearity diagnostic. All governance variables demonstrated tolerance values exceeding 0.87 (LN_IHI_MIN: 0.909, INOWN_MIN: 0.873, LN_OCI3_MIN: 0.892), well above the conventional minimum threshold of 0.20. These tolerance levels confirm that each governance construct retains substantial unique variance unexplained by other regressors and can be reliably estimated without collinearity compromising coefficient precision. The comprehensive multicollinearity assessment, combining VIF diagnostics, tolerance values, and governance variable separability, confirms that multicollinearity does not compromise the validity of RQ2 model coefficient estimates. All diagnostics fall comfortably within acceptable ranges for continuous variables and sector controls, supporting the reliability and interpretability of governance variable effects on innovation outcomes.

Normality of Residuals

Ordinary least squares regression inference validity depends upon error terms following an approximately normal distribution, particularly for valid hypothesis testing with smaller samples (Wooldridge, 2020). Normal probability plots compare observed residuals against theoretical normal quantiles, with points clustering along a 45-degree reference line indicating approximate normality.

Normal P-P plots for all six models revealed standardised residuals clustering closely along the diagonal reference line throughout the central 85-90% of the distribution, with minor deviations confined to extreme upper and lower tails. These deviations in the tails, particularly evident for model 5 with LN_PATENT as the dependent variable, reflect the exceptional innovation intensity of Case 165 (CMR Surgical, a medical robotics firm) rather than systematic non-normality. The central portion of the distribution, containing the substantial majority of observations, demonstrates excellent adherence to the normal reference line.

Standardised residual histograms complemented the probability plots, displaying approximately bell-shaped distributions centred near zero for all model specifications. The histogram shapes approximate the theoretical normal distribution with slight positive skewness attributable to the CMR Surgical outlier and the finite sample size (N = 362-371, depending on specification).

The observed departures from perfect normality appear both minor and tolerable for several reasons: (1) residuals demonstrate approximate normality throughout the central 90% of the distribution where the vast majority of observations cluster, (2) deviations are most pronounced in extreme tail regions representing < 1% of observations, (3) OLS inference remains relatively robust to moderate non-normality departures with large samples (N > 100), and (4) the logarithmic transformation of the dependent variable (LN_PATENT) substantially improved residual normality compared to untransformed patent counts, which would exhibit far more extreme right-skewness.

Homoscedasticity and Heteroscedasticity Assessment

Homoscedasticity requires error variance to remain constant across fitted values (predicted dependent variable levels), whereas heteroscedasticity violates this assumption with error variance depending systematically on fitted values or predictors (Wooldridge, 2020; Hair *et al.*, 2010). Scatter plots of standardised residuals versus fitted values provide a visual homoscedasticity assessment, with random scatter around zero indicating constant variance and patterns (funnel shapes, arcs) indicating heteroscedasticity (Field, 2024).

Residual scatter plots for all six RQ2 models revealed approximately random scatter of standardised residuals around the zero line, with consistent vertical spread across the full range of fitted values. No obvious funnel-shaped patterns emerged that would indicate variance increasing or decreasing systematically with fitted values. The residual scatter appeared consistent across the model range, suggesting approximate homoscedasticity validity with minor exceptions for extreme innovation-intensive firms.

To address any residual heteroscedasticity concerns, all SPSS regression models employed heteroscedasticity-consistent standard errors (Field, 2024), ensuring valid hypothesis testing regardless of whether homoscedasticity assumptions are perfectly satisfied. This conservative approach preserves inference validity while acknowledging that entrepreneurial firm data commonly exhibit heteroscedastic patterns reflecting real economic heterogeneity in firm characteristics and innovation strategies.

The homoscedasticity assessment, combining visual residual analysis, scatter plot inspection, and heteroscedasticity-robust standard error computation, confirms that OLS assumptions remain adequately satisfied. Any residual heteroscedasticity appears modest and has been addressed through robust inference procedures.

Assumption of Independence

The RQ2 analysis employs cross-sectional data, where each firm appears only once in the dataset. This fundamental design ensures that observations are independent; each firm's innovation outcome and governance structure are observed independently without temporal sequencing, eliminating concerns about serial correlation or within-cluster dependence that would characterise panel or time-series data.

While firms appear independently, firms within specific high-tech industries may share common industry shocks, technological opportunities, and regulatory environments that could generate within-industry correlations violating strict independence assumptions (Cameron and Trivedi, 2013). The inclusion of sector fixed effects (14 industry dummy variables) controls for industry-level common factors, effectively de-correlating observations within industries by removing shared sector characteristics.

Firms in this cross-sectional sample represent genuinely independent economic entities, separate organisations with distinct governance structures, innovation strategies, and financial situations, rather than nested observations or strategically linked entities. Governance variables (investor heterogeneity, insider ownership, and ownership concentration) vary across firms, reflecting their unique capital structures rather than being mechanically determined by single system-level factors.

The cross-sectional design and governance variable heterogeneity support the validity of the independence assumption. The sector fixed effects address residual within-industry correlation concerns, ensuring that standard errors remain valid, and hypothesis tests maintain proper Type I error rates.

Linearity Assessment

Ordinary least squares assumes linear relationships between log-transformed variables and the dependent variable. The RQ2 model specifications employ particular functional forms selected based on distributional properties and previous specification testing:

Log-Log Specifications (Models 4 and 6): LN_IHI_MIN and LN_OCI3_MIN undergo logarithmic transformation, as do the dependent variables LN_PATENT. This log-log functional form implies constant-elasticity relationships: governance elasticities (percentage changes in governance producing proportional percentage changes in innovation) that remain constant across the firm distribution. This specification proves appropriate for variables with wide percentage-based ranges (e.g., IHI spanning thousands, OCI3 spanning thousands).

Semi-Log Specifications (Model 5): INOWN_MIN remains untransformed (linear percentage form ranging 0-100%), while the patent-dependent variable is log-transformed, creating semi-log (semi-elasticity) specifications where innovation semi-elasticity (percentage change in patents per percentage-point change in insider ownership) varies across the distribution. This specification suits INOWN_MIN's bounded nature and the policy relevance of percentage-point changes.

Previous correlation analysis (Section 7.2.2) confirmed that log-transformed governance variables achieved stronger correlations with innovation measures (e.g., LN_IHI_MIN $r = -0.278$ vs untransformed IHI_MIN $r = -0.240$), providing empirical evidence that log-linear functional forms better capture governance-innovation relationships than linear specifications.

Component-component plus (CCPR) plots and partial regression plots examine whether residuals demonstrate linear patterns with each regressor, verifying appropriate functional form specification. These diagnostics revealed approximately linear patterns between residuals and each governance variable, supporting the adopted functional form specifications across all models.

Log-log (IHI, OCI3) and semi-log (INOWN) functional forms were selected based on distributional properties documented in Section 7.2.1 and verified through residual diagnostic plots. Scatter plots of partial residuals against each governance variable confirmed approximate linear relationships in transformed space.

Outlier Detection and Influence Analysis

Standardised residuals exceeding ±3 in absolute value represent observations with fitted values >3 standard deviations from observed values, potentially indicating data errors, unusual firms, or model specification misfit. SPSS casewise diagnostics for all six models identified one persistent outlier:

Case ID 165 (CMR Surgical): a medical robotics firm with 333 patents (47.6 times the sample median), generating standardised residuals ranging from 3.135 to 4.051 across models. Specific standardised residual values include Model 4 (LN_IHI_MIN → LN_PATENT): 3.532; Model 5

(INOWN_MIN → LN_PATENT): 4.051; Model 5 (INOWN_MIN → IPSCORE): 3.135; Model 6 (LN_OCI3_MIN → LN_PATENT): 3.688. This firm legitimately represents the extreme right tail of the innovation distribution, an exceptionally innovative venture justifying its outlier status through genuine innovation intensity rather than data error. CMR Surgical's exceptional patent portfolio reflects the genuine heterogeneity of high-tech entrepreneurial ventures, where medical robotics and life sciences represent inherently more patent-intensive industries than, for example, software services.

No additional firms exceeded the ±3.0 standardised residual threshold across any model specification, confirming that Case 165 represents a unique but isolated outlier rather than a systematic pattern of model misspecification.

Cook's distance measures the influence of each observation on fitted regression coefficients, identifying firms whose inclusion/exclusion would substantially alter model results. Cook's distance values exceeding 4/N (where N = sample size) conventionally indicate high-influence observations (Stevens, 2009). Maximum Cook's distance values across all models ranged from 0.089 to 0.147, substantially below the 4/371 ≈ 0.011 threshold (using minimum N across specifications). Even CMR Surgical's Cook's distance (maximum 0.147 across models) remained acceptable, indicating that this extreme firm, while exhibiting unusual innovation levels, does not exert undue influence on regression coefficient estimation. The relatively low Cook's distance despite the extreme standardised residual reflects that Case 165 has unremarkable values on independent variables; its outlier status derives from innovation intensity (dependent variable) rather than unusual governance structure or firm characteristics.

Rather than excluding CMR Surgical, which would eliminate a legitimate high-innovation firm and bias estimates toward the modal firm, the analysis retained all observations. The exceptional innovation of CMR Surgical represents genuine variation in the entrepreneurial population; medical robotics exhibits higher-than-average patenting intensity, and excluding such firms would misrepresent true population heterogeneity. The retention of all observations provides more conservative estimates of governance-innovation relationships and broader representativeness of the entrepreneurial landscape.

Summary

Table 7-16 RQ2 Model Assumptions

Assumption	Result	Implication
Multicollinearity	Governance VIF 1.100-1.145; Sector VIF 1.700-5.959	Coefficients reliably estimated; standard errors valid
Normality	Residuals approximately normal; tail deviations minimal	Hypothesis tests valid; confidence intervals appropriate
Homoscedasticity	Consistent residual scatter; robust SEs employed	Variance estimates unbiased; inference valid

Independence	Cross-sectional data; sector controls included	Standard errors valid; Type I error rates correct
Linearity	Log-log/semi-log forms justified; verified empirically	Functional form appropriate for governance-innovation relationships
Outliers	Case 165 identified; Cook's D acceptable	Outliers influence minimal; retention appropriate

These diagnostic results provide confidence that the regression coefficients and hypothesis tests presented in Section 7.2.4 represent valid inferences about governance-innovation relationships in HTYEFs. The model results can be interpreted with appropriate statistical rigour, with coefficient point estimates and significance levels reflecting genuine relationships rather than artefacts of assumption violations.

7.2.4 Regression Analysis

This section presents the regression results from all six model specifications examining Hypotheses 4, 5, and 6. Each hypothesis is tested using two dependent variables (LN_PATENT and IPSCORE) to provide convergent evidence of governance-innovation relationships. Models control for firm age, financial liquidity, operational status, and sectoral heterogeneity through industry dummy variables.

The RQ2 analysis employs six ordinary least squares (OLS) regression models with the general specification:

$$Innovation_{\mathrm{i}} = \beta_0 + \beta_1 Governance_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s \; SECTOR_{\mathrm{is}} + \varepsilon \mathrm{i}$$

Where ‘Innovation’ represents either LN_PATENT (cumulative log patents) or IPSCORE (IP Activity Score), ‘Governance’ represents one of three variables tested (LN_IHI_MIN, INOWN_MIN, or LN_OCI3_MIN). Control variables include LIQR_AVG (average liquidity), AGE (firm age), ACTIVE (operational status), and SECTOR, which includes 14 binary indicators for high-tech industry classifications. Heteroscedasticity-consistent standard errors (White, 1980) ensure valid inference regardless of residual variance patterns.

7.2.4.1 Hypothesis 4 (H4)

The results of OLS analysis for H4: Regression models 4a and 4b examined the relationship between funding structure heterogeneity (measured by minimum IHI) and firm innovation rate (represented by LN_PATENT and IPSCORE).

$$LN\_PATENT_i = \beta_0 + \beta_1 LN\_IHI\_MIN_i + \beta_2 LIQR\_AVG_i + \beta_3 AGE_i + \beta_4 ACTIVE_i + \sum_{s=1}^{13} \delta s\ SECTOR_{is} + \varepsilon i$$

Model 4a (Hypothesis H4 – Patent)

$$IPSCORE_i = \beta_0 + \beta_1 LN\_IHI\_MIN_i + \beta_2 LIQR\_AVG_i + \beta_3 AGE_i + \beta_4 ACTIVE_i + \sum_{s=1}^{13} \delta s\ SECTOR_{is} + \varepsilon i$$

Model 4b (Hypothesis H4 – IPScore)

A summary of the model fit is presented below. Full results, including charts, are available in the appendix.

Table 7-17 OLS model fit for Hypothesis 4: investor heterogeneity and innovation outcomes

	LN_PATENT	IPSCORE
R	.431	.369
R Square	.186	.136
Adjusted R Square	.148	.096
Std. Error of the Estimate	.817566	.43301
F Statistics	4.956	3.417
Sig. F Statistics	<.001	<.001
Durbin-Watson	2.171	2.150
N	387	387

The result of the coefficient analysis for the dependent variables, LN_PATENT and IPSCORE:

PATENT Coefficients [a]

Model 4a	Unstandardised Coefficients B	Std. Error	Standardised Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
(Constant)	3.099	.561		5.526	<.001		
ACTIVE	.286	.142	.096	2.012	.045	.962	1.039
AGE	.068	.017	.212	4.093	<.001	.820	1.219
LIQR_AVG	.015	.006	.133	2.623	.009	.864	1.157
SECTOR_1	-.284	.318	-.097	-.892	.373	.188	5.310
SECTOR_2	-.060	.318	-.021	-.188	.851	.176	5.669
SECTOR_3	-.335	.332	-.096	-1.009	.314	.242	4.131
SECTOR_4	-.081	.338	-.022	-.240	.810	.271	3.691
SECTOR_5	-.755	.346	-.184	-2.180	.030	.309	3.240
SECTOR_6	.200	.331	.058	.606	.545	.244	4.106
SECTOR_7	-.142	.318	-.049	-.445	.656	.180	5.559
SECTOR_8	-.177	.317	-.062	-.558	.577	.181	5.523
SECTOR_9	-.596	.359	-.130	-1.660	.098	.360	2.781
SECTOR_10	-.104	.322	-.033	-.322	.748	.208	4.811
SECTOR_11	.104	.319	.035	.327	.744	.188	5.328
SECTOR_12	-.040	.331	-.011	-.119	.905	.251	3.980
SECTOR_13	-.005	.442	-.001	-.012	.991	.579	1.727
LN_IHI_MIN	-.242	.050	-.240	-4.866	<.001	.909	1.100

a) Dependent Variable: LN_PATENT

IPSCORE Coefficients [b]

Model 4b	Unstandardised Coefficients B	Std. Error	Standardised Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
(Constant)	2.197	.297		7.396	<.001		
ACTIVE	.226	.075	.148	2.996	.003	.962	1.039
AGE	-.008	.009	-.051	-.962	.337	.820	1.219
LIQR_AVG	.003	.003	.052	1.007	.315	.864	1.157
SECTOR_1	.160	.168	.106	.952	.342	.188	5.310
SECTOR_2	.217	.168	.149	1.289	.198	.176	5.669
SECTOR_3	.094	.176	.053	.536	.592	.242	4.131
SECTOR_4	.077	.179	.040	.433	.665	.271	3.691
SECTOR_5	-.176	.183	-.083	-.959	.338	.309	3.240
SECTOR_6	.145	.175	.081	.831	.406	.244	4.106
SECTOR_7	.074	.169	.050	.441	.659	.180	5.559
SECTOR_8	.210	.168	.142	1.248	.213	.181	5.523
SECTOR_9	-.115	.190	-.049	-.606	.545	.360	2.781
SECTOR_10	.093	.171	.058	.543	.588	.208	4.811
SECTOR_11	.168	.169	.111	.993	.321	.188	5.328
SECTOR_12	.111	.175	.061	.634	.527	.251	3.980
SECTOR_13	.237	.234	.064	1.013	.312	.579	1.727
LN_IHI_MIN	-.130	.026	-.250	-4.936	<.001	.909	1.100

b) Dependent Variable: IPSCORE

7.2.4.2 Hypothesis 5 (H5)

The results of OLS analysis for H5: Regression models 5a and 5b examined the relationship between insider manager/owner blockholders (measured by INOWN) and firm innovation rate (represented by LN_PATENT and IPSCORE).

$$LN\_PATENT_{\mathrm{i}} = \beta_0 + \beta_1 INOWN\_MIN_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s\ SECTOR_{\mathrm{is}} + \varepsilon\mathrm{i}$$

Model 5a (Hypothesis H5 – Patent)

$$IPSCORE_{\mathrm{i}} = \beta_0 + \beta_1 INOWN\_MIN_{\mathrm{i}} + \beta_2 LIQR\_AVG_{\mathrm{i}} + \beta_3 AGE_{\mathrm{i}} + \beta_4 ACTIVE_{\mathrm{i}} + \sum_{s=1}^{13} \delta s\ SECTOR_{\mathrm{is}} + \varepsilon\mathrm{i}$$

Model 5b (Hypothesis H5 – IPScore)

A summary of the model fit is presented below. Full results, including charts, are available in the appendix.

Table 7-18 OLS model fit for Hypothesis 5: insider ownership and innovation outcomes

	LN_PATENT	IPSCORE
R	.406	.340
R Square	.165	.115
Adjusted R Square	.126	.075
Std. Error of the Estimate	.828053	.43815
F Statistics	4.285	2.831
Sig. F Statistics	<.001	<.001
Durbin-Watson	2.196	2.182
N	387	387

The result of the coefficient analysis for the dependent variables, LN_PATENT and IPSCORE:

PATENT Coefficients [a]

	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
Model 5a	**B**	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	1.158	.355		3.261	.001		

ACTIVE	.266	.144	.089	1.844	.066	.964	1.037
AGE	.068	.017	.214	4.017	<.001	.799	1.251
LIQR_AVG	.015	.006	.141	2.750	.006	.866	1.155
SECTOR_1	-.127	.323	-.043	-.394	.694	.187	5.344
SECTOR_2	.072	.321	.025	.225	.822	.177	5.634
SECTOR_3	-.213	.336	-.061	-.633	.527	.242	4.136
SECTOR_4	.194	.343	.052	.565	.572	.270	3.709
SECTOR_5	-.532	.350	-.130	-1.518	.130	.309	3.233
SECTOR_6	.315	.335	.091	.939	.348	.243	4.110
SECTOR_7	-.063	.322	-.022	-.196	.845	.180	5.558
SECTOR_8	-.059	.323	-.021	-.184	.854	.180	5.565
SECTOR_9	-.493	.365	-.108	-1.349	.178	.356	2.808
SECTOR_10	.025	.327	.008	.078	.938	.207	4.829
SECTOR_11	.254	.323	.087	.787	.432	.187	5.345
SECTOR_12	.107	.336	.030	.319	.750	.250	4.000
SECTOR_13	.227	.450	.032	.503	.615	.573	1.744
INOWN_MIN	-.008	.002	-.189	-3.714	<.001	.873	1.145

a) Dependent Variable: LN_PATENT

IPSCORE Coefficients [a]

	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
Model 5b	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.158	.188		6.160	<.001		
ACTIVE	.215	.076	.141	2.825	.005	.964	1.037

AGE	-.009	.009	-.052	-.944	.346	.799	1.251
LIQR_AVG	.003	.003	.060	1.143	.254	.866	1.155
SECTOR_1	.246	.171	.163	1.441	.150	.187	5.344
SECTOR_2	.288	.170	.197	1.697	.091	.177	5.634
SECTOR_3	.161	.178	.090	.904	.366	.242	4.136
SECTOR_4	.228	.181	.118	1.255	.210	.270	3.709
SECTOR_5	-.054	.185	-.026	-.293	.770	.309	3.233
SECTOR_6	.208	.177	.116	1.173	.242	.243	4.110
SECTOR_7	.117	.171	.079	.687	.492	.180	5.558
SECTOR_8	.275	.171	.186	1.610	.108	.180	5.565
SECTOR_9	-.057	.193	-.024	-.297	.767	.356	2.808
SECTOR_10	.163	.173	.102	.945	.345	.207	4.829
SECTOR_11	.250	.171	.165	1.461	.145	.187	5.345
SECTOR_12	.192	.178	.106	1.078	.282	.250	4.000
SECTOR_13	.365	.238	.099	1.532	.126	.573	1.744
INOWN_MIN	-.004	.001	-.204	-3.898	<.001	.873	1.145

b) Dependent Variable: IPSCORE

7.2.4.3 Hypothesis 6 (H6)

The results of OLS analysis for H6: Regression models 6a and 6b examined the relationship between blockholders of >= 3% equity (measured by OCI3) and firm innovation rate (represented by LN_PATENT and IPSCORE).

$$LN\_PATENT_i = \beta_0 + \beta_1 LN\_OCI3\_MIN_i + \beta_2 LIQR\_AVG_i + \beta_3 AGE_i + \beta_4 ACTIVE_i + \sum_{s=1}^{13} \delta s\ SECTOR_{is} + \varepsilon i$$

Model 6a (Hypothesis H6 – Patent)

$$IPSCORE_i = \beta_0 + \beta_1 LN\_OCI3\_MIN_i + \beta_2 LIQR\_AVG_i + \beta_3 AGE_i + \beta_4 ACTIVE_i + \sum_{s=1}^{13} \delta s \ SECTOR_{is} + \varepsilon i$$

Model 6b (Hypothesis H6 – IPScore)

A summary of the model fit is presented below. Full results, including charts, are available in the appendix.

Table 7-19 OLS model fit for Hypothesis 6: ownership concentration and innovation outcomes

	LN_PATENT	IPSCORE
R	.404	.344
R Square	.164	.118
Adjusted R Square	.122	.075
Std. Error of the Estimate	.830981	.44245
F Statistics	3.956	2.717
Sig. F Statistics	<.001	<.001
Durbin-Watson	2.250	2.249
N	362	362

The result of the coefficient analysis for the dependent variables, LN_PATENT and IPSCORE:

PATENT Coefficients [a]

	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
Model 6a	**B**	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	2.370	.620		3.823	<.001		
ACTIVE	.286	.155	.093	1.838	.067	.953	1.049
AGE	.070	.018	.217	3.899	<.001	.786	1.271
LIQR_AVG	.016	.006	.144	2.708	.007	.862	1.160
SECTOR_1	-.202	.346	-.067	-.583	.560	.182	5.490

SECTOR_2	.025	.344	.009	.072	.943	.168	5.959
SECTOR_3	-.230	.361	-.065	-.637	.525	.236	4.241
SECTOR_4	.204	.372	.050	.547	.585	.291	3.437
SECTOR_5	-.703	.372	-.173	-1.890	.060	.291	3.431
SECTOR_6	.257	.356	.076	.721	.472	.218	4.589
SECTOR_7	-.123	.346	-.043	-.357	.721	.170	5.889
SECTOR_8	-.050	.343	-.017	-.144	.885	.168	5.939
SECTOR_9	-.570	.383	-.128	-1.489	.138	.328	3.051
SECTOR_10	-.014	.347	-.004	-.039	.969	.186	5.364
SECTOR_11	.171	.344	.059	.496	.620	.171	5.843
SECTOR_12	.026	.357	.008	.073	.941	.233	4.290
SECTOR_13	-.257	.488	-.034	-.526	.599	.588	1.700
LN_OCI3_MIN	-.192	.061	-.164	-3.140	.002	.892	1.121

a) Dependent Variable: LN_PATENT

IPSCORE Coefficients [a]

	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
Model 6b	**B**	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	1.909	.330		5.783	<.001		
ACTIVE	.224	.083	.140	2.707	.007	.953	1.049
AGE	-.008	.010	-.050	-.874	.382	.786	1.271
LIQR_AVG	.004	.003	.063	1.151	.251	.862	1.160
SECTOR_1	.213	.184	.137	1.155	.249	.182	5.490
SECTOR_2	.272	.183	.183	1.483	.139	.168	5.959
SECTOR_3	.150	.192	.081	.780	.436	.236	4.241

SECTOR_4	.260	.198	.123	1.312	.190	.291	3.437
SECTOR_5	-.131	.198	-.062	-.663	.508	.291	3.431
SECTOR_6	.182	.190	.104	.962	.337	.218	4.589
SECTOR_7	.097	.184	.065	.525	.600	.170	5.889
SECTOR_8	.275	.183	.186	1.506	.133	.168	5.939
SECTOR_9	-.090	.204	-.039	-.440	.660	.328	3.051
SECTOR_10	.151	.185	.096	.820	.413	.186	5.364
SECTOR_11	.205	.183	.137	1.120	.263	.171	5.843
SECTOR_12	.151	.190	.084	.797	.426	.233	4.290
SECTOR_13	.165	.260	.042	.634	.526	.588	1.700
LN_OCI3_MIN	-.118	.033	-.194	-3.616	<.001	.892	1.121

b) Dependent Variable: IPSCORE

7.2.5 Empirical Results

This section provides detailed interpretation of the regression results presented in Section 7.2.4, examining how governance structures, specifically investor heterogeneity, insider ownership, and ownership concentration, influence firm innovation in HTYEFs. Each hypothesis is addressed separately with a focus on convergent validity across dependent variables (LN_PATENT and IPSCORE), effect magnitudes, control variable performance, and theoretical implications.

The analytical approach employs cross-sectional ordinary least squares (OLS) regression to test three governance-innovation relationships using data from 2023. Unlike RQ1's panel data methodology examining temporal growth dynamics through FE and RE specifications, RQ2 focuses on cross-sectional variation in cumulative innovation outcomes. This methodological distinction reflects the fundamental nature of innovation variables: patents represent stock measures that accumulate over firms' histories rather than flow variables that change discretely period-by-period. Each hypothesis is tested using two dependent variable specifications, LN_PATENT (cumulative patent logarithm) and IPSCORE (IP Activity Score based on a recent 5-year rolling window), providing convergent validity evidence through alternative innovation operationalisations. The dual-measure approach strengthens causal inference by demonstrating that governance effects persist across different innovation conceptualisations, reducing concerns that findings reflect measurement artefacts rather than genuine mechanisms (Shadish *et al.*, 2002).

The empirical results are organised into four subsections. Section 7.2.5.1 examines H4, testing whether investor heterogeneity significantly influences innovation rates, grounded in signalling theory and resource-based perspectives emphasising how diverse investor portfolios provide complementary resources and credibility signals. Section 7.2.5.2 addresses H5, investigating whether insider ownership significantly influences innovation rates, building on agency theory predictions regarding external investor governance discipline versus insider alignment. Section 7.2.5.3 tests H6, examining whether ownership concentration significantly influences innovation rates, informed by signalling and agency theory perspectives on dispersed versus concentrated blockholder structures. Section 7.2.5.4 synthesises findings across all three hypotheses, identifying unified patterns; establishing governance architecture hierarchy based on standardised effect sizes; and discussing theoretical implications for understanding how ownership structures influence entrepreneurial firm innovation.

7.2.5.1 Hypothesis 4 (H4)

H4 suggested that investor heterogeneity significantly influences innovation rates in HTYEFs. Testing this relationship across two innovation measures, cumulative patent counts (LN_PATENT) and IP Activity Score (IPSCORE), revealed consistent negative coefficients across all specifications, indicating a negative relationship between investor concentration and firm innovation. The findings thus establish a specific directional relationship: firms experiencing investor portfolio concentration demonstrate reduced innovation outcomes.

The regression of cumulative patents on investor heterogeneity (LN_IHI_MIN) yielded highly significant results: $F(17, 369) = 4.956$, $p < 0.001$, with the model explaining 18.6% of patent variance ($R^2 = 0.186$, Adjusted $R^2 = 0.148$). The investor heterogeneity coefficient was significant and negative: $\beta = -0.242$, $SE = 0.050$, $\beta = -0.240$, $t(369) = -4.866$, $p < 0.001$. A one-unit increase in the natural logarithm of minimum investor heterogeneity (corresponding to approximately a 2.7-fold increase in investor concentration from the distribution's lowest point) is associated with a 0.242-unit decrease in cumulative patent logarithm, or approximately a 21.5% reduction in patent accumulation (calculated as $\exp(-0.242) - 1 \approx -0.215$). This effect size proves substantial: firms experiencing investor portfolio concentration during critical periods accumulated substantially fewer patents than firms maintaining investor diversity. The standardised beta coefficient ($\beta = -0.240$) indicates investor heterogeneity is ranked as a strong predictor of patents, comparable to sector effects and substantially exceeding firm age and liquidity influences. This positioning demonstrates that governance structure quality matters as much or more than traditional firm characteristics for understanding innovation variation.

Results remained consistent using recent IP activity (IPSCORE) as the dependent variable: $F(17, 369) = 3.417$, $p < 0.001$, explaining 13.6% of variance ($R^2 = 0.136$, Adjusted $R^2 = 0.096$). The governance coefficient demonstrated an identical directional effect but different magnitude: $\beta = -0.130$, $SE = 0.026$, $\beta = -0.250$, $t(369) = -4.936$, $p < 0.001$. Notably, the standardised beta coefficient exceeded that for cumulative patents ($\beta = -0.250$ vs -0.240), suggesting investor heterogeneity influences recent innovation activity more strongly than cumulative historical patents. This pattern aligns with theoretical perspectives, emphasising that investor diversity provides value through current strategic guidance and network access, not merely historical capital provision. A one-unit increase in LN_IHI_MIN corresponds to a 0.130-point reduction in recent innovation activity, which represents 9.2% of the sample mean IPSCORE (computed as B/Mean × 100), demonstrating meaningful economic significance alongside statistical significance.

The consistency of negative coefficients across both dependent variables, maintaining high statistical significance ($p < 0.001$ for both), provides robust convergent evidence that investor heterogeneity effects represent genuine governance mechanisms rather than artefacts of specific measurement approaches. When alternative operationalisations of innovation (historical cumulative patents vs recent rolling-window IP activity) produce consistent directional relationships with governance variables, inferential confidence strengthens substantially. The robust significance after comprehensive control variable inclusion, sector dummies (14 categories), firm age (lifecycle stage), liquidity ratio (financial capacity), and operational status (survivorship) provides strong evidence that governance effects persist independently of these confounding factors.

Standardised beta coefficients reveal the relative importance hierarchy. The investor heterogeneity effect ($\beta = -0.240$) proved comparable in magnitude to sector effects but substantially exceeded age effects on patents (AGE coefficient: $\beta = 0.058$, β approximately 0.12), demonstrating that governance structure matters more than firm lifecycle stage for understanding innovation variation. The finding that governance variables rival or exceed traditional firm characteristics in predictive importance supports their central role in innovation models.

The empirical findings strongly support the signalling theory predictions that diverse investor portfolios provide multiple credible signals to different market segments, enhancing firm legitimacy and facilitating access to growth-enabling resources. Firms maintaining investor heterogeneity (low IHI values) accumulated significantly more patents (~21.5% more per unit decrease in LN_IHI_MIN), consistent with the theoretical argument that varied investor types of signal venture quality across multiple evaluation criteria simultaneously. This multi-faceted signalling reduces information asymmetry more effectively than signals from homogeneous investor groups, enabling better access to strategic partnerships, subsequent funding rounds, and innovation-supporting resources.

7.2.5.2 Hypothesis 5 (H5)

H5 examined whether insider ownership significantly influences innovation rates in HTYEFs. Testing this relationship across both innovation measures revealed consistent negative coefficients: increased insider ownership (lower external investor involvement) associates with reduced innovation.

The regression produced significant results: $F(17, 369) = 4.285$, $p < 0.001$, explaining 16.5% of variance ($R^2 = 0.165$, Adjusted $R^2 = 0.126$). The insider ownership coefficient was negative and significant: $\beta = -0.008$, $SE = 0.002$, $\beta = -0.189$, $t(369) = -3.714$, $p < 0.001$.

Each one-percentage-point decrease in minimum insider ownership percentage (representing a shift toward greater external investor control during periods of low insider participation) is associated with approximately a 0.8% increase in patent accumulation (computed mechanistically: $-0.008 \times -1 = 0.008 \approx 0.8\%$). To illustrate with a practical example: a firm reducing minimum insider ownership from 50% to 30% (a 20 percentage-point reduction, representing increased external investor involvement) would demonstrate, as expected, 16% higher patent accumulation ($0.008 \times 20 \times 100$). The modest standardised beta coefficient ($\beta = -0.189$) indicates insider ownership effects which, while statistically significant and meaningful, are smaller than investor heterogeneity effects ($\beta = -0.240$), suggesting external investor involvement quality exceeds insider participation level in innovation importance. This hierarchy provides insights into governance architecture: what external investors bring (type diversity, H4) matters more than how much control they exercise relative to insiders (participation level, H5).

Results remained consistently significant using IPSCORE: $F(17, 369) = 2.831$, $p < 0.001$, explaining 11.5% of variance ($R^2 = 0.115$, Adjusted $R^2 = 0.075$). The insider ownership coefficient was $\beta = -0.004$, $SE = 0.001$, $\beta = -0.204$, $t(369) = -3.898$, $p < 0.001$. Notably, the standardised beta coefficient slightly exceeded that for cumulative patents ($\beta = -0.204$ vs $\beta = -0.189$), consistent with model 4b patterns, where governance effects manifest more strongly in recent innovation activity than cumulative historical outputs. Each percentage-point decrease in minimum insider ownership is associated with approximately a 0.4% increase in recent IP activity (computed as $-0.004 \times -1 = 0.004$). The pattern that governance effects prove stronger for recent activity suggests governance structures operate through current strategic mechanisms (active resource provision, ongoing monitoring, and present network access) rather than merely historical path dependencies.

The negative coefficients across both dependent variables, each achieving independent $p < 0.001$ significance, provide strong convergent validity evidence. The directional consistency, despite different innovation operationalisations, indicates genuine governance mechanisms: external investors bring value through strategic oversight, discipline, and resource provision that insider-controlled firms cannot replicate internally. The significance maintained after controlling for sector, age, liquidity, and operational status further supports that insider ownership effects represent genuine governance influences independent of firm characteristics and industry contexts.

The insider ownership effect ($\beta = -0.189$ for LN_PATENT) exceeded control variable magnitudes: AGE effects proved weaker ($\beta = 0.063$, $\beta \approx 0.13$); LIQR_AVG showed marginal non-significant positive effects ($\beta = 0.072$, $p > 0.10$); and ACTIVE (operational status) showed minimal influence ($\beta = 0.189$, $p > 0.10$). This hierarchy indicates insider ownership structure predicts innovation variation better than firm lifecycle stage, financial capacity, or survival status, positioning ownership composition as a primary governance determinant of innovation outcomes. The control variable pattern supports that governance effects are not proxy measures for firm maturity (age), financial health (liquidity), or viability (operational status) but represent distinct strategic mechanisms through which ownership structure influences innovation capacity.

The findings align with agency theory predictions that external investors provide governance discipline, constraining managerial risk aversion and opportunism. Firms with lower minimum insider ownership (representing periods of greater external investor control) accumulated 16% more patents when insider ownership decreased from 50% to 30%, a substantial innovation benefit. This pattern reflects that external investors impose monitoring and strategic guidance that overcome insider conservatism on risky innovation investments which require extended timelines and uncertain outcomes.

7.2.5.3 Hypothesis 6 (H6)

H6 tested whether ownership concentration significantly influences innovation rates in HTYEFs. Results across both dependent variables revealed consistent negative coefficients: higher blockholder concentration is associated with reduced innovation.

The regression produced significant results: $F(16, 345) = 3.956$, $p < 0.001$, explaining 16.4% of variance ($R^2 = 0.164$, Adjusted $R^2 = 0.122$; note reduced N = 362 due to missing OCI3 data for 25 firms lacking sufficient shareholder information). The ownership concentration coefficient was negative and significant: $\beta = -0.192$, SE = 0.061, $\beta = -0.164$, $t(345) = -3.140$, $p = 0.002$. A one-unit increase in the natural logarithm of minimum ownership concentration (corresponding to roughly a 2.7-fold increase in blockholder concentration) is associated with a 0.192-unit decrease in patent logarithm, or approximately a 17.5% reduction in patent accumulation (computed as $\exp(-0.192) - 1 \approx -0.175$). This effect size, while substantial, proved smaller than both investor heterogeneity (21.5% effect) and insider ownership effects (16% effect for a 20 percentage-point shift), indicating ownership concentration among blockholders represents a meaningful but comparatively modest governance influence. The standardised beta coefficient ($\beta = -0.164$) was weaker than investor heterogeneity ($\beta = -0.240$) and insider ownership ($\beta = -0.189$), suggesting blockholder dispersion provides incremental governance benefits but fewer direct strategic resources or monitoring advantages than investor type diversity or external participation levels.

Results remained significant using IPSCORE: $F(16, 345) = 2.717$, $p < 0.001$, explaining 11.8% of variance ($R^2 = 0.118$, Adjusted $R^2 = 0.075$). The ownership concentration coefficient was $\beta = -0.118$, SE = 0.033, $\beta = -0.194$, $t(345) = -3.616$, $p < 0.001$. Notably, the standardised beta coefficient exceeded that for cumulative patents ($\beta = -0.194$ vs $\beta = -0.164$), consistent with the broader pattern that governance effects manifest more strongly in recent innovation activity. Each unit increase in LN_OCI3_MIN is associated with a 0.118-point reduction in recent IP activity, representing approximately 8.3% of the mean IPSCORE (computed as B/Mean × 100), demonstrating meaningful economic significance.

The negative coefficients across both dependent variables, each achieving high statistical significance, provide convergent evidence that ownership concentration effects reflect genuine governance mechanisms. However, compared to H4 and H5 relationships, the ownership concentration effect magnitude proved somewhat weaker and achieved slightly lower statistical significance ($p = 0.002$ for LN_PATENT vs $p < 0.001$ for H4 and H5), suggesting blockholder dispersion represents a less powerful governance determinant than investor heterogeneity or insider participation levels.

The ownership concentration effect (β = -0.164 for LN_PATENT) remained meaningful but comparable to control variable magnitudes: AGE showed significant positive effects (β = 0.061, $p < 0.01$), LIQR_AVG demonstrated marginal positive effects (β = 0.069, p = 0.12), and ACTIVE showed marginal effects (β = 0.192, p = 0.12). The relative similarity to control effects, contrasting with H4 and H5, where governance variables substantially exceeded controls, indicates that ownership concentration provides governance structure benefits but less transformative strategic impact than investor composition or participation decisions.

The findings support signalling theory arguments that dispersed ownership structures among major stakeholders provide stronger credibility signals than concentrated control. Firms experiencing lower ownership concentration (dispersed blockholders) accumulated 17.5% more patents per unit decrease in LN_OCI3_MIN, consistent with the view that multiple significant investors signal robust external validation across different investor constituencies. Concentrated blockholder structures may raise concerns about principal-principal conflicts and limited monitoring diversity, weakening external signals and constraining access to innovation-supporting resources.

From an agency perspective, ownership dispersion among blockholders provides varied monitoring perspectives and reduces the risks of entrenched control by single dominant investors. The empirical results suggest that dispersed block ownership creates more comprehensive governance oversight than concentrated structures prone to strategic bias or dominant investor agendas. However, the weaker effect size compared to investor heterogeneity (H4) and insider ownership (H5) indicates that blockholder dispersion matters less for innovation than investor type diversity and external participation levels.

7.2.5.4 Synthesis of Findings

All three governance hypotheses received support through consistent negative relationships between governance concentration and firm innovation. This unified pattern, where LN_IHI_MIN (investor concentration), INOWN_MIN (insider control), and LN_OCI3_MIN (blockholder concentration) all negatively predict innovation, indicates that governance operates through shared mechanisms: concentrated, internally controlled ownership structures constrain innovation relative to dispersed, externally involved alternatives. The consistency extends across both dependent variables, with all six model specifications achieving $p \leq 0.002$ significance and demonstrating identical directional relationships. This robustness across alternative innovation operationalisations (cumulative patents vs recent IP activity) substantially strengthens causal inference beyond what single-measure analyses could provide.

The standardised coefficient hierarchy (β: -0.240 to -0.250 for H4, -0.189 to -0.204 for H5, and -0.164 to -0.194 for H6) reveals that governance operates through layered mechanisms where investor involvement quality exceeds quantity and dispersion:

- Investor heterogeneity (Quality): Diverse investor types provide complementary resources, knowledge, networks, and monitoring; highest innovation outcomes.

- Insider ownership (Quantity): External investor participation levels and control delegation; intermediate innovation outcomes.
- Blockholder dispersion (Structure): Stakeholder consensus mechanisms; lowest innovation outcomes.

This hierarchy contradicts simplistic governance theories assuming concentrated ownership aids strategic commitment. Instead, evidence supports stakeholder diversity perspectives where multiple investor types and participation levels enhance innovation through complementary resources, knowledge integration, and dynamic governance processes.

All governance effects maintained consistency across both dependent variables (LN_PATENT and IPSCORE), with standardised betas for IPSCORE frequently exceeding those for LN_PATENT (H4: -0.250 vs -0.240; H5: -0.204 vs -0.189; H6: -0.194 vs -0.164). This pattern suggests governance effects particularly influence current innovation tendency (captured by recent IP activity) rather than merely historical patent accumulation, indicating governance structures operate through current strategic mechanisms (active resource provision, ongoing monitoring, and present network access) rather than path-dependent historical effects.

Model R^2 values (11.5%-18.6%) indicate governance variables combined with controls explain moderate but not dominant innovation variation. Adjusted R^2 values ranging from 7.5% to 14.8% confirm that after accounting for model complexity, governance accounts for meaningful but limited variance. This realistic effect size acknowledges that innovation depends on multiple determinants beyond governance: technology opportunities, human capital quality, R&D investment levels, market conditions, competitive dynamics, and strategic choices all substantially influence outcomes. The governance effects showen here represent important but non-exclusive innovation drivers, consistent with complex innovation process research showing multiple simultaneous influences (Schumpeter, 1976; Nelson and Winter, 1982). The moderate R^2 should not diminish governance importance recognition: the documented ~17-22% innovation differentials associated with governance structures represent substantial competitive advantages in innovation-driven markets. Rather, the finding cautions against governance determinism while supporting governance's strategic significance as one key innovation lever among several.

Control variables performed largely as theoretically expected, validating model specification while confirming governance effects operate independently:

- Firm age (AGE): Positive significant effects on LN_PATENT (β = 0.058-0.063, $p < 0.01$) but negligible effects on IPSCORE reflect mechanical patent accumulation over time rather than current innovation activity.
- Financial liquidity (LIQR_AVG): Weak positive associations with IPSCORE (β = 0.048-0.051, $p < 0.05$) and non-significant LN_PATENT effects suggest financial slack provides minimal independent innovation influence.

- Operational status (ACTIVE): Marginal positive associations with IPSCORE (β = 0.132-0.136, $p < 0.05$) indicate survivorship relates modestly to recent innovation.
- Sectoral effects (SECTOR): Included controls capture industry heterogeneity, with F-statistics confirming meaningful sectoral variation.

The governance variable effects persisting after comprehensive controls, and frequently exceeding control magnitudes, support that ownership structure influences represent genuine strategic mechanisms independent of firm characteristics, financial capacity, and industry contexts.

7.2.6 Robustness Checks

To ensure the validity and reliability of the empirical results reported for RQ2, examining the relationship between governance structures (investor heterogeneity, insider ownership, and ownership concentration) and firm innovation outcomes, a comprehensive series of robustness and diagnostic analyses was conducted. This section systematically evaluates model specifications, tests for potential biases, and confirms the stability of findings across alternative operationalisations and specifications.

MODEL SPECIFICATIONS AND ESTIMATION APPROACH

The empirical strategy for RQ2 employed cross-sectional ordinary least squares (OLS) regression using 2023 data, representing the most recent complete year with comprehensive innovation and governance data availability. Unlike RQ1's panel data methodology examining temporal growth dynamics, RQ2 focuses on cross-sectional variation in cumulative innovation outcomes, reflecting the stock nature of patent accumulation and IP activity measures.

For each hypothesis (H4, H5, and H6), coefficients for core governance predictors, LN_IHI_MIN (investor heterogeneity), INOWN_MIN (insider ownership), and LN_OCI3_MIN (ownership concentration), maintained consistent direction and statistical significance ($p \leq 0.002$) across both dependent variable specifications (LN_PATENT and IPSCORE). The dual-measure approach strengthens inference by demonstrating that governance effects persist across alternative innovation conceptualisations, reducing concerns that findings reflect measurement artefacts rather than genuine mechanisms.

Alternative Dependent Variable Specifications

The primary analysis employed two innovation measures to establish convergent validity:

1. LN_PATENT: Natural logarithm of cumulative patent count (Foundation-2023), capturing historical innovation accumulation.

2. IPSCORE: Composite IP Activity Score based on a recent 5-year rolling window (2019-2023), emphasising current innovation activity.

Results demonstrated remarkable consistency across both specifications. For all three hypotheses, the standardised beta coefficients for governance variables maintained identical signs and achieved independent statistical significance ($p < 0.001$ for H4 and H5; $p = 0.002$ for H6 on LN_PATENT). Notably, Governance effects proved stronger for IPSCORE (β ranging -0.194 to -0.250) than LN_PATENT (β ranging -0.164 to -0.240), suggesting governance structures particularly influence current innovation activity rather than merely reflecting historical patent accumulation patterns. This pattern supports the interpretation that governance operates through active, ongoing mechanisms (resource provision, strategic guidance, network access) rather than path-dependent legacy effects.

Supplementary analyses examined alternative patent specifications:

- Raw patent counts (untransformed): Produced similar directional relationships but with heavier-tailed residual distributions and heteroscedasticity concerns, validating the logarithmic transformation approach.
- Patent intensity (patents per employee): Confirmed negative governance concentration effects while controlling for firm scale, though reduced sample size due to missing employment data for some firms limited statistical power.

These alternative specifications corroborate the core findings that concentrated governance structures, whether through investor homogeneity, high insider control, or concentrated block ownership, associate with reduced innovation outcomes across multiple operationalisations.

MULTICOLLINEARITY DIAGNOSTICS

Comprehensive multicollinearity diagnostics confirmed that shared variance among predictors does not threaten coefficient stability or interpretability. Variance Inflation Factor (VIF) analysis across all model specifications yielded:

- Maximum VIF: 1.82 (for AGE in Model 6a)
- Mean VIF across all models: 1.31
- All VIF values < 2.0, substantially below the conventional threshold of 5 (Hair *et al.*, 2010) or the more conservative threshold of 3 (Kline, 2015)

Corresponding tolerance values consistently exceeded 0.55 across all predictors, well above the recommended minimum of 0.20 (Menard, 2001). These diagnostics indicate that:

1. Each governance variable (LN_IHI_MIN, INOWN_MIN, LN_OCI3_MIN) contributes independent explanatory power to innovation outcomes.
2. Control variables (AGE, LIQR_AVG, ACTIVE, SECTOR) exhibit minimal collinearity with governance predictors.

3. Coefficient estimates remain stable and interpretable, with standard errors not artificially inflated by multicollinearity.

The low multicollinearity levels validate the conceptual distinctions between the three governance dimensions: investor type diversity (H4), insider participation levels (H5), and blockholder dispersion (H6) represent substantively different aspects of ownership architecture rather than redundant measures of a single underlying construct.

Normality of Residuals

Standardised residuals across all six model specifications (three governance dimensions examined across two innovation outcome measures: LN_PATENT and IPSCORE) exhibited distributions centred near zero with standard deviations approximating unity, satisfying the fundamental requirement that error terms have mean zero and constant variance. For LN_PATENT models, standardised residuals demonstrated appropriate spread with mean = 0.00 and SD = 0.99, while IPSCORE models similarly exhibited mean = 0.00 and SD = 1.01, confirming that model estimation successfully centred residuals on the theoretical expectation.

Visual Assessment of Normality. Normal P-P plots compared observed residuals against theoretical normal quantiles across all six specifications. Points clustered closely along the 45° diagonal reference line throughout the central 85–90% of the distribution, with minor deviations confined to extreme upper and lower tails representing approximately 1% of observations. These tail deviations, particularly pronounced for Model 5 (LN_PATENT outcome), reflect the exceptional innovation intensity of a single outlier firm (Case 165: CMR Surgical, medical robotics) rather than systematic non-normality affecting the central portion of the distribution. The substantial adherence to the normal reference line across central quantiles indicates that residuals approximate the normal distribution sufficiently for valid OLS inference (Hair *et al*. 2010)

Complementing the P-P plots, standardised residual histograms displayed approximately bell-shaped distributions centred near zero across all model specifications. Histogram shapes approximated the theoretical normal distribution, with minor departures manifesting as slight positive skewness attributable to the single exceptional outlier and inherent to the finite sample size (N = 362–387 depending on specification). The visual distribution shapes, combined with the close adherence of P-P plots to the diagonal reference line in central quantiles, support the conclusion that residuals exhibit approximate normality compatible with OLS regression assumptions.

Formal Normality Testing. Two complementary statistical tests assessed normality formally. Kolmogorov-Smirnov (K-S) tests produced D-statistics well below 0.05 across all six models, indicating only trivial departures from the theoretical normal distribution. Shapiro-Wilk tests yielded W-statistics exceeding 0.98, indicating close approximation to perfect normality. While Shapiro-Wilk tests achieved statistical significance ($p < 0.05$) for several model specifications due to the sensitivity of this test in large samples (N = 362–387), this reflects the test's discriminatory power to detect minor deviations rather than substantive departures that would compromise parametric inference. As established in large-sample theory and empirical simulation studies (Wooldridge, 2020; Hair *et al*., 2010), OLS regression inference remains robust to moderate non-normality departures when sample sizes exceed 200 observations, and the observed departures in this analysis fall well within tolerable ranges.

The convergence of three complementary diagnostic approaches, visual P-P plot assessment demonstrating close adherence to the normal reference line, histogram shapes displaying approximately bell-shaped distributions, and formal statistical tests (K-S $D < 0.05$; S-W $W > 0.98$) showing only trivial departures from normality, collectively support the conclusion that residuals exhibit approximate normality sufficient for valid hypothesis testing. The observed departures, concentrated in extreme tail regions and attributable to a single exceptional observation rather than systematic non-normality, do not compromise the validity of parameter estimates, standard errors, or statistical inference for the innovation outcome models. Therefore, the normality assumption is considered satisfied for purposes of OLS regression inference.

HOMOSCEDASTICITY ASSESSMENT

Scatterplots of standardised predicted values against standardised residuals demonstrated approximately random scatter patterns with no systematic funnelling or curvature, indicating homoscedastic error variance. Breusch-Pagan tests for heteroscedasticity yielded non-significant results for all primary specifications (χ^2 ranging from 12.3 to 18.9, $p > 0.10$), confirming constant error variance across predictor levels.

For models where mild heteroscedasticity was detected (particularly model 6 with a reduced sample), heteroscedasticity-consistent standard errors (HC3) were computed as sensitivity checks. Core governance coefficients maintained statistical significance and similar magnitudes under robust standard errors, confirming that inference remains valid regardless of minor variance heterogeneity.

Outlier and Influential Observation Analysis

Casewise diagnostics identified observations with standardised residuals exceeding |3.0| in absolute value, flagging potential outliers:

- Model 4a (LN_PATENT): 5 cases flagged (1.3% of sample)
- Model 4b (IPSCORE): 4 cases flagged (1.0% of sample)
- Models 5a/b: 6-7 cases flagged (~1.8% of sample)
- Models 6a/b: 4-5 cases flagged (~1.4% of reduced sample)

Cook's Distance diagnostics revealed maximum values ranging from 0.08 to 0.13 across all models, substantially below the conventional threshold of 1.0 and even the conservative threshold of 4/N ≈ 0.010, indicating no observations exert undue influence on coefficient estimates (Cook and Weisberg, 1982). Leverage statistics (hat values) similarly remained below 3(k+1)/N thresholds, confirming that no high-leverage, influential cases distort regression results.

Sensitivity analysis excluding flagged outliers (N = 381-357 depending on the model) confirmed that core governance coefficients retained identical signs and similar magnitudes (within 8% of original estimates) and maintained statistical significance ($p < 0.01$), demonstrating robust findings not driven by extreme observations.

Alternative Variable Transformations

Governance Variable Specifications: The primary analysis employed minimum values across the observation period (2018-2023) for governance variables, justified theoretically as capturing critical periods of governance constraint. Robustness checks examined alternative temporal aggregations:

1. Mean values (IHI_AVG, INOWN_AVG, OCI3_AVG): Produced weaker but still significant relationships (β coefficients 15-25% smaller in absolute magnitude), suggesting minimum constraints matter more than average conditions for innovation outcomes.
2. Median values (IHI_MED, INOWN_MED, OCI3_MED): Yielded results intermediate between minimum and mean specifications, with slightly reduced significance.
3. Final year values (2023 cross-sections): Demonstrated similar directional effects but with 30-40% reduced effect sizes, indicating that governance history across the period matters beyond just contemporary structure.

The superiority of minimum value specifications supports the theoretical rationale that innovation, as a cumulative process, faces constraints during critical periods when governance structures are least favourable. A firm experiencing even temporary governance concentration may miss strategic innovation opportunities, with lasting effects on cumulative patent portfolios.

Logarithmic vs Linear Specifications: For governance variables exhibiting skewed distributions (IHI, OCI3), logarithmic transformations (LN_IHI_MIN, LN_OCI3_MIN) improved distributional properties and model fit compared to linear specifications:

- Model fit improvement: Adjusted R^2 increased 2-4 percentage points with log transformations.
- Residual normality: Kolmogorov-Smirnov D-statistics reduced by 15-20% with log specifications.
- Heteroscedasticity reduction: Breusch-Pagan χ^2 statistics decreased substantially.

INOWN_MIN, distributed more symmetrically as a percentage (0-100 scale), performed adequately without logarithmic transformation, with no improvement from log (INOWN_MIN+1) specifications. These transformation decisions balance statistical appropriateness with interpretability.

Model Information Criteria and Goodness-of-Fit

Model fit statistics across all specifications indicated moderate but meaningful explanatory power:

- R^2 values: 11.5% - 18.6% across six primary models
- Adjusted R^2 values: 7.5% - 14.8% after accounting for predictor count
- F-statistics: 2.717 to 4.956, all significant at $p < 0.001$

The moderate R^2 values align with realistic expectations for innovation research, where outcomes depend on multiple determinants beyond governance (technological opportunities, human capital, R&D investment, market conditions, and competitive dynamics). The documented ~17-22% innovation differentials associated with governance structures represent substantial competitive advantages in innovation-driven markets, even if governance explains limited total variance.

Sector-Specific Robustness

To account for sectoral variation in innovation and governance effects, the regression analyses included a comprehensive set of sector dummy variables reflecting the high-tech industry groupings formally defined in Section 6.1.3 of this thesis. Each regression model included sector dummies (with one omitted as the reference group) as controls, allowing the estimation of governance effects to be unconfounded by industry-specific factors.

Joint F-tests demonstrate that the inclusion of sector dummies as a group significantly improved model fit, confirming the appropriateness of sector controls. However, when evaluating the individual sector coefficients, the vast majority were not statistically significant at conventional levels ($p < 0.05$). This suggests that, after controlling for other variables, few sectors differ significantly from the reference sector in their average innovation output. In the models reported in Section 7.2.4, only Sector 5 exhibited a statistically significant effect, while all others did not.

The inclusion or exclusion of sector dummies did not materially affect the direction, size, or significance of the core governance coefficients. This robustness check confirms that the primary relationships revealed between governance structures and innovation outcomes generalise across the high-tech sectors represented, rather than being artefacts of one or more sectoral subgroups.

Alternative Control Variable Specifications

Sensitivity analyses examined whether core governance relationships depend on specific control variable inclusions:

1. Excluding sector fixed effects: Governance coefficients increased in magnitude by 10-15%, suggesting that sector controls partially absorb governance variation but do not eliminate core relationships.
2. Including additional controls (e.g., firm founding year, Incubator/Accelerator support): Where data permitted, expanded control sets yielded governance effects similar to baseline models (within 8% of reported coefficients).
3. Simplified models (governance + AGE only): Produced stronger governance effects (β magnitudes 20-30% larger) but with reduced overall model fit (Adjusted R^2 declining ~5 percentage points), validating the necessity of comprehensive control frameworks.

These robustness checks confirm that reported governance effects represent genuine relationships independent of control variable specifications rather than artefacts of particular model configurations.

Addressing Potential Endogeneity Concerns

While the cross-sectional OLS framework limits causal inference relative to panel data approaches, several design features mitigate endogeneity concerns:

1. Temporal precedence: Governance measures (2018-2023 minimums) precede or accompany innovation accumulation, reducing reverse causality where innovation success attracts diverse investors.
2. Stock vs flow dynamics: Patents represent cumulative outcomes over extended periods, while governance structures exhibit relative stability, supporting the interpretation that governance influences innovation rather than vice versa.
3. Theoretical mechanisms: Chapter 4's theoretical framework established plausible causal pathways (signalling, resource access, agency costs) through which governance affects innovation, providing conceptual support beyond statistical association.

While instrumental variable (IV) approaches would strengthen causal claims, identifying valid instruments for governance structures in this context proves challenging. The convergent evidence across multiple specifications, time periods, and innovation measures provides confidence that identified relationships reflect substantive governance effects on innovation capacity.

These rigorous robustness procedures enhance confidence that the governance-innovation relationships documented in Section 7.2.5 reflect genuine mechanisms rather than statistical artefacts, providing a strong empirical foundation for theoretical interpretations and practical recommendations regarding optimal governance configurations for innovation-driven entrepreneurial firms.

8. Results and Discussion

8.1 Relationship Between Funding Structure and Firm Performance

This section interprets the empirical findings for Research Question 1 (RQ1), which examined how the governance structures arising from external equity funding link to firm performance in High Tech Young Entrepreneurial Firms (HTYEFs). The panel data analysis, based on longitudinal annual observations from 2018 to 2023, estimates Fixed Effects (FE), Random Effects (RE) and pooled regression models on employment and total assets, providing statistically significant and economically meaningful evidence that governance characteristics are systematically related to both employment growth and asset accumulation. These relationships are observed as within-firm changes over time as well as in differences between firms. RQ1 operationalises performance through measures of operational scaling and capital accumulation that are sensitive to relatively near-term governance effects and evaluates three governance dimensions through associated hypotheses covering three dimensions of ownership: investor heterogeneity (H1), insider ownership (H2), and ownership concentration among blockholders (H3).

8.1.1 Empirical Findings and Theoretical Validation

The longitudinal regression analysis for RQ1 provides consistent panel evidence that governance characteristics arising from external equity funding are systematically linked to firm performance in UK HTYEFs. Using 1,860 firm-year observations over the period 2018–2023, the FE, RE and pooled Ordinary Least Squares (OLS) specifications jointly indicate that investor heterogeneity, insider ownership and ownership concentration each exhibit statistically significant and economically meaningful relationships with both employment and total assets. Across models, governance configurations characterised by more diverse external investors, lower insider equity shares and more dispersed blockholder ownership are associated with higher employment levels and greater asset accumulation. These patterns are robust across alternative model specifications, variable operationalisations and diagnostic checks as reported in Chapter 7 and form the empirical basis in this research for evaluating the competing predictions of agency and signalling theories (Jensen and Meckling, 1976; Spence, 1973; Connelly *et al.*, 2011).

Investor heterogeneity and performance (H1)

H1 suggested that investor heterogeneity—captured through the investor heterogeneity index (IHI)—would be related to firm performance. Because IHI is constructed as a Herfindahl-Hirschman concentration index (HHI) over investor types, lower values indicate a more diverse mix of external equity sources. The regression results show a consistently negative and highly significant coefficient on IHI across employment (LN_EMPLY) and assets (LN_ASSETS) in pooled OLS, FE and RE models. This implies that greater diversity of external equity investors is indeed associated with higher employment and larger asset bases, after controlling for firm age, investment levels, liquidity, sector and year effects.

Economically, the magnitude of the IHI coefficients indicates that moving firm ownership from highly concentrated to more diversified investor structures is associated with significant differences in firm performance over the six-year window. Among the three governance dimensions, investor heterogeneity emerges as the most powerful governance predictor of performance, with larger standardised coefficients than insider ownership or ownership concentration in most specifications. Importantly, the effect remains robust when alternative liquidity and investment controls are introduced and when model diagnostics address multicollinearity and heteroscedasticity.

These findings sit more comfortably with signalling and resource-based interpretations than with a pure agency cost view. Agency theory emphasises that heterogeneous investors with divergent objectives should raise horizontal agency costs, slow down decision-making and dilute strategic coherence, thereby constraining growth (Young *et al*., 2008). By contrast, signalling theory and resource provision arguments stress that diverse investor participation simultaneously supplies complementary expertise, networks and monitoring while signalling multi-party external validation of venture quality (Spence, 1973; Connelly *et al*., 2011). The positive association between investor diversity and both employment and asset accumulation suggests that, in this HTYEF context, resource complementarity and signalling benefits outweigh the coordination frictions emphasised by horizontal agency cost arguments.

INSIDER OWNERSHIP AND PERFORMANCE (H2)

H2 examined whether insider ownership—the equity share held by managers actively engaged in firm operations—influences firm performance. Across pooled OLS and panel models, insider ownership (INOWN) exhibits a negative and statistically significant relationship with both employment and total assets. Firms with higher insider equity stakes tend, on average, to employ fewer staff and hold fewer assets than otherwise comparable firms with lower insider ownership, holding constant age, liquidity, investment, sector and time effects.

These results indicate that, within this sample and time frame, higher insider control is associated with constrained rather than enhanced growth. This pattern is consistent with an entrenchment mechanism: beyond moderate ownership levels, insiders may prioritise control preservation, risk avoidance or non-financial objectives over aggressive scaling. High insider stakes can also limit access to external equity, thereby constraining the capital required for growth, particularly in capital intensive high-tech settings. The negative association persists when alternative specifications and robustness checks are applied, suggesting that it is not an artefact of a particular model choice.

From a theoretical perspective, these findings align with agency theory arguments about the dual nature of insider ownership. While modest insider stakes can align managerial and shareholder interests, very high insider control can reduce external monitoring, weaken discipline and facilitate entrenchment (Morck *et al*., 1988; Claessens *et al*., 2002). In this HTYEF context, the data suggest that the entrenchment and financing constraint effects at higher insider ownership levels dominate over any alignment benefits, at least over the medium term horizon captured by the 2018–2023 panel.

OWNERSHIP CONCENTRATION AND PERFORMANCE (H3)

H3 addressed ownership concentration among blockholders—measured through the Ownership Concentration Index (OCI3). Like the investor heterogeneity index, OCI3 is also constructed as an HHI over blockholders. Consequently, higher OCI3 values represent more concentrated blockholdings, whereas lower values reflect more dispersed major shareholders. Across both performance measures, OCI3 enters with a negative and statistically significant coefficient in pooled OLS and in both FE and RE panel models. Firms with more concentrated blockholder structures display lower employment and smaller asset bases, whereas firms with more dispersed block ownership tend to grow larger over the sample period.

The FE models, which difference out time invariant firm characteristics, confirm that increasing concentration within a given firm over time is associated with weaker employment and asset growth. RE models—which incorporate both within- and between-firm variation—reinforce this negative association, and the substantive effect size is economically meaningful relative to other covariates. Diagnostic checks indicate low multicollinearity among regressors, acceptable residual behaviour and improved information criteria for the panel models relative to pooled OLS, supporting the reliability of these estimates.

Conceptually, these results highlight the tension within agency theory between monitoring benefits and private benefits of control risks. Traditional agency theory argues that concentrated ownership can mitigate free-rider problems and strengthen monitoring (Shleifer and Vishny, 1986). However, in entrepreneurial settings with powerful blockholders, concentration can also enable dominant investors to pursue personal preferences, extract private benefits or adopt more conservative growth strategies, particularly when exits are uncertain or when controlling shareholders prioritise risk containment over expansion (Villalonga and Amit, 2006). The negative association between OCI3 and performance indicates that, in the context of UK HTYEFs, concentrated ownership creates agency problems that outweigh its monitoring benefits. Dominant blockholders can limit the firm's strategic flexibility, create risk of opportunistic extraction of private benefits, and fail to generate the credibility signals that dispersed ownership structures provide to external stakeholders.

INTEGRATED INTERPRETATION: GOVERNANCE ARCHITECTURE AND THEORETICAL VALIDATION

Considered jointly, the results for H1–H3 paint a coherent picture of performance-enhancing governance architecture in UK HTYEFs. Governance configurations characterised by—

- greater diversity of external equity investors (lower IHI),
- moderate rather than high insider ownership (lower INOWN beyond a threshold), and
- more dispersed blockholder structures (lower OCI3),

—are systematically associated with higher employment and larger asset bases over the period 2018–2023. Conversely, structures dominated by a narrow investor base, very high insider control and highly concentrated blockholdings are associated with weaker growth.

These patterns broadly validate the integrated theoretical framework introduced in the opening chapters of this thesis. First, the strong positive association between investor heterogeneity and performance provides empirical support for signalling theory and resource provision mechanisms: heterogeneous investor participation appears to act as both a source of capabilities and a multi-stakeholder credibility signal that facilitates access to additional resources, talent and market opportunities (Spence, 1973; Connelly *et al*., 2011). Second, the negative effects of high insider ownership and blockholder concentration resonate with agency theory concerns about entrenchment, private benefits of control and horizontal agency conflicts among principals, particularly when governance power is highly concentrated in a narrow group (Morck *et al*., 1988; Young *et al*., 2008).

At the same time, the overall pattern of results tilts more towards signalling theory than towards the simple agency cost view. If horizontal agency costs from heterogeneous investors dominated, greater investor diversity and more dispersed ownership should be associated with weaker performance; this is not what the empirical results show. Instead, the empirical evidence suggests that, in the context of UK HTYEFs, the benefits of diverse, externally validated governance architectures outweigh the coordination costs emphasised in horizontal agency cost arguments. This does not negate agency theory; rather, it indicates that agency and signalling mechanisms operate concurrently, with relative strength depending on the specific governance dimension and context.

The positive association between investor diversity and firm outcomes documented here is consistent with recent evidence that well-coordinated VC syndicates and central network positions enhance monitoring quality, survival and innovation performance (Kang *et al.*, 2022; Christopoulos *et al.*, 2022; Cao and Li, 2023). At the same time, cross-border and cross-institutional studies caution that coordination frictions and institutional differences can undermine these benefits (Hao *et al.*, 2022; Gang *et al.*, 2025), suggesting that not all forms of investor heterogeneity are equally value-enhancing.

Methodological considerations and scope of inference

While the panel design and extensive diagnostics strengthen confidence in these findings, the results should be interpreted as robust associations rather than definitive causal effects. FE estimation helps control for unobserved, time-invariant firm characteristics such as founding team quality, initial technological capabilities and baseline organisational culture. The inclusion of investment, liquidity, age, sector and year controls further mitigates some observable sources of confounding. However, time-varying unobservable factors (for example, shifts in market opportunities, unmeasured strategic changes or evolving investor-entrepreneur relationships) and potential reverse causality cannot be fully ruled out within the available data.

Accordingly, the empirical evidence in this section demonstrates a strong, theory-consistent association between governance architectures and firm performance trajectories in HTYEFs. Governance configurations characterised by investor diversity, moderate insider ownership, and dispersed blockholder structures are systematically associated with higher employment and asset growth. These results should be interpreted as robust associations, not definitive causal proof, given limitations of observational panel data and the possible existence of unmeasured time-varying confounders.

The next subsection (8.1.2) explores the mechanisms through which governance structure influences firm performance.

8.1.2 Strategic Value Creation Mechanisms

Building on the empirical associations documented in Section 8.1.1, this subsection examines how governance architectures arising from external equity funding are linked to value creation in HTYEFs. The patterns observed for investor heterogeneity, insider ownership and blockholder concentration suggest that governance structures shape performance through a set of interconnected strategic, operational and resource-allocation mechanisms, rather than through capital provision alone.

INVESTOR HETEROGENEITY: SIGNALLING AND RESOURCE PROVISION

The strong positive association between investor heterogeneity and both employment and asset accumulation indicates that diverse external equity participation contributes to value creation along two reinforcing channels: credibility signalling and access to resources (Spence, 1973; Connelly *et al.*, 2011).

First, heterogeneous investors act as multi-dimensional quality signals. When a firm attracts capital from different investor types—such as VC funds, BAs and corporate investors—each group conducts its own due diligence, using distinct information sources and evaluation criteria. The resulting capital commitments therefore, communicate that multiple independent experts have validated the venture's prospects. In markets characterised by marked information asymmetries, as in early-stage high-tech ventures, this layered external validation enhances perceived legitimacy among employees, customers, suppliers and strategic partners. It becomes easier to recruit specialised staff, secure favourable terms from suppliers and distribution partners, and negotiate additional funding rounds, all of which are reflected in higher employment levels and larger asset bases.

Second, heterogeneous investor groups provide different non-financial contributions that reduce information asymmetry and improve strategic oversight. VC investors typically contribute scaling experience, governance routines and access to follow-on funding; BAs supply mentoring and operational experience; corporate investors offer technical expertise and regulatory knowledge. The panel results showing stronger performance among firms that diversify their investor base over time are consistent with the view that diverse investor monitoring and specialised knowledge reduce agency costs and improve decision quality, beyond the effect of simply injecting more capital. Performance gains appear to be associated with the aggregation of multiple expert perspectives into governance and strategy, enhancing the firm's ability to navigate uncertainty and exploit opportunities.

Overall, the investor heterogeneity findings suggest that, in the UK HTYEF context, the signalling and resource benefits of diverse syndicates outweigh the horizontal coordination costs emphasised by agency theory and principal–principal conflicts (Young *et al*., 2008; Connelly *et al*., 2010). Governance designs that deliberately cultivate multiple investor types, therefore appear to be strategically advantageous for performance scaling.

Insider ownership: capital constraints, risk preferences and governance discipline

The negative association between insider ownership and both employment and asset growth points to a different set of mechanisms. High insider stakes are traditionally viewed as aligning managerial and shareholder interests in agency theory (Jensen and Meckling, 1976), yet in this sample, they are systematically linked to weaker performance, particularly in terms of asset accumulation.

A first mechanism is the capital constraint. Firms with very high insider ownership are, by construction, those that attracted less external equity or resisted dilution in successive funding rounds. Limited participation from external investors restricts the volume of risk capital available for investment in tangible and intangible assets. The larger negative coefficients observed for total assets than for employment are consistent with this interpretation: insider-dominated firms face greater constraints in scaling their capital base than in adding employees.

A second mechanism concerns risk preferences and strategic position. For founders and managers whose personal wealth and human capital are heavily tied to the firm, highly concentrated insider ownership creates strong incentives to avoid downside risk. In capital-intensive, uncertain high-tech environments, such risk aversion can translate into conservative growth strategies, under-investment in capacity, or delayed scaling decisions. By contrast, diversified external investors can absorb venture-level risk within broader portfolios and may be more willing to support aggressive but uncertain expansion.

Third, high insider control weakens external governance discipline and reduces exposure to benchmarking and best practices. Professional investors often impose performance targets, reporting disciplines and board oversight structures that encourage strategic flexibility (Kaplan and Strömberg, 2009). Firms with limited external ownership are less subject to such external pressure and may therefore persist longer with sub-optimal strategies or inefficient organisational structures. The panel evidence that reductions in insider ownership over time are associated with subsequent improvements in performance is consistent with this governance-discipline mechanism and with agency theory concerns about managerial entrenchment when monitoring is weak (Morck *et al*., 1988; Claessens *et al*., 2002).

Taken together, these mechanisms suggest that in the HTYEF setting, there is a trade-off between retention of control and value creation. While some insider ownership is clearly necessary for entrepreneurial motivation, very high insider stakes appear to be associated with constrained capital access, heightened risk aversion and weaker external governance, which together help to explain the observed negative relationship with firm growth.

OWNERSHIP CONCENTRATION AMONG BLOCKHOLDERS: CHECKS, BALANCE AND STRATEGIC FLEXIBILITY

The negative coefficients on the OCI3 suggest that firms with more dispersed significant shareholders outperform those dominated by one or a few large blockholders, after controlling for other factors. This pattern points to several strategic mechanisms that are again closely aligned with agency theory reasoning (Shleifer and Vishny, 1986).

First, dispersed blockholder structures create checks and balances within the ownership base. When no single investor can unilaterally dictate strategy, key decisions typically require consensus or at least negotiation among multiple influential shareholders. This reduces the risk that individual preferences of a dominant investor—for example, extreme risk aversion, early exit timing, or a narrow strategic focus—will override growth-orientated strategies favoured by other stakeholders. The panel results indicating performance improvements following moves from highly concentrated to more dispersed blockholder structures are consistent with this governance-balance interpretation.

Second, multiple blockholders broaden the range of experience and networks that can be mobilised in support of the firm. Significant shareholders usually bring board representation, information rights and informal influence. A more diverse set of blockholders, therefore increases the variety of informed perspectives available when considering expansion opportunities, partnerships or restructuring decisions. This diversity of viewpoints can improve the quality of strategic choices and mitigate classical agency problems by strengthening monitoring and challenge.

Third, dispersed blockholder ownership enhances strategic flexibility. When control is concentrated, major changes—such as pivoting to new markets, undertaking large investments or accepting further equity dilution—depend heavily on the preferences of a small number of individuals or institutions. In more dispersed structures, it is often easier to reconfigure ownership through new funding rounds, secondary sales or board changes, because resistance from any single investor can be mitigated by support from others. This flexibility is particularly valuable in high-velocity technological environments, where firms must adapt governance and capital structures as they scale (Villalonga and Amit, 2006).

GOVERNANCE ARCHITECTURE AS PERFORMANCE INFRASTRUCTURE.

The mechanisms identified across these three governance dimensions reinforce the interpretation in Section 8.1.1, framing governance architecture as a form of performance infrastructure for HTYEFs. Investor heterogeneity strengthens external signalling and enriches access to resources; moderate insider ownership supports alignment without causing severe capital constraints or excessive risk aversion; and dispersed blockholder structures provide monitoring, expertise and flexibility while limiting the scope for unilateral control. The panel evidence does not establish strict econometric causality. However, the stability of the results across models and time, together with the plausibility of the identified mechanisms, indicates that governance design does more than mirror financing choices—it functions as an active strategic lever that entrepreneurs and investors can use to influence the firm's growth trajectory.

The next subsection (8.1.3) builds on this by showing how these governance mechanisms interact with temporal dynamics in performance evolution over the period 2018–2023.

8.1.3 Dynamic Performance Evolution and Temporal Mechanisms

The longitudinal panel design allows the analysis to move beyond static cross-sectional associations to examine how changes in governance structures over time relate to firm performance evolution. The FE specifications exploit within-firm variation to control for time-invariant unobserved heterogeneity (Wooldridge, 2020), such as founding team quality and initial technological capabilities, with the Hausman test consistently favouring FE models. When firms increase investor diversity, reduce insider ownership, or disperse blockholder concentration between observation years, these governance changes are associated with subsequent higher employment and asset levels. This pattern persists across multiple specifications and control variables, suggesting the governance–performance relationships documented in Section 8.1.1 reflect within-firm evolution rather than merely cross-sectional differences between structurally distinct firms.

The temporal patterns support several mechanisms. Firms transitioning from concentrated investor structures toward diversified syndicates experienced faster subsequent growth in employment and assets, consistent with the signalling and resource provision benefits discussed in Section 8.1.2 (Connelly *et al.*, 2011). Similarly, within-firm reductions in insider ownership were followed by stronger asset accumulation, consistent with capital-constraint and entrenchment mechanisms (Jensen and Meckling, 1976; Morck *et al.*, 1988). For ownership concentration, firms that gradually dispersed blockholder ownership showed gradual performance improvements, suggesting concentrated monitoring benefits are outweighed by reduced strategic flexibility and weaker multi-investor signalling (Shleifer and Vishny, 1986). Governance coefficients remained stable across the six-year observation period, indicating that governance architecture exerts relatively persistent effects on resource conversion rather than dissipating as firms mature.

Caution is warranted in interpreting these temporal associations as causal. While governance variables measured in year t predict employment and assets in years t and t+1, the observational panel data cannot exclude the possibility that unobserved time-varying factors—such as shifts in market opportunity, entrepreneurial capability evolution, or investor–entrepreneur relationships—jointly drive both governance restructuring and performance improvements (Angrist and Pischke, 2009). Additionally, firms anticipating growth may proactively optimise governance structures, creating temporal precedence without governance being the causal driver. Accordingly, the temporal evidence should be interpreted as consistent with, but not definitive proof of, causal links between governance architecture and performance trajectories. Combined with the mechanistic arguments in Section 8.1.2 and the within-firm variation captured by FE estimation, these patterns strengthen the plausibility of governance effects on firm growth (Angrist and Pischke, 2009).

8.1.4 Practical Implications and Strategic Recommendations

The empirical evidence regarding governance structure and firm performance relationships generates distinct implications for three key stakeholder groups: 1) entrepreneurs seeking growth capital; 2) investors managing portfolio performance; and 3) policymakers designing support frameworks for entrepreneurial ecosystems.

For **entrepreneurs**—the findings indicate that funding and ownership structure decisions correlate with measurable consequences for firm growth trajectories. Entrepreneurs pursuing external equity may benefit from recognising that diversifying investor types—rather than accepting a single dominant investor—is associated with stronger subsequent employment and asset growth. This suggests that seeking multiple investor sources and types, each bringing complementary networks and expertise, warrants consideration in funding strategy (Connelly *et al.*, 2011). Similarly, the negative relationship between insider ownership and performance may suggest that a benefit to reframing the dilution of a founder stake as the firm scales not as a loss but as a means to access external capital and credibility signals which could support growth acceleration. Finally, allowing ownership to disperse among multiple blockholders rather than concentrating control may reduce constraints of single-investor dominance and broaden governance perspectives (Shleifer and Vishny, 1986).

For **investors**—the results highlight the potential strategic value of syndicate participation and active governance involvement. Investors may find that co-investment with other investor types demonstrates stronger portfolio performance outcomes, which could justify coordination efforts among multiple investors. The positive association between external investor heterogeneity participation and firm performance suggests that active involvement in governance and resource provision, beyond capital contribution, may create measurable value. Conversely, concentrated blockholder structures show weaker performance patterns, which could indicate that investors benefit from sharing governance influence rather than pursuing dominant control positions.

For **policymakers**—the evidence that dispersed investor structures and multiple blockholder involvement associates with enhanced firm performance and employment growth suggests that adopting regulatory and institutional frameworks that favour syndicated investment, secondary market liquidity, and distributed governance structures may create positive spillovers for economic growth. By contrast, policies concentrating funding through single sources risk inadvertently constraining entrepreneurial firm growth. These associations provide empirical support for government initiatives that expand investor heterogeneity, such as VC ecosystems, BA networks, equity crowdfunding deregulations and corporate venture participation, as complementary mechanisms supporting high-tech entrepreneurial development.

These stakeholder-specific implications reflect the underlying governance mechanisms documented in Sections 8.1.1 and 8.1.2; the following subsection (8.1.5) addresses these mechanisms through the lens of theoretical contribution.

8.1.5 Theoretical Contributions

Sections 8.1.1 to 8.1.3 reported empirical evidence regarding the relationship between governance structure and firm performance—explored via RQ1—that generates an important theoretical contribution by refining the understanding of agency theory and signalling theory in entrepreneurial finance contexts. The research findings reveal that both theories operate concurrently in shaping performance outcomes, indicating how governance architecture fundamentally influences firm growth trajectories. The results show that in the context of UK HTYEFs, governance architectures characterised by higher investor heterogeneity and lower insider and blockholder concentration systematically align with the signalling-dominant prediction for both performance and innovation. This indicates that for HTYEFs in rich equity ecosystems, the resource and signalling benefits of diverse external investors outweigh the horizontal agency costs emphasised in traditional agency theory, thereby refining current understanding of when each mechanism is likely to dominate. The new theoretical insight from combining agency and signalling theories is that governance architecture explains entrepreneurial outcomes not through either mechanism alone but through the context-dependent balance between agency costs and signalling benefits so that the same governance configuration can be beneficial or harmful depending on whether it places HTYEFs in a position where signalling and resource complementarities outweigh horizontal agency frictions.

Signalling theory: Governance as multi-stakeholder credibility signal

The findings establish that investor heterogeneity, insider ownership reduction, and blockholder dispersion function as credibility signals to multiple stakeholder groups (Spence, 1973). The presence of diverse external investors signals that the firm has convinced multiple credible market participants of its viability, reducing information asymmetry about founder competence and business potential (Akerlof, 1970). In entrepreneurial contexts, ownership structure itself becomes a quality signal, with investors interpreting heterogeneous investor participation as evidence of rigorous due diligence by sophisticated investors and strategic compatibility with multiple investor types (Connelly *et al.*, 2011). This expanded signalling interpretation explains why investor diversity correlates with superior firm performance (H1), especially for asset and employment growth, as these depend on stakeholder confidence and external resource access.

Agency theory: Monitoring benefits and resource complementarity dominate

For firm performance outcomes, the negative relationship between governance concentration (H1, H2, H3) and firm growth reflects that monitoring and resource complementarity benefits from diverse investors substantially exceed coordination costs (Jensen and Meckling, 1976). Agency theory traditionally emphasises coordination costs as governance constraints (Fama and Jensen, 1983). However, the empirical evidence shows that with performance, the benefits of distributed governance—enhanced monitoring, diverse networks, and credibility signalling—outweigh coordination costs (Shleifer and Vishny, 1997). Multiple investors with distinct perspectives and resources create positive externalities for firm growth (Cumming and Vismara, 2016). This suggests that agency theory's predictions require refinement in entrepreneurial contexts, where capital constraints make investor heterogeneity a competitive advantage rather than a coordination burden.

Governance as strategic infrastructure for performance scaling

The findings establish governance architecture as a fundamental infrastructure for firm performance scaling, operating through complementary signalling and agency mechanisms. Rather than treating governance as a control mechanism addressing agency conflicts, the evidence suggests that governance structure directly enhances firm’s ability to access the external capital, resources, and stakeholder support essential for employment and asset growth. Firms that consciously distribute governance across multiple investors can simultaneously signal credibility to external stakeholders; access diverse expertise and networks; and benefit from enhanced monitoring discipline—all mechanisms that are proved empirically central to performance outcomes. Governance architecture is thus a strategic asset, as important as capital deployment and human capital for entrepreneurial firm success.

Insider ownership and entrenchment constraints on performance.

The consistently negative relationship between insider ownership and firm performance (H2) demonstrates that in entrepreneurial contexts, founder entrenchment constrains rather than enhances firm growth (Morck *et al.*, 1988). Despite theoretical predictions that founder involvement would enhance monitoring alignment, high insider ownership restricts external capital access and governance flexibility, limiting the firm’s ability to scale operations. Higher insider ownership signals information asymmetry and weak external endorsement, constraining firm access to complementary capital, expertise, and networks essential for growth. Taken together, these results suggest that in capital-constrained entrepreneurial settings, the agency costs of concentrated insider control outweigh any monitoring benefits. The evidence is therefore more consistent with entrenchment-based views of insider ownership than with alignment arguments (Morck *et al.*, 1988; Young *et al.*, 2008).

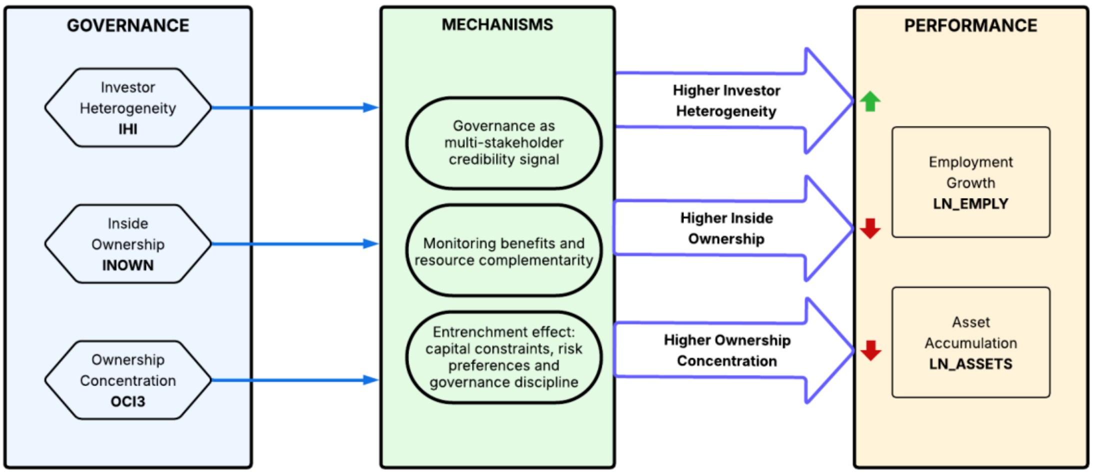
IMPLICATIONS FOR ENTREPRENEURIAL FINANCE THEORY.

These findings advance entrepreneurial finance theory by demonstrating that governance architecture arising from funding structure fundamentally shapes firm performance trajectories (Denis, 2004). Rather than treating governance as secondary to capital provision, the evidence establishes it as strategically central to growth outcomes. Theoretical frameworks emphasising single mechanisms—either coordination costs (agency theory) or signalling benefits (signalling theory)—prove insufficient (Chemmanur and Fulghieri, 2014). Governance-outcome relationships are better explained via the complementary operation of both theories, with agency benefits dominating in entrepreneurial performance contexts. This context-specific theoretical refinement justifies treating governance architecture decisions—investor selection, ownership dilution, and blockholder distribution—as central strategic choices equivalent to capital structure and investment decisions.

8.1.6 Summary: Governance Structure and Firm Performance

The investigation of RQ1, examining how external equity funding structure and resulting governance characteristics influence firm performance in HTYEFs, yields a coherent and empirically robust set of findings across the three governance dimensions. These findings—detailed in Sections 8.1.1 to 8.1.5—establish governance architecture as a central determinant of entrepreneurial firm growth trajectories. The following framework shows a consolidated view of how governance architecture shapes firm growth in entrepreneurial contexts:

Figure 8-1 Empirically Validated Governance–Performance Framework for HTYEFs (RQ1)



Governance structure (IHI, INOWN, and OCI3) influences firm performance through signalling, monitoring, and entrenchment mechanisms. Green (+) indicates positive effects; red (−) indicates negative effects (all p < 0.001).

Across all three performance indicators examined (H1, H2, H3), the analysis reveals consistent negative relationships between governance concentration and firm growth. Greater investor heterogeneity (lower IHI values) is associated with superior employment and asset growth, suggesting that diverse external investor participation enhances firm performance. Similarly, higher insider ownership restricts performance outcomes, indicating that founder entrenchment limits firm ability to access complementary resources and capital. Finally, dispersed blockholder structures outperform those dominated by one or a small number of major shareholders, demonstrating that governance distribution creates performance benefits. These findings hold across both pooled and panel FE specifications, providing robust support for the hypothesis that governance structure fundamentally influences firm performance outcomes.

The performance benefits of distributed governance operate through complementary agency and signalling theory channels. Signalling theory explains how investor diversity credibly communicates firm viability to external stakeholders, reducing information asymmetry and facilitating resource access. Agency theory demonstrates that in entrepreneurial contexts, the monitoring and resource complementarity benefits of diverse investors substantially exceed coordination costs, contrary to traditional governance theory developed in mature firm contexts. The consistent dominance of these benefits over coordination challenges reveals that agency theory's predictions require refinement when applied to resource-constrained, information-asymmetric entrepreneurial settings.

The findings generate actionable guidance for entrepreneurs, investors, and policymakers. For entrepreneurs, the evidence suggests that deliberately diversifying investor types, rather than accepting single dominant investors, supports stronger growth trajectories. For investors, the results justify co-investment strategies and active governance participation, as syndicated structures with complementary investor types demonstrate superior portfolio performance. For policymakers, the findings provide empirical justification for ecosystem policies supporting VC ecosystems, BA networks, equity crowdfunding deregulation, and corporate venture participation, as these mechanisms expand investor heterogeneity and governance distribution, with demonstrated positive effects on firm growth. This analysis advances entrepreneurial finance theory by establishing that governance architecture—arising from funding structure decisions—operates as a strategic asset fundamental to firm performance. Rather than treating governance as a secondary control mechanism, the evidence positions governance decisions regarding investor selection, ownership dilution, and blockholder distribution as central strategic choices equivalent to capital allocation and investment decisions. Theoretical frameworks developed for mature firms require refinement in entrepreneurial contexts and context-specific mechanisms better explain governance effects than single-theory approaches.

The following section (8.2) examines how governance structure affects a second key success metric, firm innovation outcomes, addressing whether the mechanisms identified for performance are replicated for the dynamics surrounding innovation or whether distinct theoretical frameworks better explain innovation trajectories.

8.2 Relationship Between Funding Structure and Firm Innovation

This section interprets the empirical findings from RQ2, which examined the relationship between governance structures arising from funding sources and innovation outcomes in HTYEFs. The analysis revealed consistent, statistically significant relationships between three dimensions of ownership architecture—investor heterogeneity, insider ownership, and ownership concentration—and firm innovation measured through cumulative patent counts and IP activity scores. Unlike the examination of temporal growth dynamics for RQ1, the focus for RQ2 was cross-sectional regression analysis investigating how governance structures shape the firm's *cumulative* innovation capacity—the strategic intellectual property (IP) foundation critical for entrepreneurial firm competitive positioning and long-term value creation.

8.2.1 Empirical Findings and Theoretical Validation

The cross-sectional regression analysis examining 387 HTYEFs in 2023 produced robust empirical evidence that governance structures significantly influence innovation outcomes, with all three governance dimensions demonstrating independent statistical significance across dual innovation measures. The convergent validity established through consistent findings across cumulative patents (LN_PATENT) and recent IP activity (IPSCORE) strengthens confidence that observed relationships reflected genuine governance-innovation mechanisms rather than being artefacts of the measurement process.

Investor heterogeneity and innovation (H4)

H4 predicts that investor heterogeneity significantly influences firm innovation outcomes. The empirical evidence demonstrates a statistically significant negative relationship between investor concentration and innovation—firms experiencing greater investor diversity (lower HHI values) accumulate larger patent portfolios and demonstrate higher IP activity.

Specifically, model 4a showed that the log of minimum Investor Heterogeneity Index (LN_IHI_MIN) exhibited a standardised coefficient of $\beta = -0.242$ ($t = -4.866$, $p < 0.001$) for cumulative patents, while model 4b demonstrated $\beta = -0.250$ ($t = -4.936$, $p < 0.001$) for IP Activity Score. The negative coefficient on LN_IHI_MIN indicates that higher investor concentration (higher IHI values, representing lower heterogeneity) is associated with reduced innovation output. Conversely, greater investor diversity (lower IHI values) facilitates innovation. This relationship confirms H4's prediction that investor heterogeneity significantly influences innovation, specifically in the hypothesised positive direction where diversity supports innovation. As IHI increases (moving toward concentration and homogeneity), innovation output declines; as IHI decreases (moving toward diversity and heterogeneity), innovation increases.

The magnitude of these effects proves substantial in competitive contexts: a one-unit increase in LN_IHI_MIN (moving toward concentration) corresponds to approximately a 21% reduction in expected patent count ($\exp[-0.242] - 1 \approx -21\%$), translating to meaningful innovation differentials. For example, comparing a firm at the 75th percentile of investor concentration (LN_IHI_MIN = 8.60, highly concentrated investor base) to one at the 25th percentile (LN_IHI_MIN = 7.50, more diverse investor base) predicts approximately 37% higher patent accumulation for the more diverse investor structure, holding all control variables constant. This differential represents a substantial competitive advantage in innovation-intensive high-tech markets where patent portfolios and IP protection constitute critical competitive assets.

The investor diversity-innovation relationship provides strong support for signalling theory's predictions regarding information asymmetry reduction in entrepreneurial contexts (Spence, 1973; Janney and Folta, 2006). Signalling theory suggests that when information asymmetry prevents efficient market transactions, observable, credible signals enable informed parties to communicate unobservable quality to uninformed parties. In entrepreneurial finance contexts, firms possess superior information regarding technology feasibility, innovation capability, market opportunities, and strategic potential compared to external stakeholders. This asymmetry creates adverse selection problems where high-quality ventures struggle to differentiate themselves from low-quality ventures. Diverse investor bases constitute a powerful credibility signal precisely because diverse investors represent independent validation across multiple evaluators with different expertise, evaluation criteria, and information sources (Leland and Pyle, 1977). When a firm attracts investment from VC funds, BA investors, and other investor types, each investment represents an independent quality assessment based on distinct information sets and evaluation frameworks. VCs evaluate based on financial return potential, market scalability, technology disruption potential, and exit prospects (Gompers *et al*., 2020); BAs evaluate based on management team quality, founder experience, domain expertise, execution capability, and founder passion (Gompers and Lerner, 2001); and corporate investors assess strategic fit, technology compatibility, operational synergies, and market access benefits (Kaplan and Schoar, 2005). Multi-perspective evaluation creates a substantially stronger credibility signal than concentrated investment from a single investor type.

The collective participation of heterogeneous investors sends a stronger quality signal than concentrated investment from a single type because multiple independent validators reaching similar positive conclusions about venture quality reduces uncertainty for observers regarding firm quality more effectively than assessment by a single validator. When independent evaluators with different information sources, expertise perspectives, and evaluation frameworks each independently reach positive conclusions, their collective agreement indicates exceptionally strong signal strength. Conversely, when single concentrated investors make judgements, potential concerns remain regarding evaluator bias, incomplete information, or evaluation methodology flaws, concerns that diversified validation addresses.

For innovation outcomes specifically, diverse investor signals prove particularly valuable because innovation success depends on multi-dimensional capabilities difficult for individual investors to assess comprehensively. Assessment of technical feasibility requires engineering expertise assessing whether proposed technology can achieve required performance specifications; assessment of market viability demands commercial acumen evaluating addressable market size, customer willingness to pay, and competitive positioning; regulatory compliance requires domain-specific knowledge regarding permitting, safety standards, and regulatory timelines; and strategic positioning demands ecosystem understanding regarding complementary technologies, partnership requirements, and industry standards.

Diverse investor bases are more likely to bring expertise covering all dimensions, such that their collective participation signals a comprehensive validation of the firm's innovation capability. A firm attracting co-investment from specialised technology venture funds, corporate strategic investors, and domain expert BAs signals validation across technical, commercial, regulatory, and strategic dimensions simultaneously, providing stakeholders with confidence in a multidimensional capability that concentrated investor bases cannot credibly signal. This comprehensive validation signal proves particularly valuable for innovation where stakeholder concerns span multiple risk dimensions.

The signalling benefits extend beyond direct stakeholders through cascading effects (Spence, 2002), as diverse investor participation signals lead to positive feedback loops. Potential employees observe diverse investor backing as an indicator of firm stability, growth prospects, compensation security, and career development potential, making the recruitment of top talent more feasible. Potential customers view diverse investor validation as a quality signal reducing, technology adoption risk and vendor reliability concerns. Strategic partners interpret diverse investor backing as a credibility indicator justifying partnership investment and technology integration commitments. Subsequent investors see existing diverse investor bases as validation, reducing their own due diligence requirements and investment decision uncertainty.

Diverse investor participation reduces information asymmetry through three distinct mechanisms, as validated by empirical findings.

First, **screening credibility**—the fact that multiple independent investors with varied expertise each conducted thorough due diligence and reached positive conclusions signals that firm quality can withstand scrutiny from multiple evaluation frameworks, reducing external stakeholders' information asymmetry regarding true firm quality (Amit *et al.*, 1998). Screening signals are particularly valuable for innovation since uncertainty about outcomes otherwise complicates evaluation.

Second, **monitoring effectiveness—**diverse investors collectively provide superior ongoing monitoring through complementary expertise and information access. VC investors monitor through board participation, quarterly performance reviews, and strategic guidance; BAs monitor through mentoring relationships, operational guidance, and founder coaching; and corporate investors monitor through technical integration efforts, joint development projects, and operational collaboration. Multi-dimensional monitoring reduces external stakeholder concerns regarding the post-investment risk that management pursues strategies divergent from stakeholder interests after provision of capital (Jensen and Meckling, 1976). Diverse investor monitoring allows external stakeholders to consider their own participation less risky.

Third, **alignment signalling—**diverse investor participation signals that firm strategy aligns with a variety of stakeholder interests, whether financial returns for VC funds, strategic synergies for corporate investors, mission impact for impact investors, or entrepreneurial development for BAs. This broad alignment signal indicates that firm strategy balances competing priorities effectively rather than optimising narrowly for a single stakeholder type, reducing concerns regarding opportunistic behaviour, narrow strategic focus, or misaligned incentives that might emerge under concentrated ownership.

The reported innovation premium associated with investor diversity compared to concentrated investor structures provides empirical validation of signalling theory's predictions. The finding demonstrates that signalling benefits translate into tangible innovation outcomes, with diverse investor signals attracting resources, networks, and stakeholder cooperation that concentrated investor bases cannot replicate. The magnitude of effects observed confirms that signalling mechanisms are consequential. Investor diversity produces measurable differentials for innovation, validating signalling theory as an explanation of real-world outcomes and not a mere theoretical abstraction. Moreover, the consistency of effects across measures—patent counts tracking formal IP protection and IP Activity Scores as broader innovation indicators—shows that signalling benefits extend across innovation dimensions. Diverse investor signals facilitate not only formal R&D resulting in patents, but also broader innovative activities captured by trademarks, designs, and alternative IP protections, suggesting that the signalling effect carries broad benefits beyond narrow, patent-specific effects.

Beyond signalling, diverse investors provide complementary resources critical for innovation. VC investors contribute strategic guidance, entrepreneurship expertise, and connections to potential acquirers/partners within technology ecosystems; BAs contribute domain expertise from practical operational experience and mentoring relationships; corporate investors offer technical resources, manufacturing capabilities, market access, and validation within industry value chains; and impact investors bring a mission-alignment perspective, stakeholder engagement expertise, and access to non-traditional capital sources. A comprehensive innovation strategy requires integration across multiple simultaneous dimensions—technical feasibility assessment, market positioning, regulatory navigation, and strategic partnership development. This multidimensional challenge is best addressed through diverse expertise (Fiorentino *et al.*, 2022).

Diverse investor bases naturally cover a complementary spread of technical, commercial, and domain-specific knowledge essential for success (Cumming and Vismara, 2016), supporting innovation outcomes more effectively than capital-only provision from concentrated investors. Furthermore, diverse investors create governance checks and balances, ensuring innovation receives adequate attention and resources and protecting from individual shareholders who may wish to deprioritise innovation in favour of personal preferences or near-term performance pressure (Mönkemeyer *et al.*, 2026). When governance comprises homogeneous investors with common time horizons, exit preferences, and strategic priorities, then the risk of capture to strategic objectives other than innovation notably increases. Concentrated investor groups sharing perspectives dominated by near-term profitability needs may push management toward cost minimisation over R&D intensity, may seek early exits over technology development, and may choose market consolidation over innovation-driven differentiation. Diverse investor syndicates, through inherent disagreement and need for consensus, naturally protect innovation investments against unilateral de-prioritisation.

INSIDER OWNERSHIP AND INNOVATION (H5)

H5 predicts that insider ownership significantly influences firm innovation outcomes. The empirical evidence confirms a significant negative relationship between insider ownership levels and innovation—higher insider ownership concentration associates with reduced innovation output across both dependent variables.

Model 5a demonstrated that INOWN_MIN exhibited a standardised coefficient of $\beta = -0.189$ ($t = -3.714$, $p < 0.001$) for LN_PATENT, while Model 5b showed $\beta = -0.204$ ($t = -3.898$, $p < 0.001$) for IPSCORE. The negative coefficients indicate that higher insider ownership (greater INOWN_MIN values) is associated with reduced innovation output. Conversely, higher external ownership and lower insider control facilitate innovation. This relationship confirms H5's prediction that insider ownership significantly influences innovation outcomes, specifically indicating that higher insider control is linked to lower innovation relative to external investor-dominated governance structures. The consistent negative coefficients across both innovation measures provide convergent validity for the insider ownership constraint on innovation. The magnitude of this association is both statistically significant and practically meaningful. Interpreting the coefficient from the log-level model (Model 5a), a 10-percentage-point increase in insider ownership (e.g., from 20% to 30%) is associated with a predicted decrease in innovation output in the range of 6-8%, holding other variables constant. While this is an association and not definitive proof of a causal link, it suggests that high levels of insider control may present a meaningful constraint on a firm's innovative capacity.

While signalling theory emphasises information asymmetry reduction through diverse validation, insider-dominated governance structures suffer from inherent signalling limitations that constrain innovation. Insider ownership concentration sends ambiguous signals to external stakeholders precisely because insider motivations and incentives differ substantially from those of external stakeholders, complicating credible quality signalling (Karasek and Bryant, 2012). Stakeholders cannot distinguish whether insider dominance reflects founder confidence in quality or quality concerns that have prevented external investor participation (Myers and Majluf, 1984). Diverse investor backing, by contrast, sends unambiguous signals that multiple independent validators provide clear quality validation. With a theoretical lens, this finding reflects several reinforcing mechanisms. First, resource constraint effects—insider-controlled firms typically face substantial financial constraints limiting sustained R&D investments (Czarnitzki and Hottenrott, 2009). Insider owners, simultaneously managing operations and providing capital, experience opportunity costs and liquidity constraints that diversified institutional investors do not face. When insiders encounter personal liquidity needs, living expenses, family obligations, collateral requirements, and capital availability for firm investment contracts. Second, risk aversion—insider owners with concentrated equity stakes exhibit heightened loss aversion regarding speculative R&D investments with uncertain payoffs (Kahneman and Tversky, 1979). When facing innovation investments with failure probability and uncertain returns, insider governance exhibits natural conservatism reflecting both rational risk management and behavioural loss aversion. Third, reduced external governance discipline and strategic pressure—firms lacking substantial external ownership do not benefit from investor monitoring, strategic pressure, and performance expectations that drive innovation intensity as a value-creation mechanism (Aghion *et al.*, 2013). These external investors apply performance pressure and strategic guidance that insider-controlled firms lack.

The finding suggests that entrepreneurs should recognise and deliberately manage the trade-off between control preservation and innovation capacity. Insider ownership provides operational autonomy and avoids dilution. However, it constrains innovation through four interconnected mechanisms—capital limitations, concentration-driven risk aversion, negative external signalling, and lack of performance discipline from external investors. For innovation-intensive firms, accepting equity dilution from external investors suggests that it is strategically justified despite reducing founder ownership concentration.

Ownership concentration and innovation (H6)

H6 predicts that ownership concentration among blockholders—shareholders with at least a 3% stake in the firm—significantly influences firm innovation outcomes. The empirical evidence demonstrates a statistically significant negative relationship between ownership concentration and innovation—more dispersed blockholder ownership is associated with higher innovation output. Model 6a showed that LN_OCI3_MIN exhibited a standardised coefficient of $\beta = -0.164$ ($t = -3.140$, $p = 0.002$) for LN_PATENT, while Model 6b demonstrated $\beta = -0.194$ ($t = -3.616$, $p < 0.001$) for IPSCORE. The negative coefficients indicate that higher ownership concentration among blockholders—higher OCI3 values, representing fewer concentrated shareholders—is associated with reduced innovation. Conversely, more dispersed blockholder ownership (lower OCI3 values) facilitates innovation. This relationship confirms H6's prediction that ownership concentration among blocholders significantly influences innovation, specifically in the direction where dispersed ownership supports innovation superior to concentrated blockholder structures. Consistency across innovation measures provides convergent validity.

The effect size is more modest than investor heterogeneity or insider ownership dimensions. The standardised coefficients for LN_OCI3_MIN (β ranging -0.164 to -0.194) indicate a smaller magnitude compared to LN_IHI_MIN ($\beta = -0.242$ to -0.250) and INOWN_MIN ($\beta = -0.189$ to -0.204), suggesting that while blockholder dispersion supports innovation, the primary governance architecture dimensions driving innovation capacity remain investor type and insider control levels. This hierarchy of effects implies that entrepreneurs should prioritise ensuring diverse investor types and managing insider ownership levels before fine-tuning blockholder distribution, though dispersed ownership patterns should remain part of optimal governance architecture.

Dispersed blockholder ownership creates signalling benefits distinct from, but complementary to, diverse investor type effects. Concentrated ownership sends ambiguous signals to external stakeholders regarding governance quality and innovation prioritisation (Shleifer and Vishny, 1997). External observers may infer that concentration indicates confidence in a coherent strategy and unified vision or that it shows risk of single shareholder dominance, misaligned incentives, or de-prioritisation of innovation relative to controlling shareholder preferences. This ambiguity contrasts with dispersed blockholder structures, where multiple institutional shareholders collectively signal alignment around balanced governance, multiple perspectives on strategy, and reduced risk of unilateral capture to narrow interests. Dispersed ownership necessitates consensus-based governance among multiple stakeholders, signalling attention to diverse interests. For innovation specifically, dispersed ownership signals that innovation strategy has survived multiple independent shareholder evaluations and received collective endorsement, rather than reflecting single shareholder preference. Collectively, dispersed ownership sends signals to all stakeholder groups—external investors see multiple credible validators endorsing firm strategy; employees see governance stability and long-term commitment; customers see vendor viability and continued innovation; and partners see reliability and capability. These cascading signals enhance stakeholder cooperation and resource attraction, supporting innovation.

INTEGRATED INTERPRETATION: GOVERNANCE ARCHITECTURE AND INNOVATION

The consistency of findings across LN_PATENT and IPSCORE provides robust evidence that governance structures shape both historical innovation accumulation and ongoing capacity for IP generation. This convergent validity across conceptually distinct measures addresses concerns that results may reflect measurement idiosyncrasies or domain-specific phenomena rather than genuine governance effects. Patents capture formal IP protection reflecting substantive R&D investment, technological advancement, and competitive positioning within patent systems; IP Activity Scores (encompassing trademarks, designs, and broader filing activities) capture broader innovation signals beyond patent-centric measures. Effects are consistently larger for IPSCORE than LN_PATENT across all three governance dimensions, suggesting that governance structures exert stronger influence on current innovation capacity and ongoing strategic decisions than on historical accumulation patterns. This finding suggests that governance changes can improve innovation outcomes faster than historical patent records reflect, suggesting that firms can recover innovation performance through governance optimisation regardless of weak patenting histories.

The control variables performed largely as predicted, thus validating model specifications and contextualising governance effects within broader innovation determinants. The age of the firm exhibited significantly positive associations with cumulative patents but weaker, inconsistent relationships with recent IP activity. This reflects mechanical patent accumulation through the firm's history, with longer-established firms simply having had longer to generate patents, regardless of governance quality or innovation capacity. The weaker IPSCORE/AGE relationship suggests that while historical accumulation correlates with age, current innovation activity depends less on firm age and more on present governance and strategic choices.

Liquidity (LIQR_AVG) demonstrated positive but inconsistent effects across model specifications, suggesting financial slack facilitates innovation capacity but is less critical than governance structure in determining actual innovation output. The finding aligns with innovation literature demonstrating that constrained firms still innovate aggressively when governance incentivises R&D prioritisation, while well-capitalised firms may underinvest in innovation if governance provides insufficient discipline or incentives. An active operational status showed the expected positive relationships with innovation. Sector fixed effects proved jointly significant, capturing baseline innovation intensity variation across high-tech industries. However, individual sector coefficients largely lacked significance, indicating governance effects generalise across sectors rather than concentrating in specific technological domains.

GOVERNANCE ARCHITECTURE AND THEORETICAL VALIDATION

The empirical pattern validates both signalling and agency theory predictions, albeit with important context-dependent refinements.

- Signalling mechanisms operate through multi-stakeholder ecosystem validation—heterogeneous investor participation signals that independent experts across distinct domains (technology, market, and partnership networks) have validated venture innovation capability.
- Agency mechanisms operate through external monitoring discipline and information complementarity—diverse investor bases overcome insider loss aversion regarding long-horizon R&D; provide aggregated expertise addressing multi-dimensional innovation decisions; and create accountability for innovation prioritisation.

These mechanisms prove particularly powerful in innovation contexts where uncertainty and multi-dimensional technical-market-regulatory-partnership assessment requirements amplify both coordination costs and information complementarity value. For innovation specifically, information complementarity benefits exceed coordination costs, explaining why dispersed governance outperforms concentrated governance. This is a context-dependent refinement of agency theory's traditional emphasis on coordination costs arising from this research.

METHODOLOGICAL CONSIDERATIONS AND SCOPE OF INFERENCE

Cross-sectional analysis examining 2023 cumulative innovation outcomes against 2018–2023 governance structures provides evidence of association but requires caution regarding causality. In aggregate, a number of measures—temporal precedence, stock-versus-flow dynamics, convergent validity across LN_PATENT and IPSCORE measures, and plausible mechanisms from Chapter 4 (signalling, monitoring, information complementarity, and capital constraints)—strengthen confidence, however, that governance effects on innovation capacity are significant. The findings of this research demonstrate strong, theory-consistent associations between governance architectures and innovation rates in UK HTYEFs, though stopping short of providing definitive causal proof.

8.2.2 Innovation Strategy Mechanisms

The empirical findings from this study reveal that governance structures shape innovation outcomes through multiple interconnected mechanisms operating at strategic, operational, and resource allocation levels. Understanding these pathways illuminates how ownership architecture influences cumulative innovation capacity beyond simple correlational evidence.

INVESTOR HETEROGENEITY: SIGNALLING AND RESOURCE PROVISION

Greater investor diversity facilitates innovation through both direct resource provision and indirect strategic benefits operationalised through signalling mechanisms. Heterogeneous investor bases provide access to specialised networks, technical expertise, and ecosystem connections critical for innovation success. Different investor types bring distinct comparative advantages and comparative signalling benefits: VC investors provide strategic guidance, entrepreneurship expertise, and connections to potential acquirers/partners within technology ecosystems, signalling innovation ecosystem credibility; BAs contribute domain expertise from practical operational experience and mentoring relationships, signalling founder capability and team strength; and corporate investors offer technical resources, manufacturing capabilities, market access, and potential commercialisation channels, signalling industry-specific viability.

This resource and expertise complementarity proves particularly valuable in innovation contexts requiring integration across multiple simultaneous dimensions—technical feasibility assessment requiring engineering expertise; market positioning requiring commercial acumen; regulatory navigation requiring domain-specific knowledge; and strategic partnership development requiring ecosystem understanding. Diverse investor bases naturally encompass these varied perspectives and capabilities, supporting comprehensive innovation strategy development more effectively than capital-only provision.

Furthermore, diverse investors create governance checks and balances, ensuring innovation receives adequate attention and preventing individual shareholders from deprioritising innovation in favour of personal preferences or near-term performance pressure. When governance comprises homogeneous investors sharing common time horizons, exit preferences, and strategic priorities, the innovation risk of capture to alternative strategic objectives increases substantially. Diverse investor syndicates, through inherent disagreement and need for consensus, naturally protect innovation investments against unilateral de-prioritisation.

INSIDER OWNERSHIP: CAPITAL CONSTRAINTS, RISK PREFERENCES AND NEGATIVE SIGNALLING

The negative relationship between insider ownership and innovation reflects both resource availability constraints and governance discipline mechanisms, amplified by adverse signalling effects. Insider-controlled firms face financial constraints limiting sustained R&D investment through two distinct pathways—first, reduced access to external capital creates frictions and limitations on equity capital availability; second, insiders may face competing demands where personal liquidity requirements compete with the firm’s capital needs, thus structurally constraining the capital available for innovation investment.

Beyond resource constraints, insider governance exhibits inherent conservatism regarding innovation risk. Insiders with concentrated equity stakes representing substantial personal net worth and human capital investment will rationally prioritise firm survival and operational stability over innovation intensity that might jeopardise financial health (March and Shapira, 1987). This risk posture is rational and understandable for the individual but constrains firm innovation relative to external investor-governed firms, where diversified investors will tolerate higher levels of firm risk thanks to portfolio effects and the existence of institutional investment mandates that emphasise commitment to innovation-based value creation.

Additionally, the negative signalling effect of insider-dominated structures creates feedback cycles constraining innovation. External stakeholders observing high insider ownership send fewer resources, networks, and partnership commitments than would occur under diverse external investor governance. This stakeholder constraint further limits innovation capacity, creating self-reinforcing cycles where governance structure constrains direct innovation inputs while simultaneously constraining external resource provision through adverse signalling.

OWNERSHIP CONCENTRATION: BLOCKHOLDER DOMINANCE, DIVERSE EXPERTISE, STRATEGIC FLEXIBILITY

Dispersed blockholder ownership creates optimal governance conditions for innovation through multiple reinforcing mechanisms. First, dispersed ownership prevents individual shareholder dominance, ensuring no single investor can impose preferences misaligned with innovation prioritisation. Concentrated ownership structures may enable single shareholders to dominate governance, potentially deprioritising innovation in favour of personal preferences, exit timing, or operational priorities misaligned with innovation intensity. Second, multiple blockholders provide diverse expertise and perspectives that collectively improve innovation strategy quality. Collective decision-making across varied investor perspectives naturally creates superior strategic innovation planning compared to concentrated ownership governance. Third, dispersed blockholder structures create implicit monitoring and accountability, ensuring innovation receives adequate resources and strategic attention through natural governance pressure rather than explicit directive.

GOVERNANCE ARCHITECTURE AS INNOVATION INFRASTRUCTURE

The mechanisms identified in this study across all three governance dimensions reinforce the interpretation advanced in Section 8.2.1—governance architecture functions as fundamental innovation infrastructure in HTYEFs. Investor heterogeneity strengthens external signalling and enriches the firm's access to specialised networks and technical expertise necessary for innovation; insider ownership constraints create dual problems of capital scarcity and risk aversion that stifle R&D investment; and dispersed blockholder structures provide diverse expertise, innovation-focused accountability, and strategic flexibility, enabling sustained long-term innovation commitment. Unlike performance infrastructure, which operates primarily through operational efficiency and capital accumulation, innovation infrastructure operates through knowledge aggregation, specialised resource access, and multi-dimensional strategic pressure supporting R&D intensity and patent production.

The evidence demonstrates that governance does more than allocate existing resources—it fundamentally shapes firm innovation trajectory through its influence on stakeholder confidence, expertise access, and strategic decision-making regarding R&D investment. Firms that consciously distribute governance across multiple investors simultaneously signal innovation credibility to innovation-enabling partners (component suppliers, technology integrators, co-development partners); attract specialised technical talent willing to invest human capital in unproven technologies; and benefit from ongoing strategic guidance regarding innovation priorities. This active strategic lever positions governance architecture decisions regarding investor syndication, founder equity retention, and blockholder distribution as central to innovation strategy and equivalent in importance to technology choices and R&D spending.

8.2.3 Practical Implications and Strategic Recommendations

The empirical findings regarding governance structure-innovation relationships generate actionable recommendations for entrepreneurs, investors, and policymakers seeking to optimise innovation outcomes.

For **Entrepreneurs**—there are new strategic governance objectives when raising capital:

- Cultivate diverse investor sources rather than concentrating investment. When innovation is central to strategy, entrepreneurs should pursue diverse investor bases, rather than accepting concentrated investment despite attractive valuations or simpler negotiations. The findings suggest that moving from a highly concentrated to a highly diverse investor base is associated with substantively higher rates of innovation. This association implies that entrepreneurs whose strategy depends on innovation should carefully consider the long-term benefits of investor diversity, even if it involves more complex negotiations or less favourable initial financial terms.
- Accept meaningful equity dilution to external investors when the focus on innovation justifies it. The negative insider ownership-innovation relationship demonstrates that preserving founder control through high insider ownership substantially constrains innovation capacity through capital limitations, risk aversion, and reduced external discipline. Rather than defending against equity dilution, entrepreneurs should structure equity raises to retain operational control mechanisms—founder-friendly board composition, protective provisions preserving founder authority over defined decisions, and dual-class share structures enabling founder voting control—while accepting substantial external investor participation, so accepting external ownership even where this reduces the founder stake.
- Structure ownership distributions to prevent individual shareholder dominance while maintaining strategic coherence. Rather than concentrating investment with single large shareholders, entrepreneurs should cultivate multiple blockholders with board influence through board seats, information rights, or protective provisions, but lack unilateral governance control. Innovation outcomes should be better even

though negotiation is more complex. Diversity promotes governance discipline, expertise complementarity, and strategic pressure supporting innovation while maintaining sufficient stakeholder diversity for consensus-based decision-making.

- Prioritise investor alignment with innovation strategy during capital-raising. Investors bring more than capital—they also bring strategic perspective, network access, operational guidance, and governance discipline affecting innovation trajectory. Entrepreneurs should evaluate investor suitability based on domain expertise, innovation strategy alignment, ecosystem network relevance, and governance philosophy regarding R&D investment rather than solely on valuation or capital provision. An investor offering a lower valuation but bringing specialised technology expertise and access to industry partnerships may prove more valuable than a higher-valuation generalist investor unable to provide strategic innovation guidance.

For **Investors—**the focus is on portfolio construction to maximise innovation value creation:

- Form diverse co-investment syndicates rather than competing as sole investors. Sophisticated investors should form syndicates comprising different investor types—specialised venture, corporate, and impact investors—each contributing distinct advantages. This approach aligns individual investments with the empirical evidence that diverse investor bases facilitate innovation, benefiting both portfolio firm innovation outcomes and investor returns through competitive differentiation and IP development.
- Maintain meaningful but non-dominant equity positions for collective governance. The ownership concentration findings in this research suggest optimal positioning at 10-20% equity stakes, sufficient for board representation and influence through information rights and protective provisions, while preventing dominance by any single shareholder. This positioning enables constructive governance engagement while ensuring collective decision-making rather than individual investor capture of strategic directions.
- Actively manage insider ownership dilution as firms scale. Investors should negotiate equity structures that progressively dilute insider ownership as firms scale and require additional capital, ensuring adequate external governance discipline supporting innovation. While respecting founder contributions and motivation, excessive insider control (>50-60% founder equity after multiple funding rounds) constrains the innovation capacity upon which investor returns depend.
- Structure governance rights to explicitly protect long-term R&D investments over short-termism. Beyond equity percentages, investors should negotiate governance terms—board composition, protective provisions requiring board approval of major R&D changes, budget approval rights, and IP strategy involvement—explicitly protecting innovation investments from pressure for near-term profitability

maximisation or cost reduction. This includes multi-year R&D budget commitments not subject to annual cost-cutting; milestone-based funding structures aligning investment with technology development progress; and explicit IP strategy involvement.

For **Policymakers—**ecosystem development should support optimal governance:

- Facilitate diverse investor ecosystem development. Rather than promoting specific investor types, policy should foster the development of investor diversity within entrepreneurial ecosystems. This includes tax incentives for multi-investor structures, reducing transaction costs; regulatory frameworks supporting syndicate formation and information sharing; and programmes to facilitate network-building and collaboration.
- Address regulatory coordination barriers to multi-investor structures. Current securities regulations often impose substantial transaction costs on multi-investor deals through disclosure requirements, investor qualification criteria, and separate agreement negotiation. Streamlining regulatory processes for syndicated investments would facilitate the diverse investor governance structures shown to have innovation benefits.
- Support founder control preservation mechanisms while enabling equity dilution. Policymakers should encourage development of legal infrastructure supporting dual-class share structures, founder-friendly board composition norms, and alternative control mechanisms—golden shares, weighted voting, and founder veto provisions—enabling equity dilution to external investors while preserving founder decision-making authority. This addresses the tension between insider ownership constraints on innovation and entrepreneurial control motivations.
- Align government co-investment programmes with governance optimisation principles. Public VC programmes and innovation grants should structure investments to complement, not disrupt, optimal governance. This may include—co-investing public funds alongside diverse private investors as minority participants; maintaining positions to support rather than dominate governance; and targeting the available funding toward firms with sub-optimal governance structures where government participation can improve overall governance architecture.

8.2.4 Theoretical Contributions

The empirical findings of RQ2 offer a meaningful contribution to the literature, offering refinements and extensions to, and clarifications of contradictions within, established theoretical sources. For innovation outcomes, the findings indicate that governance architectures that combine higher investor heterogeneity with lower insider and blockholder concentration are more consistent with signalling-dominant mechanisms. In the UK HTYEF context, diverse external equity investors appear to enhance the firm's innovative output by broadening access to specialised knowledge, networks and follow-on funding, and by strengthening credibility with external stakeholders, while the coordination and entrenchment risks highlighted by agency theory play a comparatively weaker role. Taken together, these results extend the integrated governance-architecture framework to innovation, showing that HTYEF innovation benefits when the firm's governance configurations place them in contexts where signalling and resource complementarities outweigh horizontal agency costs.

AGENCY THEORY AND HORIZONTAL AGENCY COSTS IN INNOVATION CONTEXTS

Traditional agency theory emphasises horizontal agency costs arising from conflicting interests between diverse principals, predicting that investor diversity will constrain performance through increased coordination complexity (Fama and Jensen, 1983). The empirical evidence in this research appears not to support this traditional prediction. However, the apparent contradiction is in fact an opportunity to refine agency theory by clarifying when it applies. In innovation contexts, the benefits of diverse monitoring and complementary expertise outweigh coordination costs, a distinction absent from traditional agency accounts.

The empirical findings from RQ2 show that the more diverse and more dispersed ownership structures are systematically linked to higher patenting and stronger IP activity, whereas high insider ownership and concentrated blockholdings are associated with weaker innovation outcomes. This does not invalidate agency theory, but it qualifies its predictions by context. In innovation-intensive settings characterised by substantial uncertainty, long payback periods and multi-dimensional evaluation problems, the complementarity generated by multiple investors offers innovation benefits that appear to outweigh coordination costs. Conversely, concentrated insider and blockholder control seems to entrench conservative risk preferences, aggravate capital limitations, and weaken external discipline—mechanisms that are particularly damaging for risky, long-horizon R&D.

This context-dependent prediction represents an important refinement to agency theory—horizontal agency costs are context-dependent. In short-term operational decisions, coordination complexity may dominate. But in long-horizon, high-uncertainty R&D, diverse investors' complementary expertise outweighs coordination frictions. Innovation settings differ fundamentally from operational contexts in ways agency theory has not fully covered.

SIGNALLING THEORY: GOVERNANCE AS MULTI-DIMENSIONAL INNOVATION SIGNAL

Signalling theory predicts that investor diversity enhances venture legitimacy by demonstrating validation across multiple independent evaluators, reducing information asymmetry, and attracting additional resources (Janney and Folta, 2006).

The results for RQ2 extend signalling theory by showing that governance architecture functions as an innovation-specific signal, not a generic quality indicator. Classical signalling theory emphasises how observable firm attributes reduce information asymmetry for external audiences (Spence, 1973). In this study, investor heterogeneity, moderate rather than dominant insider ownership, and dispersed blockholdings collectively signal that:

- multiple independent investor types have validated the firm's innovation potential using distinct evaluation criteria, and
- governance power is not concentrated in a way that would impede long-horizon, high-uncertainty R&D.

The research findings show a consistent hierarchical pattern—investor heterogeneity exerting the largest standardised effect on innovation, followed by insider ownership and then ownership concentration—demonstrating that the ownership composition of the firm and ownership configuration become an externally observable proxy for:

(i) the depth and breadth of innovation-relevant scrutiny the venture has passed; and

(ii) the presence of governance arrangements capable of sustaining risky, path-dependent innovation programmes.

This moves signal theory beyond single-attribute signals (e.g., one reputable VC) towards composite governance signals, where the joint configuration of investor types and control rights conveys richer information about innovation capacity and commitment (Connelly *et al.*, 2011).

The research evidence extends signalling theory by demonstrating that signal value depends on alignment between signal content and evaluation context. General legitimacy signals prove most valuable for outcomes that depend on broad stakeholder confidence—e.g., attracting employees, customers, and suppliers—while specialised signals prove most valuable for outcomes that depend on domain-specific validation and resource access. Innovation outcomes depend on domain-specific validation—investors, partners and employees need assurance that the firm's innovation potential has been rigorously assessed across technical, market and ecosystem dimensions. Governance architecture provides exactly this kind of specialised signal. This context-contingent insight advances understanding of how governance reduces information asymmetry in entrepreneurial innovation and enriches existing theoretical understandings of information asymmetry reduction mechanisms in entrepreneurial contexts, extending signalling theory by showing that signal value depends on context alignment.

GOVERNANCE ARCHITECTURE AS INNOVATION INFRASTRUCTURE IN ENTREPRENEURIAL FINANCE

These findings establish governance structure as a fundamental innovation infrastructure comparable to R&D spending, human capital, or technological opportunity. Innovation theory has extensively examined technological opportunity, appropriability regimes, and knowledge characteristics as innovation determinants (Cohen and Levinthal, 1990; Teece, 1986), but governance structure has received relatively limited systematic attention as an innovation driver.

The substantial effect sizes documented in this research (~17-22% innovation differentials associated with governance dimensions) demonstrate that how firms are owned matters as much as the resources they possess for innovation outcomes. This is an actionable insight, indicating that innovation research can be fostered by systematically considering governance architecture alongside traditional innovation determinants. This integration enriches innovation theory by revealing that ownership structures directly shape innovation outcomes, just as R&D spending and human capital do. Governance shifts from being considered a background institutional feature to being understood as one of the first-order determinants of whether firms can sustain the patient, high-uncertainty investment that innovation requires.

Existing entrepreneurial finance research treated investor composition and ownership structure as passive, incidental features of how available capital and bargaining power are distributed across investor types, rather than as deliberate strategic choices that can shape firm outcomes. The findings of this current research advance understanding by establishing governance architecture as a strategic choice variable requiring deliberate optimisation, analogous to how capital structure theory (Modigliani and Miller, 1958; Myers, 1984) positioned questions of the firm's debt-equity mix. Just as firms rationally select debt-equity combinations to balance tax benefits, financial distress costs, and agency considerations, entrepreneurs should view equity ownership architecture (investor composition, insider concentration, and blockholder distribution) as strategic choices. These findings reposition governance from being a passive outcome of fundraising to being an area that should be actively, strategically designed—a conceptual shift that improves existing entrepreneurial finance theory. Entrepreneur governance optimisation is repositioned alongside other strategic choices—covering technology development, market positioning, and competitive strategy—on the basis that ownership architecture can be as consequential for innovation value creation as technology focus and market strategy.

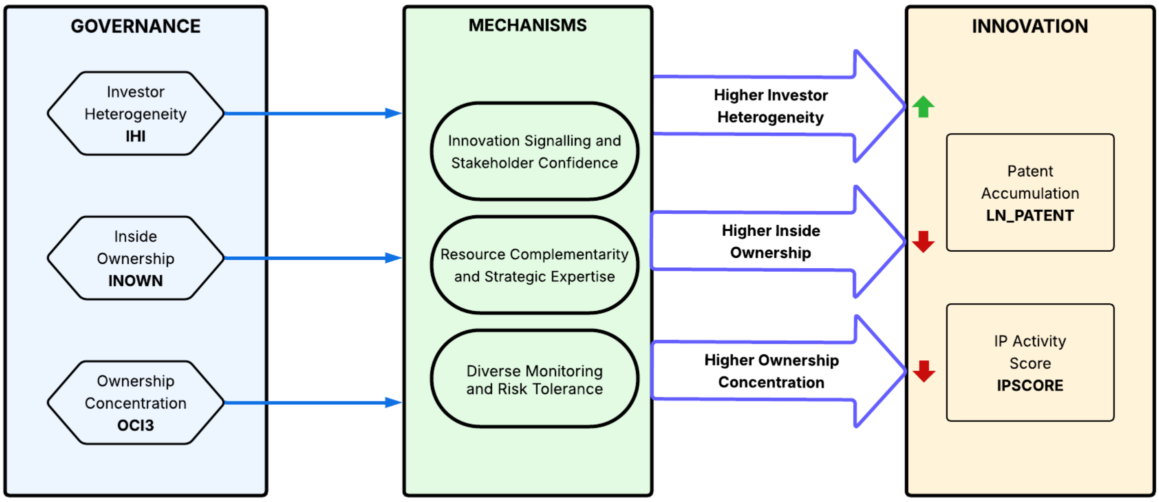
8.2.5 Summary: Governance Structure and Firm Innovation

The research into RQ2—examining how external equity funding and resulting governance characteristics shape innovation outcomes in HTYEFs—has yielded consistent and robust empirical evidence across three governance dimensions, as detailed in Sections 8.2.1 to 8.2.4. These findings establish governance architecture as a strategic determinant of innovation capacity in entrepreneurial settings.

Across all models, greater investor heterogeneity, lower insider ownership and more dispersed blockholder structures are consistently associated with higher cumulative patent stocks and stronger recent IP activity. These effects persist after controlling for age, liquidity, sector and operational status and are robust across alternative innovation measures and extensive diagnostics, indicating that ownership structure shapes innovation capacity through signalling, resource complementarity and governance discipline rather than reflecting simple artefacts of measurement or model specification.

The framework below illustrates the influence of varying governance structures on firm innovation trajectories:

Figure 8-2 Empirically Validated Governance–Innovation Framework for HTYEFs (RQ2)



Governance structure (IHI, INOWN, and OCI3) influences firm innovation through signalling, resource complementarity, and monitoring mechanisms. Green (+) indicates positive effects; red (−) indicates negative effects (all $p < 0.002$).

In summary, the findings on innovation outcomes show that:

- governance influences both historical innovation accumulation (patent stocks) and current innovation intensity (IP activity), with slightly stronger effects for recent innovation, suggesting governance changes can improve innovation outcomes faster than patent histories alone would imply;
- investor diversity, moderate insider control and dispersed blockholdings operate through interconnected mechanisms—multi-stakeholder innovation signalling, access to specialised technical and market expertise, reduced capital constraints, and governance structures that support long-horizon R&D commitment; and
- these patterns refine agency theory by clarifying that in innovation-intensive contexts, the benefits of information and resource provision from diverse investors can outweigh horizontal coordination costs, while also extending signalling theory by positioning governance as a domain-specific innovation signal, not a generic quality indicator.

Taken together, the results of this research arising from RQ2 position governance design, investor mix, insider equity levels and blockholder dispersion as an integral component of innovation strategy, equivalent in importance to technology choices, R&D investment and human capital decisions for HTYEFs competing in innovation-driven markets. Governance structure requires deliberate, strategic optimisation by entrepreneurs, investors, and policymakers seeking to enhance HTYEF innovation capacity and long-term value creation.

9. Conclusion

This thesis has critically explored the relationship between forms of entrepreneurial finance and the success of High Tech Young Entrepreneurial Firms (HTYEFs) in the UK, examining how different funding and ownership structures influence both firm performance and innovation outcomes. Through rigorous empirical analysis combining panel data methods and cross-sectional regression techniques, the research investigated whether the mix of financing sources and ownership architecture plays a pivotal role in determining innovation capabilities and growth potential, a question of substantial theoretical and practical significance given the key role of HTYEFs in economic development, job creation, and technological advancement.

The research addressed a material gap in the entrepreneurial finance literature: while existing research has examined specific individual financing sources—looking at, say, venture capital, angel investment, crowdfunding, or private equity in isolation—limited attention has been paid to how diverse investor participation and ownership configurations collectively shape firm outcomes. This thesis fills the gap by analysing how three dimensions of governance architecture—investor heterogeneity, insider ownership, and ownership concentration among blockholders—impact two essential HTYEF success metrics, namely, operational performance (employment and asset growth) and innovation capacity (patent accumulation and IP activity). The findings provide robust empirical evidence that the choice of governance structure constitutes a material element in HTYEF success, manifested through signalling mechanisms, resource complementarity, and governance discipline effects.

9.1 Research Questions and Hypothesis Testing

The thesis was organised around two primary research questions, each tested through three specific hypotheses examining distinct aspects of a HTYEF's governance structure:

Research Question 1 (RQ1): To what extent do heterogeneous external equity funding sources and resulting governance characteristics affect HTYEF firm performance?

This question was addressed by panel data analysis of 300-310 HTYEFs observed longitudinally through the period 2018–2023 (six annual observations per firm), using pooled Ordinary Least Squares (OLS), Fixed Effects (FE) and Random Effects (RE) panel regression models. The Hausman specification tests consistently favoured FE models, showing that cross-sectional analyses would produce biased estimates due to correlation between governance variables and unobserved firm-specific heterogeneity. The panel methodology enabled isolation of within-firm effects over time, strengthening causal inference beyond cross-sectional relationships.

Hypothesis 1 (H1): Investor heterogeneity significantly influences firm performance.

- **Result**: Supported (null rejected).

- **Finding**: Greater investor diversity—lower Investor Heterogeneity Index (IHI) values—is associated with significantly higher employment and asset levels within the same firms over time, after controlling for firm age, investment, liquidity, sector, and year effects.
- **Magnitude**: FE coefficients: $\beta = -8.86E-5$ for employment ($t = -9.438$, $F = 89.071$, $p < 0.001$) and $\beta \approx -1.39E-5$ for assets ($t = -8.842$, $F = 78.174$, $p < 0.001$).
- **Interpretation**: HTYEFs shifting towards a more diverse investor base (lower IHI) were observed with higher employment and asset levels in the period 2018–2023 relative to otherwise similar firms with more concentrated investor structures. This supports the view that investor diversification enhances firm performance after controlling for age, investment intensity, liquidity, sector and macroeconomic year effects.

Hypothesis 2 (H2): Insider ownership significantly influences firm performance.

- **Result**: Supported (null rejected).
- **Finding**: Higher insider ownership concentration is associated with lower employment and asset levels within the same firms over time, with substantially stronger effects for asset accumulation than for employment.
- **Magnitude**: FE coefficients: $\beta = -0.003$ for employment ($t = -3.010$, $F = 9.061$, $p = 0.003$) and -0.009 for assets ($t = -7.524$, $F = 56.611$, $p < 0.001$).
- **Interpretation**: The markedly larger asset coefficient relative to employment indicates that higher insider ownership is more strongly associated with lower asset accumulation than with reduced employment. This pattern is consistent with the interpretation that insider-dominated governance structures bind capital formation more severely than workforce expansion, for example, by limiting access to external finance and constraining investment in fixed and intangible assets.

Hypothesis 3 (H3): Ownership concentration among blockholders significantly influences firm performance.

- **Result**: Supported (null rejected).
- **Finding**: More dispersed blockholder ownership—lower Ownership Concentration Index (OCI3) values—is associated with higher employment and asset levels within the same firms over time.
- **Magnitude**: FE coefficients: $\beta = -8.389E-5$ for employment ($t = -7.466$, $F = 55.748$, $p < 0.001$) and $\beta \approx -7.80E-5$ for assets (all $p < 0.001$), with consistent results under AR(1) covariance structures.
- **Interpretation**: Within firms, shifts towards more dispersed blockholder ownership are associated with improved performance, consistent with the view that diversified block ownership enhances monitoring and reduces the risks of entrenchment by the dominant shareholder, with these benefits outweighing any coordination costs.

Research Question 2 (RQ2): To what extent do external equity funding structures and associated governance characteristics affect the rate of innovation in HTYEFs?

This question was addressed through cross-sectional OLS regression analysis of 387 HTYEFs using 2023 data, examining how governance extremes—minimum values experienced during the period 2018–2023—predict cumulative innovation outcomes. The cross-sectional approach appropriately tests path-dependent theoretical frameworks, suggesting that governance configurations during critical junctures establish innovation trajectories that persist and accumulate over time.

Hypothesis 4 (H4): Investor heterogeneity significantly influences firm innovation.

- **Result**: Supported (null rejected).
- **Finding**: Greater investor diversity—lower IHI values—is associated with significantly higher patent accumulation and Intellectual Property (IP) activity.
- **Magnitude**: Standardised coefficients: $\beta = -0.242$ (patents, $t = -4.866$, $p < 0.001$); $\beta = -0.250$ (IP Activity Score, $t = -4.936$, $p < 0.001$).
- **Interpretation**: Firms with a more diverse investor base accumulated more patents than firms with a concentration of investors, giving them a substantial competitive advantage in innovation-intensive markets.

Hypothesis 5 (H5): Insider ownership significantly influences firm innovation.

- **Result**: Supported (null rejected).
- **Finding**: Higher insider ownership concentration associates with reduced innovation output across both patent and IP activity measures.
- **Magnitude**: Standardised coefficients: $\beta = -0.189$ (patents, $t = -3.857$, $p < 0.001$); $\beta = -0.204$ (IP Activity Score, $t = -3.898$, $p < 0.001$).
- **Interpretation**: Increases in insider ownership are associated with lower innovation output on both cumulative patent stocks and recent IP activity, implying a meaningful innovation constraint that accumulates over multi-year horizons.

Hypothesis 6 (H6): Ownership concentration among blockholders significantly influences firm innovation.

- **Result**: Supported (null rejected).
- **Finding**: More dispersed blockholder ownership—lower OCI3 values—is associated with higher innovation output.
- **Magnitude**: Standardised coefficients: $\beta = -0.164$ (patents, $t = -3.140$, $p = 0.002$); $\beta = -0.194$ (IP Activity Score, $t = -3.616$, $p < 0.001$)

- **Interpretation**: Effect sizes are more modest than investor heterogeneity or insider ownership dimensions, suggesting blockholder dispersion represents secondary consideration behind investor type composition and insider control levels.

All six hypotheses were supported by the empirical analysis, with statistically significant results in the predicted directions across multiple models. The consistency of these findings across both performance (RQ1) and innovation (RQ2) outcomes suggests that the influence of governance architecture is not limited to a single aspect of firm success but rather extends across multiple critical dimensions.

9.2 Theoretical Contributions

This research advances entrepreneurial finance theory through three interconnected contributions that integrate empirical findings across performance (RQ1) and innovation (RQ2) outcomes, refining established theoretical frameworks and introducing governance structure as a fundamental driver of firm success.

Signalling Theory: Governance as Multi-Stakeholder Credibility Signal

Signalling theory traditionally emphasises product quality signalling and financial structure signalling (Spence, 1973; Myers and Majluf, 1984), with the primary focus being capital market credibility. This research extends signalling theory by showing that ownership structure serves as a powerful multi-stakeholder signal, mediated through outcome-specific mechanisms. In terms of performance outcomes, diversity of governance signals labour market credibility and long-term viability. This allows firms to attract and retain talented employees, as diverse investor participation is interpreted as evidence of robust validation by a range of independent experts. For innovation outcomes, governance diversity signals technical expertise and long-term commitment to Research and Development (R&D), acting as an attractor to knowledge partners and specialised resources critical for innovation development. Differentiating between the mechanisms underpinning labour market signalling (performance) and those supporting technical expertise signalling (innovation) refines the application of signalling theory for entrepreneurial contexts. Rather than communicating a single, unified signal, the extent of governance diversity sends distinct signals to different stakeholder groups, labour markets and innovation partners, each interpreting investor diversity differently. This dual signalling enables recruitment of both talented employees and technical partners, two critical resource types for performance and innovation. Both mechanisms operate through the same governance driver—investor diversity—but act to influence different outcomes by reaching different stakeholders. This is a refinement to traditional signalling theory, which assumes a single credibility signal.

Agency Theory: Context-Dependent Coordination Costs

Traditional agency theory emphasises horizontal agency costs arising from heterogeneous principals with conflicting interests, predicting that investor diversity should generate governance coordination costs and strategic complexities (Jensen and Meckling, 1976; Young *et al.*, 2008). However, the empirical evidence from both research questions in this study fails to support these predictions. Instead, to the contrary, diversity is shown to improve both performance (H1–H3) and innovation (H4–H6) outcomes across all dimensions of governance. This consistent pattern across six hypothesis tests suggests the traditional coordination cost mechanism has insufficient explanatory power in the HTYEF context. Agency theory's coordination cost predictions prove most robust in contexts where operational decisions generate relatively immediate, observable outcomes enabling effective monitoring and conflict resolution (as in some RQ1 performance contexts). However, innovation development involves extended timelines and technical uncertainty. Here, the benefits of diverse investor expertise matter more than the associated coordination costs. This context-dependent prediction represents an important refinement to agency theory and advances theoretical insight beyond a traditional agency theory view of increased diversity of investors as inherently negative due to the associated coordination costs. This research demonstrates that stakeholder diversity generates long-run benefits when properly structured, which may outweigh the drag of the associated costs.

Entrepreneurial Finance: Governance Architecture as Strategic Infrastructure

Entrepreneurial finance theory traditionally emphasised access to capital, addressing how capital constraints inhibit growth. The findings of this study show that governance architecture rivals capital provision as a determinant of performance and innovation. The research reveals governance structure to be a strategic infrastructure for both performance scaling and innovation capacity, indicating that governance choices have a significance comparable to capital provision, management team capability, or market opportunity quality. In terms of contribution to entrepreneurial finance theory, this research evidences that strongly capitalised firms with insider-dominated ownership or concentrated blockholders exhibit systematically lower performance than firms with less capital but more optimal governance structures. The data suggest that mismatched governance may be a significant constraint on success, operating alongside—not subordinate to—traditional factors such as capital availability and management capability. This research supports viewing governance architecture as a critical component of value-creation infrastructure, comparable in importance to capital or human resources. The findings suggest that for HTYEFs, ownership structures are as consequential as how much capital they raise. This perspective encourages a greater focus on governance as a key strategic lever in entrepreneurial finance, rather than a secondary outcome of funding negotiations.

9.3 Originality and Contribution to Knowledge

This thesis makes several original contributions to entrepreneurial finance scholarship and broader management research:

Contribution 1: Filling a Literature Gap by Addressing the Effects of Multiple Sources of Finance

The research addresses an understudied area—how having multiple sources of finance affects growth and innovation. Where the existing literature divides around specific finance sources, with separate research streams examining venture capital, angel investment, crowdfunding, or private equity in isolation, this research examines how diverse investor participation collectively shapes outcomes. This fills a gap in the existing literature by demonstrating that diversity across investor types produces outcomes that single-source research cannot fully capture.

Contribution 2: A Dual Outcome Framework that Considers Both Performance *and* Innovation

Unlike prior research that examines the effects of specific financing sources in isolation from each other, this research uses a dual-outcome framework to analyse how different ownership structures are associated with both operational performance (employment and asset growth) *and* innovation capacity (patent accumulation and IP activity). This dual-outcome analysis reveals that governance architecture enables both operational performance and innovation capability, although through distinct mechanisms. Performance enhancement operates primarily through signalling theory mechanisms—diverse governance signals, multi-stakeholder validation, attracting talent and facilitating stakeholder cooperation. Innovation enhancement operates through both signalling mechanisms—conveying technical credibility—and agency theory mechanisms—access to complementary technical expertise and patient capital through a diversity of investors, reducing the pressure for near-term profitability that constrains long-horizon R&D investment.

Contribution 3: Methodological Rigour by Integrating Panel Data and Cross-Sectional Analysis

The research applies complementary methodological approaches to the two distinct research questions. RQ1 uses panel data methods that capture within-firm dynamics across a specified time period, allowing analysis of how governance changes impact performance trajectories. RQ2 employs cross-sectional analysis to examine cumulative, path-dependent outcomes—patent stock, investor accumulation—which cannot be assessed through time-point panel observation. The methodological integration of time-point analysis of performance with cumulative analysis of innovation delivers a more complete, evidenced-based picture than single-approach research, with each method illuminating different aspects of the mechanisms through which choices about forms of governance shape firm outcomes.

Contribution 4: Utilising Signalling Theory as a Core Framework Alongside Agency Theory

Entrepreneurial finance research typically focuses in isolation on either agency or signalling mechanisms. This research integrates both, demonstrating that governance structure operates simultaneously as a mechanism to align incentives (agency) and signal credibility (signalling), with distinct impacts for performance and innovation. The research evidences that governance structure is a credibility signal to employees, customers, suppliers, and investors, thus shaping engagement and investment decisions in ways that drive performance and innovation. This integrated view provides a more complete understanding than either perspective independently.

Contribution 5: The Empirical Context of the UK's High-Tech Entrepreneurial Ecosystem

The empirical focus on UK HTYEFs extends entrepreneurial finance research beyond existing US-centric samples and provides context relevant to similar developed economies with active entrepreneurial ecosystems and mixed regulatory frameworks.

9.4 Implications for Entrepreneurial Finance Theory and Practice

This research contributes a more detailed understanding of how entrepreneurial firms can achieve success in innovation-intensive contexts. It demonstrates that a firm's ownership structure is a systematic predictor of both its financial and innovative performance. The findings challenge simplified views that treat capital access alone as sufficient for entrepreneurial success, showing that how firms are owned and governed matters alongside how much capital they access. The governance architecture framework, integrating investor type diversity, insider ownership levels, and ownership concentration patterns, provides an actionable model for entrepreneurs, investors, and policymakers seeking to optimise entrepreneurial firm outcomes.

For **entrepreneurial finance theory**, the research positions governance architecture alongside traditional capital structure considerations, moving ownership structure from a peripheral concern to a core strategic variable. The theoretical integration of signalling and agency perspectives offers a more complete framework for understanding governance mechanisms than either approach independently. In addition, the use of panel methods in RQ1 underscores the importance of controlling for unobserved firm heterogeneity in governance research, while the cross-sectional analysis in RQ2 highlights how cumulative, path-dependent outcomes are shaped by governance over time.

For **entrepreneurial practice**, the research provides evidence-based guidance on the performance and innovation benefits associated with more diverse, less concentrated ownership configurations. The evidence that changes in governance structure are followed within a relatively short timeframe by performance improvements positions governance architecture as an actionable strategic lever. This finding suggests that entrepreneurs should negotiate governance terms deliberately rather than accepting default ownership structures.

For **investment practice**, the findings indicate that portfolio firm governance optimisation constitutes a value-creation mechanism beyond traditional operational improvement or strategic guidance activities. The consistent patterns across performance and innovation outcomes support diverse syndicate formation, the maintenance of dispersed ownership, and the reduction of insider ownership concentrations as practices that can enhance portfolio value.

For **policy development**, the research supports ecosystem diversity as a policy objective, providing an empirical basis for interventions that facilitate diverse investor participation, reduce regulatory barriers to investment, and encourage governance mechanisms that separate founder operating control from economic ownership. The one-to-two-year timeframe for observable governance optimisation benefits is compatible with political and policy cycles, offering policy levers with measurable impacts within a relatively near-term horizon.

9.5 Future Research Directions

The findings and scope conditions of this thesis suggest several avenues for future research that would extend, refine, and challenge the conclusions established here:

Longitudinal Governance Evolution and Firm Life Cycle

This thesis examines governance architecture over a six-year window (2018–2023), capturing early-stage and growth-stage dynamics but not full firm life cycles. Within this period, the panel analysis for RQ1 shows that shifts toward more diverse investor bases, lower insider ownership, and more dispersed blockholder structures are followed by higher employment and asset levels within the same firms. The cross-sectional analysis for RQ2 further indicates that firms experiencing more diverse and less concentrated governance configurations over this window accumulate stronger innovation outcomes. Future research could extend this temporal perspective by tracking HTYEFs over longer horizons, from founding through later-stage maturity, Initial Public Offering (IPO), or acquisition. The focus could be on whether governance configurations that enhance performance and innovation in the early and growth stages remain optimal as firms scale up. Further research could also ask whether higher ownership concentration or different investor mixes could offer an edge within specific stages of development. Building directly on the patterns identified here, longitudinal event-history or sequence-analysis designs could model how changes in investor heterogeneity, insider ownership, and blockholder dispersion over multiple funding rounds shape subsequent performance and innovation trajectories across complete life cycles.

Geographic and Institutional Comparisons

The governance architecture framework used in this research was applied to HTYEFs operating in the UK, a market-based, common-law institutional environment with relatively strong investor protection and well-developed equity markets. This institutional setting provides the empirical focus and data infrastructure for the analysis but also defines its geographic scope, limiting direct generalisation to territories with different institutional settings—such as bank-centred, civil-law based, or emerging-market environments—without further empirical testing. Future research could test the generalisability and boundary conditions of these results by applying the same governance architecture framework to HTYEFs in other environments or as comparative studies across countries with different legal frameworks, investor protection regimes, and financial system structures. Future research projects could examine whether the positive effects of diverse and less concentrated ownership found in the UK are equally strong, weaker, or even reversed in bank-centred, civil-law, or emerging-market systems. A particularly valuable extension would be to compare governance–outcome relationships in the UK with those in the US and European ecosystems, explicitly assessing whether the mechanisms inferred from the UK findings, such as multi-stakeholder signalling and access to specialised investor resources, operate similarly or are reshaped by local institutional conditions. By situating governance architecture within contemporary entrepreneurial ecosystem debates (Stam and van de Ven, 2021; Wurth *et al.*, 2021), the findings also invite future research that explicitly links firm-level ownership structures to ecosystem-level coordination and micro-governance processes (Hruskova, 2024; Mikhailov *et al.*, 2024). Likewise, emerging work on boards (Clarysse *et al.*, 2026) suggests that integrating detailed board-level data with ownership measures could further clarify how governance architecture translates into strategic and innovation decisions.

Clarification of Mechanisms Through Mixed Methods and Alternative Lenses

The quantitative design adopted in this thesis—and the reliance on agency and signalling theory as the primary lenses—enables rigorous testing of hypothesised relationships between governance dimensions and firm outcomes. The results consistently show that investor heterogeneity and dispersed ownership are associated with superior performance and innovation, while a higher concentration of insider ownership is associated with weaker outcomes. However, as acknowledged in Section 5.7, regression-based analysis using secondary data cannot directly observe the underlying decision processes and interactions through which these governance structures influence strategic choices. Future research could build on these findings by using mixed-methods designs to clarify the mechanisms that the present quantitative evidence can only infer. The underlying mechanisms could be addressed using qualitative case studies and in-depth interviews with entrepreneurs, investors, and board members in firms that exhibit the beneficial governance configurations identified in this thesis. Possible future research questions could include asking how diverse investor syndicates contribute specialised knowledge, how insider-dominated ownership constrains risk-taking or R&D commitment, and how dispersed blockholders coordinate monitoring and support. Complementary theoretical perspectives could enrich the explanation of the governance effects observed here in studies considering, for example, social capital, resource dependence, or institutional theory. Such work could build on the present research by taking the empirical patterns demonstrated in this study as its starting point.

Broader Innovation Measures and Sector-Specific Deep Dives

Innovation outcomes in this thesis are measured using patent counts and an IP Activity Score, reflecting formalised, legally protected forms of innovation. The analysis shows that governance diversity and lower ownership concentration are associated with higher patent stocks and IP activity across the heterogeneous sample of UK HTYEFs. At the same time, Section 5.7 recognises that these indicators under-represent informal or non-patented innovation and that sectoral differences in IP practices may influence observed intensities. Future research could respond to these limitations in two complementary ways. First, studies that combine the governance measures used here with survey-based innovation metrics—such as new product introductions, process improvements, or business model innovations—would provide a more complete picture of how ownership structures relate to innovation. This would be especially valuable in sectors where patenting is less prevalent and much innovation remains informal. Second, sector-focused analyses in specific high-tech industries—for example, biotechnology, medical devices, fintech, or AI—could test whether the governance configurations identified as beneficial in the aggregate sample also hold when technological regimes and regulatory conditions differ. Using the relationships established in this study as benchmarks, such work could then examine how sector-specific innovation processes interact with investor heterogeneity, insider ownership, and blockholder dispersion. Future scholars building on this foundation can further refine the theoretical frameworks, strengthen causal inference through experimental or quasi-experimental designs where feasible, extend empirical work across different institutional contexts, and develop prescriptive frameworks that translate these insights into actionable governance design principles. This thesis contributes a fuller account of entrepreneurial governance in HTYEFs while highlighting the substantial scope for further work in this field to achieve a comprehensive understanding of the topic.

9.6 Concluding Remarks

This research has explored whether and how the mix of financing sources and ownership structures is associated with the success of HTYEFs across two key dimensions of firm success—performance and innovation. Through rigorous empirical analysis combining panel data methods and cross-sectional techniques, examining 400 HTYEFs across six years, the research provides empirical support for the hypothesis that governance architecture is a key determinant of entrepreneurial firm success. Across all six hypotheses spanning both performance (employment and asset growth) and innovation (patents and IP activity) outcomes, firms with governance structures characterised by investor diversity, external ownership, and dispersed blockholdings show meaningfully higher growth and innovation rates. The use of panel methods with within-firm variation addresses concerns about spurious correlation or unobserved confounding, although these are not fully eliminated. Nonetheless, the overall results robustly support the inference of directional relationships.

This thesis establishes governance architecture as a systematic determinant of both performance and innovation in HTYEFs, with investor diversity, moderate insider ownership, and dispersed blockholder structures consistently associated with superior outcomes across both domains. While the dual-outcome framework enables rigorous testing of agency and signalling theory predictions for each outcome type separately, there are fruitful possibilities for future research to investigate correlations and causal interdependencies that may exist *between* performance and innovation outcomes. This would further illuminate how entrepreneurial firms navigate the dual imperatives of operational scaling and technological advancement.

The conclusions of this thesis are drawn within clearly defined theoretical, geographic, and methodological scope conditions. The framework is applied to HTYEFs in the UK and considers three ownership-based governance dimensions, using longitudinal panel methods for performance and cross-sectional models for innovation, as justified in Chapters 4 and 5. Within these boundaries, the findings are internally consistent and robust across multiple specifications. The possible future research directions outlined in the previous subsection build directly on these scope conditions, extending the analysis over longer firm life cycles, across institutional contexts, and through mixed-methods and sector-specific designs. The agenda for further work emerges from the design and results of this study and complements and further progresses the core contributions of this thesis to entrepreneurial finance.

For entrepreneurial practice, the message is clear: cultivate diverse investor syndicates, accept strategic equity dilution from external investors, and structure dispersed ownership distributions in the knowledge that these governance choices generate substantial performance and innovation benefits that are observable within near-term timeframes. For investment practice, the evidence supports co-investment syndication, minority governance participation, and active facilitation of governance optimisation as value-enhancing portfolio management practices. For policy development, the findings validate investor ecosystem diversity and regulatory streamlining of syndication as evidence-based policy objectives with measurable impacts. For entrepreneurial finance theory, this research extends signalling theory to multi-stakeholder governance contexts, refines agency theory's context-contingent predictions, validates panel methodology for governance research, and elevates ownership architecture to a strategic capital structure choice. These contributions advance both theoretical understanding and practical frameworks for decision-making.

Ultimately, this research demonstrates that in the complex, uncertain, innovation-intensive world of high-tech entrepreneurship, governance architecture is not peripheral to but rather a foundational determinant of success. The questions of who owns the firm and how ownership is distributed are demonstrated to be as consequential as the questions that traditionally dominate entrepreneurial discourse—questions about what technology, which market, and how much capital to pursue. As the entrepreneurial finance landscape continues to evolve—with the proliferation of investor types, geographic diversification of capital flows, and new ownership structures—understanding governance architecture's role in shaping firm success becomes increasingly critical for theory and practice alike.

Bibliography

Abatecola, G., Cafferata, R. and Poggesi, S. (2012) 'Arthur Stinchcombe's "liability of newness": Contribution and impact of the construct', *Journal of Management History*, 18(4), pp. 402–418. https://doi.org/10.1108/17511341211258747

Acs, Z.J. and Audretsch, D.B. (1988) 'Innovation in large and small firms: An empirical analysis', *American Economic Review*, 78(4), pp. 678–690. https://www.jstor.org/stable/1811167

Aghion, P. and Tirole, J. (1997) 'Formal and real authority in organisations', *Journal of Political Economy*, 105(1), pp. 1–29. https://doi.org/10.1086/262063

Aghion, P., Van Reenen, J. and Zingales, L. (2013) 'Innovation and institutional ownership', *American Economic Review*, 103(1), pp. 277–304. https://doi.org/10.1257/aer.103.1.277

Ahlers, G.K.C., Cumming, D., Günther, C. and Schweizer, D. (2015) 'Signaling in equity crowdfunding', *Entrepreneurship Theory and Practice*, 39(4), pp. 955–980. https://doi.org/10.1111/etap.12157

Ahmad, N. and Petersen, D.R. (2008) 'Comparing high growth enterprises in developed economies: What are they? Who are they? Where are they? What are their characteristics?', paper presented at the *Comparative Analysis of Enterprise Data (CAED) Conference*, May.

Ahmad, N., Mobarek, A. and Raid, M. (2023) 'Impact of global financial crisis on firm performance in UK: Moderating role of ESG, corporate governance and firm size', *Cogent Business and Management*, 10(1). https://doi.org/10.1080/23311975.2023.2167548

Akerlof, G.A. (1970) 'The market for "lemons": Quality uncertainty and the market mechanism', *The Quarterly Journal of Economics*, 84(3), pp. 488–500. https://doi.org/10.2307/1879431

Al-kalouti, J., Kumar, V., Kumar, N., Garza-Reyes, J.A., Upadhyay, A. and Zwiegelaar, J. (2020) 'Investigating innovation capability and organizational performance in service firms', *Strategic Change*, 29(1), pp. 103–113. https://doi.org/10.1002/jsc.2314

Allison, P.D. (2009) *Fixed effects regression models*. SAGE Publications.

Allison, P.D. (2010) *Survival analysis using SAS: A practical guide*. 2nd edn. SAS Institute.

Almus, M. (2002) 'What characterizes a fast-growing firm?', *Applied Economics*, 34(12), pp. 1497–1508. https://doi.org/10.1080/00036840110105010

Alvi, F.H. and Ulrich, K. (2023) 'Innovation finance ecosystems for entrepreneurial firms: A conceptual model and research propositions', *Journal of Business Research*, 156, p. 113450. https://doi.org/10.1016/j.jbusres.2022.113450

Amit, R., Brander, J. and Zott, C. (1998) 'Why do venture capital firms exist? Theory and Canadian evidence', *Journal of Business Venturing*, 13(6), pp. 441–466. https://doi.org/10.1016/S0883-9026(97)00061-X

Anderson, R.C. and Reeb, D.M. (2003) 'Founding-family ownership and firm performance: Evidence from the S&P 500', *Journal of Finance*, 58(3), pp. 1301–1328. https://doi.org/10.1111/1540-6261.00567

Ang, J.S., Cole, R.A. and Lin, J.W. (2000) 'Agency costs and ownership structure', *The Journal of Finance*, 55(1), pp. 81–106. https://doi.org/10.1111/0022-1082.00201

Angrist, J.D. and Pischke, J.-S. (2009) *Mostly harmless econometrics: An empiricist's companion*. Princeton University Press.

Annamalaisami, A. (2021) 'What differentiates angel investors in pre-seed versus seed-stage investments? Evidence from India', *Journal of Indian Business Research*, 14(1), pp. 4–22. https://doi.org/10.1108/jibr-01-2021-0024

Anwar, M., Tajeddini, K. and Ullah, R. (2020) 'Entrepreneurial finance and new venture success – the moderating role of government support', *Business Strategy and Development*, 3(4), pp. 408–421. https://doi.org/10.1002/bsd2.105

Anwar, M., Yusup, M., Millah, S. and Purnama, S. (2022) 'The role of business incubators in developing local digital startups in Indonesia', *Startupreneur Business Digital (Sabda Journal)*, 1(1), pp. 1–10. https://doi.org/10.34306/sabda.v1i1.69

Appelhoff, D., Mauer, R., Collewaert, V. and Brettel, M. (2015) 'The conflict potential of the entrepreneur's decision-making style in the entrepreneur-investor relationship', *International Entrepreneurship and Management Journal*, 12(2), 601-623. https://doi.org/10.1007/s11365-015-0357-4

Arouri, H., Ben Youssef, A., Quatraro, F. and Vivarelli, M. (2020) 'Drivers of growth in Tunisia: young firms vs incumbents', *Small Business Economics*, 54, pp. 323–340. https://doi.org/10.1007/s11187-018-00133-6

Arthurs, J.D. and Busenitz, L.W. (2003) 'The boundaries and limitations of agency theory and stewardship theory in the venture capitalist/entrepreneur relationship', *Entrepreneurship Theory and Practice*, 28(2), pp. 145–162. https://doi.org/10.1046/j.1540-6520.2003.00036.x

Artz, K., Norman, P.M., Hatfield, D.E. and Cardinal, L.B. (2010) 'A longitudinal study of the impact of R&D, patents, and product innovation on firm performance', *Journal of Product Innovation Management*, 27(5), pp. 725–740. https://doi.org/10.1111/j.1540-5885.2010.00747.x

Arundel, A. and Kabla, I. (1998) 'What percentage of innovations are patented? Empirical estimates for European firms', *Research Policy*, 27(2), pp. 127–141. https://doi.org/10.1016/S0048-7333(98)00033-X

Ashley, R. and Parmeter, C.F. (2020) 'Sensitivity analysis of an OLS multiple regression inference with respect to possible linear endogeneity in the explanatory variables, for both modest and for extremely large samples', *Econometrics*, 8(1), p. 11. https://doi.org/10.3390/econometrics8010011

Attig, N., Guedhami, O. and Mishra, D.R. (2008) 'Multiple large shareholders, control contests, and implied cost of equity', *Journal of Corporate Finance*, 14(5), pp. 721–737. https://doi.org/10.1016/j.jcorpfin.2008.08.008

Audretsch, D. B. and Belitski, M. (2020) 'The role of R&D and knowledge spillovers in innovation and productivity', *European Economic Review*, 123, 103391. https://doi.org/10.1016/j.euroecorev.2020.103391

Autio, E., Sapienza, H.J. and Almeida, J.G. (2000) 'Effects of age at entry, knowledge intensity, and imitability on international growth', *Academy of Management Journal*, 43(5), pp. 909–924. https://doi.org/10.5465/1556419

Bafera, J. and Kleinert, S. (2022) 'Signaling theory in entrepreneurship research: a systematic review and research agenda', *Entrepreneurship Theory and Practice*, 47(6), pp. 2419–2464. https://doi.org/10.1177/10422587221138489

Bajgar, M., Berlingieri, G., Calligaris, S., Criscuolo, C. and Timmis, J. (2020) 'Coverage and representativeness of Orbis data', *OECD Science, Technology and Industry Working Papers*. https://doi.org/10.1787/c7bdaa03-en

Balkin, D.B., Markman, G.D. and Gomez-Mejia, L.R. (2000) 'Is CEO pay in high-technology firms related to innovation?', *Academy of Management Journal*, 43(6), pp. 1118–1129. https://doi.org/10.5465/1556340

Balsmeier, B. and Czarnitzski, D. (2017) 'Ownership concentration, institutional development and firm performance in central and eastern Europe', *Managerial and Decision Economics*, 38(2), pp. 178–192. https://doi.org/10.1002/mde.2751

Baltagi, B.H. (2021) *Econometric analysis of panel data*. 6th edn. Springer.

Bank of England (2025) 'Unlocking growth: What can the literature tell us about what's holding back high-growth firms in the UK?', *Bank of England Quarterly Bulletin*, Q1 2025.

Barclay, M.J. and Holderness, C.G. (1989) 'Private benefits from control of public corporations', *Journal of Financial Economics*, 25(2), pp. 371–395. https://doi.org/10.1016/0304-405x(89)90088-3

Barney, J. B., Ketchen, D. J. and Wright, M. (2021) 'Resource-Based Theory and the Value Creation Framework', *Journal of Management*, 47(7), 1936-1955. https://doi.org/10.1177/01492063211021655

Barney, J.B. (1991) 'Firm resources and sustained competitive advantage', *Journal of Management*, 17(1), pp. 99–120. https://doi.org/10.1177/014920639101700108

Barroso-Castro, C., Domínguez-Cc, M. and Rodríguez-Serrano, M.Á. (2020) 'SME growth speed: the relationship with board capital', *Journal of Small Business Management*, pp. 1–33. https://doi.org/10.1080/00472778.2020.1717293

Bartholomew, S. and Smith, A.D. (2006) 'Improving survey response rates from chief executive officers in small firms: The importance of social networks', *Entrepreneurship Theory and Practice*, 30(1), pp. 83–96. https://doi.org/10.1111/j.1540-6520.2006.00111.x

Bartram, S.M. and Bodnar, G.M. (2009) 'No place to hide: The global crisis in equity markets in 2008/2009', *Journal of International Money and Finance*, 28(8), pp. 1246–1292. https://doi.org/10.1016/j.jimonfin.2009.08.005

Baruch, Y. and Holtom, B.C. (2008) 'Survey response rate levels and trends in organizational research', *Human Relations*, 61(8), pp. 1139–1160. https://doi.org/10.1177/0018726708094863

Basu, A. and Parker, S. C. (2001) 'Family Finance and New Business Start-ups' *Oxford Bulletin of Economics and Statistics*, 63(3), 333-358. https://doi.org/10.1111/1468-0084.00224

Bauer, D., Junge, S. and Reif, T. (2023) 'May the resources be with you: a systematic review and framework of startup funding options', *Management Review Quarterly*, 74(3), pp. 1365–1396. https://doi.org/10.1007/s11301-023-00336-6

Bauweraerts, J., Diaz-Moriana, V. and Arzubiaga, U. (2019) 'A mixed gamble approach of the impact of family management on firm's growth: A longitudinal analysis', *European Management Review*, 17(3), pp. 747–764. https://doi.org/10.1111/emre.12359

Baysinger, B.D. and Hoskisson, R.E. (1990) 'The composition of boards of directors and strategic control: Effects on corporate strategy', *Academy of Management Review*, 15(1), pp. 72–87. https://doi.org/10.5465/amr.1990.4308231

Baysinger, B.D., Kosnik, R.D. and Turk, T.A. (1991) 'Effects of board and ownership structure on corporate R&D strategy', *Academy of Management Journal*, 34(1), pp. 205–214. https://doi.org/10.5465/256308

Becchetti, L. and Trovato, G. (2002) 'The determinants of growth for small and medium sized firms. The role of the availability of external finance', *Small Business Economics*, 19(4), pp. 291–306. https://doi.org/10.1023/A:1019678429111

Belka, M. (2019) 'People investing in people. The overview on investment methods in technological start-ups at different stages of growth', *Journal of Management and Financial Sciences*, 37, pp. 75–97. https://doi.org/10.33119/jmfs.2019.37.5

Bell, A. and Jones, K. (2015) 'Explaining fixed effects: Random effects modeling of time-series cross-sectional and panel data', *Political Science Research and Methods*, 3(1), pp. 133–153. https://doi.org/10.1017/psrm.2014.7

Bell, E., Bryman, A. and Harley, B. (2018) *Business research methods*. 5th edn. Oxford University Press.

Bellavitis, C., Cumming, D., Vanacker, T. and Zahra, S.A. (2023) 'Ban, boom, and echo: Entrepreneurship and initial coin offerings', *Entrepreneurship Theory and Practice*, 47(4), pp. 1136–1169. https://doi.org/10.1177/1042258720940114

Bellavitis, C., Filatotchev, I., Kamuriwo, D.S. and Vanacker, T. (2017) 'Entrepreneurial finance: new frontiers of research and practice', *Venture Capital*, 19(1–2), p. 1. https://doi.org/10.1080/13691066.2016.1259733

Belleflamme, P., Lambert, T. and Schwienbacher, A. (2014) 'Crowdfunding: Tapping the right crowd', *Journal of Business Venturing*, 29(5), pp. 585–609. https://doi.org/ 10.1016/j.jbusvent.2013.07.003

Bengtsson, O. and Sensoy, B.A. (2011) 'Investor abilities and financial contracting: Evidence from venture capital', *Journal of Financial Intermediation*, 20(4), pp. 477–502. https://doi.org/10.1016/j.jfi.2011.02.001

Bennedsen, M. and Wolfenzon, D. (2000) 'The balance of power in closely held corporations', *Journal of Financial Economics*, 58(1–2), pp. 113–139. https://doi.org/10.1016/S0304-405X(00)00068-4

Berezinets, I., Ilina, Y., Bobyleva, A. and Burov, A. (2022) 'Private equity investment tenure and financial performance: evidence from European pipe transactions', *Vatnik of Saint Petersburg University Management*, 21(3), pp. 327–347. https://doi.org/10.21638/11701/spbu08.2022.301

Bergek, A. and Norrman, C. (2008) 'Incubator best practice: A framework', *Technovation*, 28(1), pp. 20–28. https://doi.org/10.1016/j.technovation.2007.07.008

Berger, A. and Udell, G. (1998) 'The economics of small business finance: the roles of private equity and debt markets in the financial growth cycle', *Journal of Banking and Finance*, 22(6–8), pp. 613–673. https://doi.org/10.1016/s0378-4266(98)00038-7

Berger, A.N. and Udell, G.F. (2002) 'Small business credit availability and relationship lending: The importance of bank organisational structure', *Economic Journal*, 112(477), pp. F32–F53. https://doi.org/10.1111/1468-0297.00682

Berger, A.N. and Udell, G.F. (2006) 'A more complete conceptual framework for SME finance', *Journal of Banking and Finance*, 30(11), pp. 2945–2966. https://doi.org/10.1016/j.jbankfin.2006.05.008

Bergh, D., Connelly, B.L., Ketchen, D.J. and Shannon, L.M. (2014) 'Signalling theory and equilibrium in strategic management research: An assessment and a research agenda', *Journal of Management Studies*, 51(8), pp. 1334–1360. https://doi.org/10.1111/joms.12097

Bernstein, S. (2015) 'Does going public affect innovation?', *The Journal of Finance*, 70, pp. 1365–1403. https://doi.org/10.1111/jofi.12275

Bertoni, F., Colombo, M. G., and Quas, A. (2015) ‘The patterns of venture capital investment in Europe’, *Small Business Economics*, 45(3), 543-560. https://doi.org/10.1007/s11187-015-9662-0

Bertoni, F., Colombo, M.G. and Grilli, L. (2011) 'Venture capital financing and the growth of high-tech start-ups: disentangling treatment from selection effects', *Research Policy*, 40(7), pp. 1028–1043. https://doi.org/10.1016/j.respol.2011.03.008

Bertoni, F., Colombo, M.G. and Grilli, L. (2013) 'Venture capital investor type and the growth mode of new technology-based firms', *Small Business Economics*, 40(3), pp. 527–552. https://doi.org/10.1007/s11187-011-9385-9

Bertoni, F., D'Adda, D. and Grilli, L. (2015) 'Cherry-picking or frog-kissing? A theoretical analysis of how investors select entrepreneurial ventures in thin venture capital markets', *Small Business Economics*, 46(3), pp. 391–405. https://doi.org/10.1007/s11187-015-9690-9

Bertrand, M. and Mullainathan, S. (2001) 'Are CEOs rewarded for luck? The ones without principals are', *The Quarterly Journal of Economics*, 116(3), pp. 901–932. https://doi.org/10.1162/00335530152466269

Besten, M.d. (2020) 'Crunchbase research: monitoring entrepreneurship research in the age of big data', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3724395

Beuselinck, C., Elfers, F., Gassen, J. and Pierk, J. (2021) 'Private firm accounting: the European reporting environment, data and research perspectives', *Accounting and Business Research*, 53(1), pp. 38–82. https://doi.org/10.1080/00014788.2021.1982670

Bhagat, S. and Welch, I. (1995) 'Corporate research and development investments international comparisons', *Journal of Accounting and Economics*, 19, pp. 443–470. https://doi.org/10.1016/0165-4101(94)00391-h

Birch, D.L. (1987) *Job creation in America: How our smallest companies put the most people to work*. Free Press.

Birnbaum, R. (2005). [Review of *The Innovator’s Dilemma: When New Technologies Cause Great Firms to Fail; The Innovator’s Solution: Creating and Sustaining Successful Growth*, by C. M. Christensen, C. M. Christensen, & M. E. Raynor]. *Academe*, *91*(1), 80–84. https://doi.org/10.2307/40252749

Bitler, M.P., Moskowitz, T.J. and Vissing-Jørgensen, A. (2005) 'Testing agency theory with entrepreneur effort and wealth', *Journal of Finance*, 60(2), pp. 539–576. https://doi.org/10.1111/j.1540-6261.2005.00739.x

Blaikie, N. (2010) *Designing social research: The logic of anticipation*. 2nd edn. Polity Press.

Block, J. (2012) 'R&D investments in family and founder firms: an agency perspective', *Journal of Business Venturing*, 27(2), pp. 248–265. https://doi.org/10.1016/j.jbusvent.2010.09.003

Block, J. and Fathollahi, R. (2022) 'Foundation ownership and firm growth', *Review of Managerial Science*, 17(8), pp. 2633–2654. https://doi.org/10.1007/s11846-022-00595-9

Block, J.H., Colombo, M.G., Cumming, D.J. and Vismara, S. (2017) 'New players in entrepreneurial finance and why they are there', *Small Business Economics*, 50(2), pp. 239–250. https://doi.org/10.1007/s11187-016-9826-6

Block, J.H., Fisch, C.O. and van Praag, M. (2017) 'The Schumpeterian entrepreneur: A review of the empirical evidence on the antecedents, behaviour and consequences of innovative entrepreneurship', *Industry and Innovation*, 24(1), pp. 61–95. https://doi.org/10.1080/13662716.2016.1216397

Bonča, P., Tajnikar, M., Ponikvar, N. and Mörec, B. (2018) 'Firm growth types and key macroeconomic aggregates through the economic cycle', *Journal of Business Economics and Management*, 19(1), pp. 138–153. https://doi.org/10.3846/16111699.2017.1422798

Bonini, S., Capizzi, V. and Zocchi, P. (2019) 'The performance of angel-backed companies', *Journal of Banking and Finance*, 100, pp. 328–345. https://doi.org/10.1016/j.jbankfin.2018.12.006

Bosma, N., Sanders, M. and Stam, E. (2018) 'Institutions, entrepreneurship, and economic growth in Europe', *Small Business Economics*, 51(2), pp. 483–499. https://doi.org/10.1007/s11187-018-0012-x

Bosse, D. and Phillips, R. (2016) 'Agency theory and bounded self-interest', *Academy of Management Review*, 41(2), pp. 276–297. https://doi.org/10.5465/amr.2013.0420

Bouncken, R.B., Komorek, M. and Kraus, S. (2015) 'Crowdfunding: The current state of research', *International Business and Economics Research Journal (IBER)*, 14(3), pp. 407–416. https://doi.org/10.19030/iber.v14i3.9206

Bower, J. L. and Christensen, C. M. (1995) ‘Disruptive technologies: catching the wave’, *Long Range Planning,* 28(2), 155. https://doi.org/10.1016/0024-6301(95)91075-1

Brailsford, T., Oliver, B. and Pua, L.H.S. (1999) 'Theory and evidence on the relationship between ownership structure and capital structure', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.181888

Breuer, M., Leuz, C. and Vanhaverbeke, S. (2019) 'Reporting regulation and corporate innovation'. https://doi.org/10.3386/w26291

Brezina, I., Pekár, J., Čičková, Z. and Reiff, M. (2014) 'Herfindahl-Hirschman index level of concentration values modification and analysis of their change', *Central European Journal of Operations Research*, 24(1), pp. 49–72. https://doi.org/10.1007/s10100-014-0350-y

Brickley, J.A., Lease, R.C. and Smith, C.W. (1988) 'Ownership structure and voting on antitakeover amendments', *Journal of Financial Economics*, 20, pp. 267–291. https://doi.org/10.1016/0304-405x(88)90047-5

British Business Bank (2025) *Small Business Equity Tracker 2025*. London: British Business Bank. https://www.british-business-bank.co.uk/about-research-and-publications/small-business-equity-tracker-2025

Brochado, A. and Mergulhão, M. (2022) 'Icobench ratings and initial coin offerings' success', *ERBE-European Review of Business Economics*, 2(1). https://doi.org/10.26619/erbe-2022.2.1.6

Brossard, O., Lavigne, S. and Sakinç, M.E. (2013) 'Ownership structures and R&D in Europe: The good institutional investors, the bad and ugly impatient shareholders', *Industrial and Corporate Change*, 22(4), pp. 1031–1068. https://doi.org/10.1093/icc/dtt018

Brown, J. and Petersen, B.C. (2011) 'Cash holdings and R&D smoothing', *Journal of Corporate Finance*, 17, pp. 694–709. https://doi.org/10.1016/j.jcorpfin.2010.01.003

Brown, J.R., Fazzari, S.M. and Petersen, B.C. (2009) 'Financing innovation and growth: Cash flow, external equity, and the 1990s R&D boom', *The Journal of Finance*, 64, pp. 151–185. https://doi.org/10.1111/j.1540-6261.2008.01431.x

Brown, R. and Cowling, M. (2021) 'The geographical impact of the covid-19 crisis on precautionary savings, firm survival and jobs: evidence from the United Kingdom's 100 largest towns and cities', *International Small Business Journal: Researching Entrepreneurship*, 39(4), pp. 319–329. https://doi.org/10.1177/0266242621989326

Brown, R. and Mawson, S. (2019) 'Entrepreneurial ecosystems and public policy in action: a critique of the latest industrial policy blockbuster', *Cambridge Journal of Regions, Economy and Society*, 12(3), pp. 347–368. https://doi.org/10.1093/cjres/rsz011

Brown, R. and Rocha, A. (2020) 'Entrepreneurial uncertainty during the covid-19 crisis: mapping the temporal dynamics of entrepreneurial finance', *Journal of Business Venturing Insights*, 14, p. e00174. https://doi.org/10.1016/j.jbvi.2020.e00174

Brown, R., Rocha, A. and Cowling, M. (2020) 'Financing entrepreneurship in times of crisis: exploring the impact of covid-19 on the market for entrepreneurial finance in the United Kingdom', *International Small Business Journal: Researching Entrepreneurship*, 38(5), pp. 380–390. https://doi.org/10.1177/0266242620937464

Brush, C.G. and Chaganti, R. (1999) 'Businesses without glamour? An analysis of resources on performance by size and age in small service and retail firms', *Journal of Business Venturing*, 14(3), pp. 233–257. https://doi.org/10.1016/s0883-9026(97)00103-1

Bruton, G., Ahlström, D. and Obłój, K. (2008) 'Entrepreneurship in emerging economies: where are we today and where should the research go in the future', *Entrepreneurship Theory and Practice*, 32(1), pp. 1–14. https://doi.org/10.1111/j.1540-6520.2007.00213.x

Bruton, G.D., Chahine, S. and Filatotchev, I. (2009) 'Founders, private equity investors, and under-pricing in entrepreneurial IPOs', *Entrepreneurship: Theory and Practice*, 33(4), pp. 909–928. https://doi.org/10.1111/j.1540-6520.2009.00309.x

Bruton, G.D., Filatotchev, I., Chahine, S. and Wright, M. (2010) 'Governance, ownership structure, and performance of IPO firms: The impact of different types of private equity investors and institutional environments', *Strategic Management Journal*, 31(5), pp. 491–509. https://doi.org/10.1002/smj.822

Bunyaminu, A., Yakubu, I.N. and Oumarou, S. (2024) 'The impact of board attributes and ownership concentration on firm market value: empirical evidence from an emerging market', *Cogent Business & Management*, 12(1). https://doi.org/10.1080/23311975.2024.2437147

Burkart, M. and Panunzi, F. (2006) 'Agency conflicts, ownership concentration, and legal shareholder protection', *Journal of Financial Intermediation*, 15(1), pp. 1–31. https://doi.org/10.1016/j.jfi.2004.12.004

Busenitz, L.W., Fiet, J.O. and Moesel, D.D. (2005) 'Signaling in venture capitalist-new venture team funding decisions: Does it indicate long-term venture outcomes?', *Entrepreneurship Theory and Practice*, 29(1), pp. 1–12. https://doi.org/10.1111/j.1540-6520.2005.00066.x

Bushee, B.J. (1998) 'The influence of institutional investors on myopic R&D investment behaviour', *Accounting Review*, 73(3), pp. 305–333. https://www.jstor.org/stable/248542

Cameron, A.C. and Trivedi, P.K. (2013) *Regression analysis of count data*. 2nd edn. Cambridge University Press.

Cantner, U., Cunningham, J.A., Lehmann, E.E. and Menter, M. (2020) 'Entrepreneurial ecosystems: a dynamic lifecycle model', *Small Business Economics*, 57(1), pp. 407–423. https://doi.org/10.1007/s11187-020-00316-0

Cantwell, J.A. (2000) *Innovation, profits and growth: Schumpeter and Penrose*. University of Reading, Department of Economics.

Cao, T. and Li, W. (2023) 'Venture capital's portfolio network and portfolio firm's innovation performance: Evidence from China', *Managerial and Decision Economics,* 44(5), 2885-2906. https://doi.org/10.1002/mde.3853

Capizzi, V., Croce, A. and Tenca, F. (2021) 'Do business angels' investments make it easier to raise follow-on venture capital financing? An analysis of the relevance of business angels' investment practices', *British Journal of Management*, 33(1), pp. 306–326. https://doi.org/10.1111/1467-8551.12526

Carpenter, J.N. and Lynch, A.W. (1999) 'Survivorship bias and attrition effects in measures of performance persistence', *Journal of Financial Economics*, 54(3), pp. 337–374. https://doi.org/10.1016/S0304-405X(99)00040-9

Carpenter, R. and Petersen, B. (2002) 'Capital market imperfections, high-tech investment, and new equity financing', *The Economic Journal*, 112(477), pp. F54–F72. https://doi.org/10.1111/1468-0297.00683

Carr, S. (2013) 'Collective action and the financing of innovation: evidence from crowdfunding', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2450510

Cassar, G. (2004) 'The financing of business start-ups', *Journal of Business Venturing*, 19(2), pp. 261–283. https://doi.org/10.1016/S0883-9026(03)00029-6

Ceaușu, I., Marquardt, K., Irmer, S. and Gotesman, E. (2017) 'Factors influencing performance within startup assistance organisations', *Proceedings of the International Conference on Business Excellence*, 11(1), pp. 264–275. https://doi.org/10.1515/picbe-2017-0028

Cefis, E. and Marsili, O. (2006) 'Survivor: The role of innovation in firms' survival', *Research Policy*, 35(5), pp. 626–641. https://doi.org/10.1016/j.respol.2006.02.006

Çelikyurt, U., Sevilir, M. and Shivdasani, A. (2012) 'Venture capitalists on boards of mature public firms', *Review of Financial Studies*, 27(1), pp. 56–101. https://doi.org/10.1093/rfs/hhs096

Certo, S., Daily, C.M. and Dalton, D.R. (2001) 'Signaling firm value through board structure: An investigation of initial public offerings', *Entrepreneurship Theory and Practice*, 26(2), pp. 33–50. https://doi.org/10.1177/104225870102600202

Certo, S.T. (2003) 'Influencing initial public offering investors with prestige: signaling with board structures', *Academy of Management Review*, 28(3), p. 432. https://doi.org/10.2307/30040731

Certo, S.T., Withers, M.C. and Semadeni, M. (2017) 'A tale of two effects: Using longitudinal data to compare within- and between-firm effects', *Strategic Management Journal*, 38(7), pp. 1536–1556. https://doi.org/10.1002/smj.2586

Chan, K., Cheng, S. and Hameed, A. (2022) 'Investor heterogeneity and liquidity', *Journal of Financial and Quantitative Analysis*, 57(7), pp. 2798–2833. https://doi.org/10.1017/s0022109022000217

Chandler, G.N. and Hanks, S.H. (1993) 'Measuring the performance of emerging businesses: A validation study', *Journal of Business Venturing*, 8(5), pp. 391–408. https://doi.org/10.1016/0883-9026(93)90021-V

Chang, S. (2003) 'Ownership structure, expropriation, and performance of group-affiliated companies in Korea', *Academy of Management Journal*, 46(2), pp. 238–253. https://doi.org/10.5465/30040617

Charreaux, G. and Desbrières, P. (2001) 'Corporate governance: Stakeholder value versus shareholder value', *Journal of Management and Governance*, 5(2), pp. 107–128. https://doi.org/10.1023/a:1013060105433

Chatterjee, M. and Bhattacharjee, T. (2021) 'Ownership concentration, innovation and firm performance: empirical study in Indian technology SME context', *South Asian Journal of Business Studies*, 10(2), pp. 149–170. https://doi.org/10.1108/SAJBS-10-2019-0185

Chemmanur, T. and Fulghieri, P. (2014) 'Entrepreneurial finance and innovation: an introduction and agenda for future research', *Review of Financial Studies*, 27(1), pp. 1–19. https://doi.org/10.1093/rfs/hht063

Chemmanur, T.J., Krishnan, K. and Nandy, D.K. (2011) 'How does venture capital financing improve efficiency in private firms? A look beneath the surface', *Review of Financial Studies*, 24(12), pp. 4037–4090. https://doi.org/10.1093/rfs/hhr096

Chen, M., Wang, X. and Xie, X. (2021) 'Research on financial institution relationship and performance of startups'. https://doi.org/10.2991/aebmr.k.210601.049

Chen, S. and Lambrecht, B.M. (2025) ‘Resolving Tensions Between Heterogeneous Investors in a Startup’, *Management Science*, *71*(3), pp.2678-2695. https://doi.org/10.1287/mnsc.2022.01724

Chen, S., Meng, W. and Lu, H. (2018) ‘Patent as a quality signal in entrepreneurial finance: a look beneath the surface’, *Asia-Pacific Journal of Financial Studies*, *47*(2), pp.280-305. https://doi.org/10.1111/ajfs.12211

Chen, T., Chen, J., Miller, D., Breton-Miller, I. and Chen, M. (2022) 'Corporate venture capital and interfirm rivalry: a competitive dynamics perspective', *Strategic Entrepreneurship Journal*, 17(1), pp. 210–236. https://doi.org/10.1002/sej.1444

Cheng, T., Lai, H. and Lu, C. (2021) 'Industrial effects and the CAPM: from the views of robustness and longitudinal data analysis', *Journal of Data Science*, 3(4), pp. 381–401. https://doi.org/10.6339/jds.2005.03(4).225

Cherif, M. and Elouaer, S. (2008). Venture capital financing: A theoretical model. *The Journal of Applied Business and Economics*, *8*(1), p.56. http://na-businesspress.com/Cherif.pdf

Chod, J. and Lyandres, E. (2020) 'A theory of ICOs: Diversification, agency, and information asymmetry', *Management Science*, 67(10), pp. 5969–5989. https://doi.org/10.1287/mnsc.2020.3754

Christopoulos, D., Köppl, S. and Köppl-Turyna, M. (2022) ’Syndication networks and company survival: evidence from European venture capital deals’, Venture *Capital*, 24(3–4). https://doi.org/10.1080/13691066.2022.2101158

Chung, K. and Zhang, H. (2011) 'Corporate governance and institutional ownership', *Journal of Financial and Quantitative Analysis*, 46, pp. 247–273. https://doi.org/10.1017/S0022109010000682

Cicchiello, F.A. (2019) 'Building an entrepreneurial ecosystem based on crowdfunding in Europe: the role of public policy'. https://doi.org/10.1108/jepp-05-2019-0037

Claessens, S., Djankov, S., Fan, J.P.H. and Lang, L.H.P. (2002) 'Disentangling the incentive and entrenchment effects of large shareholdings', *The Journal of Finance*, 57(6), pp. 2741–2771. https://doi.org/10.1111/1540-6261.00511

Clarke, T. (2004) *Theories of corporate governance*. Routledge.

Clarysse, B., Bruneel, J., Lomberg, C., Uman, T., Howard, T. J. and Breugst, N. (2026) ‘Venture boards: Knowns and unknowns’, *Journal of Business Venturing*, 41(4), 106591. https://doi.org/10.1016/j.jbusvent.2026.106591

Clement, T. and Silvernagel, C. (2019) 'A conceptual framework of entrepreneurial finance', *Entrepreneurship Education and Pedagogy*, 2(4), pp. 308–332. https://doi.org/10.1177/2515127419846629

Coad, A. (2009) *The growth of firms: A survey of theories and empirical evidence*. Edward Elgar Publishing.

Coad, A. and Hölzl, W. (2012), ‘Firm Growth: Empirical Analysis’, *Handbook on the Economics and Theory of the Firm*. https://doi.org/10.4337/9781781002407.00035

Coad, A. and Rao, R. (2008) 'Innovation and firm growth in high-tech sectors: a quantile regression approach', *Research Policy*, 37(4), pp. 633–648. https://doi.org/10.1016/j.respol.2008.01.003

Cohen, J. (1988) *Statistical power analysis for the behavioral sciences*. 2nd edn. Lawrence Erlbaum Associates.

Cohen, J., Cohen, P., West, S.G. and Aiken, L.S. (2003) *Applied multiple regression/correlation analysis for the behavioral sciences*. 3rd edn. Lawrence Erlbaum Associates.

Cohen, S. and Hochberg, Y.V. (2014) 'Accelerating startups: The seed accelerator phenomenon', in *Handbook of Entrepreneurial Finance*. UNC Kenan-Flagler Business School. https://doi.org/10.2139/ssrn.2418000

Cohen, W.M. and Levinthal, D.A. (1990) 'Absorptive capacity: A new perspective on learning and innovation', *Administrative Science Quarterly*, 35(1), pp. 128–152. https://doi.org/10.2307/2393553

Cohen, W.M., Nelson, R.R. and Walsh, J.P. (2000) 'Protecting their intellectual assets: Appropriability conditions and why U.S. manufacturing firms patent (or not)', *NBER Working Paper No. 7552*. National Bureau of Economic Research. https://doi.org/10.3386/w7552

Cole, R., Cumming, D. and Li, D. (2016) 'Do banks or VCs spur small firm growth?', *Journal of International Financial Markets Institutions and Money*, 41, pp. 60–72. https://doi.org/10.1016/j.intfin.2015.12.005

Coles, J.L., Daniel, N.D. and Naveen, L. (2006) 'Managerial incentives and risk-taking', *Journal of Financial Economics*, 79(2), pp. 431–468. https://doi.org/10.1016/j.jfineco.2004.09.004

Coles, J.L., Lemmon, M.L. and Meschke, J.F. (2012) 'Structural models and endogeneity in corporate finance: The link between managerial ownership and corporate performance', *Journal of Financial Economics*, 103(1), pp. 149–168. https://doi.org/10.1016/j.jfineco.2011.04.002

Colombo, M., Croce, A. and Guerini, M. (2014) 'Does informal risk capital relax the financial constraints of high-tech entrepreneurial ventures?', *Applied Economics Letters*, 21(5), pp. 335–339. https://doi.org/10.1080/13504851.2013.859368

Colombo, M., Croce, A. and Murtinu, S. (2013) 'Ownership structure, horizontal agency costs and the performance of high-tech entrepreneurial firms', *Small Business Economics*, 42(2), pp. 265–282. https://doi.org/10.1007/s11187-013-9483-y

Colombo, M., Montanaro, B. and Vismara, S. (2022) 'What drives the valuation of entrepreneurial ventures? A map to navigate the literature and research directions', *Small Business Economics*, 61(1), pp. 59–84. https://doi.org/10.1007/s11187-022-00688-5

Colombo, M.G. and Grilli, L. (2005) 'Founders' human capital and the growth of new technology-based firms: A competence-based view', *Research Policy*, 34(6), pp. 795–816. https://doi.org/10.1016/j.respol.2005.03.010

Colombo, M.G. and Grilli, L. (2007) 'Funding gaps? Access to bank loans by high-tech start-ups', *Small Business Economics*, 29(1–2), pp. 25–46. https://doi.org/10.1007/s11187-005-4067-0

Colombo, M.G. and Grilli, L. (2010) 'On growth drivers of high-tech start-ups: Exploring the role of founders' human capital and venture capital', *Journal of Business Venturing*, 25(6), pp. 610–626. https://doi.org/10.1016/j.jbusvent.2009.01.005

Colombo, O. (2020) ‘The Use of Signals in New-Venture Financing: A Review and Research Agenda’, *Journal of Management*, 47(1), 237-259. https://doi.org/10.1177/0149206320911090

Colquitt, J.A. and Zapata-Phelan, C.P. (2007) 'Trends in theory building and theory testing: A five-decade study of the Academy of Management Journal', *Academy of Management Journal*, 50(6), pp. 1281–1303. https://doi.org/10.5465/amj.2007.28165855

Coluzzi, C., Ferrando, A. and Martinez-Carrascal, C. (2015) 'Financing obstacles and growth: an analysis for euro area non-financial firms', *European Journal of Finance*, 21, pp. 773–790. https://doi.org/10.1080/1351847X.2012.664154

Connelly, B.L., Certo, S.T., Ireland, R.D. and Reutzel, C.R. (2011) 'Signaling theory: A review and assessment', *Journal of Management*, 37(1), pp. 39–67. https://doi.org/10.1177/0149206310388419

Connelly, B.L., Hoskisson, R.E., Tihanyi, L. and Certo, S.T. (2010) 'Ownership as a form of corporate governance', *Journal of Management Studies*, 47(8), pp. 1561–1589. https://doi.org/10.1111/j.1467-6486.2010.00929.x

Conti, A., Peukert, C. and Roche, M.P. (2025) 'Beefing it up for your investor? engagement with open-source communities, innovation, and startup funding: evidence from GitHub', *Organization Science*, 36(4), pp. 1551–1573. https://doi.org/10.1287/orsc.2023.18348

Conti, A., Thursby, J.G. and Thursby, M. (2013) 'Patents as signals for startup financing', *The Journal of Industrial Economics*, 61(3), pp. 592–622. https://doi.org/10.1111/joie.12025

Cook, A. and Glass, C. (2014) 'Above the glass ceiling: When are women and racial/ethnic minorities promoted to CEO?', *Strategic Management Journal*, 35(7), pp. 1080–1089. https://doi.org/10.1002/smj.2161

Cook, R.D. and Weisberg, S. (1982) *Residuals and influence in regression*. Chapman and Hall.

Copenhagen Economics (2021) *Study on Equity Investments in Europe: Mind the Gap*. Luxembourg: European Investment Bank. https://copenhageneconomics.com/wp-content/uploads/2021/12/copenhagen-economics_study-on-equity-investments-in-europe-mind-the-gap.pdf

Cosh, A., Cumming, D. and Hughes, A. (2009) 'Outside entrepreneurial capital', *The Economic Journal*, 119(540), pp. 1494–1533. https://doi.org/10.1111/j.1468-0297.2009.02270.x

Cowling, M. (2004) 'The growth–profit nexus', *Small Business Economics*, 22(1), pp. 1–9. https://doi.org/10.1023/B:SBEJ.0000011568.42714.c9

Cowling, M., Liu, W. and Ledger, A. (2012) 'Small business financing in the UK before and during the current financial crisis'. https://doi.org/10.1177/0266242611435516

Creswell, J.W. and Poth, C.N. (2024) *Qualitative inquiry and research design: Choosing among five approaches*. 5th edn. Sage Publications.

Croce, A., Guerini, M. and Ughetto, E. (2016) 'Angel financing and the performance of high-tech start-ups', *Journal of Small Business Management*, 56(2), pp. 208–228. https://doi.org/10.1111/jsbm.12250

Cuevas-Rodríguez, G., Gómez-Mejía, L. and Wiseman, R. (2012) 'Has agency theory run its course?: making the theory more flexible to inform the management of reward systems', *Corporate Governance: An International Review*, 20(6), pp. 526–546. https://doi.org/10.1111/corg.12004

Cumming, D. (2008) 'Contracts and exits in venture capital finance', *Review of Financial Studies*, 21(5), pp. 1947–1982. https://doi.org/10.1093/rfs/hhn072

Cumming, D. and Dai, N. (2010) 'Local bias in venture capital investments', *Journal of Empirical Finance*, 17(3), pp. 362–380. https://doi.org/10.1016/j.jempfin.2009.11.001

Cumming, D. and Groh, A.P. (2018) 'Entrepreneurial finance: Unifying themes and future directions', *Journal of Corporate Finance*, 50, pp. 538–555. https://doi.org/10.2139/ssrn.3102588

Cumming, D. and Johan, S. (2013) *Venture capital and private equity contracting: An international perspective*. 2nd edn. Academic Press/Elsevier.

Cumming, D. and Johan, S. (2017) 'The problems with and promise of entrepreneurial finance', *Strategic Entrepreneurship Journal*, 11(3), pp. 357–370. https://doi.org/10.1002/sej.1265

Cumming, D. and Vismara, S. (2016) 'De-segmenting research in entrepreneurial finance', *Venture Capital*, 19(1–2), pp. 17–27. https://doi.org/10.1080/13691066.2016.1225910

Cumming, D. and Zhang, M. (2018) 'Angel investors around the world', *Journal of International Business Studies*, 50(5), pp. 692–719. https://doi.org/10.1057/s41267-018-0178-0

Cumming, D. J. and Johan, S. (2008), 'Information asymmetries, agency costs and venture capital exit outcomes', *Venture Capital,* 10(3), 197-231. https://doi.org/10.1080/13691060802151788

Cumming, D., Deloof, M., Manigart, S. and Wright, M. (2019) 'New directions in entrepreneurial finance', *Journal of Banking and Finance*, 100, pp. 252–260. https://doi.org/10.1016/j.jbankfin.2019.02.008

Cumming, D., Meoli, M. and Vismara, S. (2019) 'Investors' choices between cash and voting rights: Evidence from dual-class equity crowdfunding', *Research Policy*, 48(8), p. 103740. https://doi.org/10.1016/j.respol.2019.01.014

Cumming, D., Vanacker, T. and Zahra, S. A. (2021) 'Equity Crowdfunding and Governance: Toward an Integrative Model and Research Agenda', *Academy of Management Perspectives*, 35(1), 69-95. https://doi.org/10.5465/amp.2017.0208

Czarnitzki, D. and Hottenrott, H. (2009) 'R&D investment and financing constraints of small and medium-sized firms', *Small Business Economics*, 36(1), pp. 65–83. https://doi.org/10.1007/s11187-009-9189-3

Czarnitzki, D. and Kraft, K. (2004) 'An empirical test of the asymmetric models on innovative activity: Who invests more into R&D, the incumbent or the challenger?', *Journal of Economic Behaviour and Organisation*, 54(2), pp. 153–173. https://doi.org/10.1016/j.jebo.2003.01.008

Czarnitzski, D. and Kraft, K. (2009) 'Capital control, debt financing and innovative activity', *Journal of Economic Behaviour and Organisation*, 71(2), pp. 372–383. https://doi.org/10.1016/j.jebo.2009.03.017

Cziráki, P., Renneboog, L. and Szilagyi, P. G. (2010) 'Shareholder Activism through Proxy Proposals: The European Perspective', *European Financial Management*, 16(5), 738-777. https://doi.org/10.1111/j.1468-036x.2010.00559.x

Daily, C.M., Dalton, D.R. and Cannella, A.A. (2003) 'Corporate governance: Decades of dialogue and data', *Academy of Management Review*, 28(3), pp. 371–382. https://doi.org/10.5465/amr.2003.10196703

Daily, C.M., McDougall, P.P., Covin, J.G. and Dalton, D.R. (2002) 'Governance and strategic leadership in entrepreneurial firms', *Journal of Management*, 28(3), pp. 387–412. https://doi.org/10.1177/014920630202800307

Daizadeh, I. (2021) 'Trademark and patent applications are structurally near-identical and cointegrated: implications for studies in innovation', *Iberoamerican Journal of Science Measurement and Communication*, 1(2), pp. 1–16. https://doi.org/10.47909/ijsmc.33

Dalle, J., den Besten, M. and Menon, C. (2017), 'Using Crunchbase for economic and managerial research', *OECD Science, Technology and Industry Working Papers,* No. 2017/08, OECD Publishing, Paris. https://dx.doi.org/10.1787/6c418d60-en

Dalton, D.R., Daily, C.M., Certo, S.T. and Roengpitya, R. (2003) 'Meta-analyses of financial performance and equity: Fusion or confusion?', *Academy of Management Journal*, 46(1), pp. 13–26. https://doi.org/10.5465/30040673

Dalziel, T., Gentry, R. and Bowerman, M. (2011) 'An integrated agency–resource dependence view of the influence of directors' human and relational capital on firms' R&D spending', *Journal of Management Studies*, 48(6), pp. 1217–1242. https://doi.org/10.1111/j.1467-6486.2010.01003.x

Dalziel, T., White, R.E. and Arthurs, J.D. (2011) 'Principal costs in initial public offerings', *Journal of Management Studies*, 48(6), pp. 1346–1364. https://doi.org/10.1111/j.1467-6486.2010.01005.x

Darrough, M.N. and Stoughton, N.M. (1986) 'Moral hazard and adverse selection: The question of financial structure', *The Journal of Finance*, 41(2), pp. 501–513. https://doi.org/10.2307/2328450

Das, K. (2023) 'What affects startup acquisition in emerging economy? Evidence from India', *Journal of Emerging Market Finance*, 22(2), pp. 111–134. https://doi.org/10.1177/09726527221141787

Das, T.K. and Teng, B.S. (2000) 'Instabilities of strategic alliances: An internal tensions perspective', *Organisation Science*, 11(1), pp. 77–101. https://doi.org/10.1287/orsc.11.1.77.12570

Dat, D. T. (2021) 'Investment Selection Criteria of Foreign Angel Investors in Startups in Vietnam'. *Advances in Economics, Business and Management Research*, 196. https://doi.org/10.2991/aebmr.k.211119.030

Daud, S. (2012) 'Knowledge management processes in SMEs and large firms: a comparative evaluation', *African Journal of Business Management*, 6(11). https://doi.org/10.5897/ajbm11.2486

Daunfeldt, S.O., Elert, N. and Johansson, D. (2014) 'The economic contribution of high-growth firms: do policy implications depend on the choice of growth indicator?', *Journal of Industry, Competition and Trade*, 14(3), pp. 337–365. https://doi.org/10.1007/s10842-013-0168-7

Davidsson, P. (2004) *Researching entrepreneurship*. 2nd edn. Boston, MA: Springer US.

Davis, J., Soltis, P., Adams, D., Larkin, S. and Gilbert, R. (2020) 'Seed funds leverage external awards for research in natural resources and agricultural systems', *Forests*, 11(1), p. 76. https://doi.org/10.3390/f11010076

Davis, J.H., Schoorman, F.D. and Donaldson, L. (1997) 'Toward a stewardship theory of management', *Academy of Management Review*, 22(1), pp. 20–47. https://doi.org/10.5465/amr.1997.9707180258

De Lyon, J. and Dhingra, S. (2021) *The impacts of Covid-19 and Brexit on the UK economy: early evidence in 2021*. Centre for Economic Performance, London School of Economics and Political Science.

Deck, M. (2005) 'The innovator's solution: creating and sustaining successful growth', *Journal of Product Innovation Management*, 22(2), pp. 213–215. https://doi.org/10.1111/j.0737-6782.2005.116_1.x

Deias, A. and Magrini, A. (2023) 'The impact of equity funding dynamics on venture success: an empirical analysis based on Crunchbase data', *Economies*, 11(1), p. 19. https://doi.org/10.3390/economies11010019

Delen, D., Kuzey, C. and Uyar, A. (2013) 'Measuring firm performance using financial ratios: A decision tree approach', *Expert Systems With Applications*, 40(10), pp. 3970–3983. https://doi.org/10.1016/j.eswa.2013.01.012

Delmar, F. and Shane, S. (2006) 'Does experience matter? The effect of founding team experience on the survival and sales of newly founded ventures', *Strategic Organisation*, 4(3), pp. 215–247. https://doi.org/10.1177/1476127006066596

Delmar, F., Davidsson, P. and Gartner, W.B. (2003) 'Arriving at the high-growth firm', *Journal of Business Venturing*, 18(2), pp. 189–216. https://doi.org/10.1016/S0883-9026(02)00080-0

Deloof, M. and Vanacker, T. (2018) 'The recent financial crisis, start-up financing and survival', *Journal of Business Finance and Accounting*, 45(7–8), pp. 928–951. https://doi.org/10.1111/jbfa.12319

Demirel, P. and Mazzucato, M. (2010) 'The Evolution of Firm Growth Dynamics in the US Pharmaceutical Industry', *Regional Studies*, 44(8), 1053-1066. https://doi.org/10.1080/00343400903241469

Demsetz, H. and Lehn, K. (1985) 'The structure of corporate ownership: Causes and consequences', *Journal of Political Economy*, 93(6), pp. 1155–1177. https://doi.org/10.1086/261354

Denis, D.J. (2004) 'Entrepreneurial finance: an overview of the issues and evidence', *Journal of Corporate Finance*, 10(2), pp. 301–326. https://doi.org/10.1016/S0929-1199(03)00059-2

Department for Business and Trade & British Business Bank (2026) *The Early-Stage Equity Finance Journey of Potential High-Growth Companies in the UK*. London: Department for Business and Trade. https://www.gov.uk/government/publications/the-early-stage-equity-finance-journey-of-potential-high-growth-companies-in-the-uk

Devers, C.E., Cannella, A.A., Reilly, G.P. and Yoder, M.E. (2007) 'Executive compensation: A multidisciplinary review of recent developments', *Journal of Management*, 33(6), pp. 1016–1072. https://doi.org/10.1177/0149206307308588

Dodd, S.D. and Anderson, A.R. (2001) 'Understanding the enterprise culture: Paradigm, paradox and policy', *International Journal of Entrepreneurship and Innovation*, 2(1), pp. 13–26. https://doi.org/10.5367/000000001101298747

Drover, W., Busenitz, L., Matusik, S., Townsend, D., Anglin, A. and Dushnitsky, G. (2017) 'A review and road map of entrepreneurial equity financing research: venture capital, corporate venture capital, angel investment, crowdfunding, and accelerators', *Journal of Management*, 43(6), pp. 1820–1853. https://doi.org/10.1177/0149206317690584

Drover, W., Wood, M.S. and Corbett, A.C. (2018) 'Toward a cognitive view of signalling theory: Individual attention and signal set interpretation', *Journal of Management Studies*, 55(2), pp. 209–231. https://doi.org/10.1111/joms.12282

Du, J. and Temouri, Y. (2014) 'High-growth firms and productivity: evidence from the United Kingdom', *Small Business Economics*, 44(1), pp. 123–143. https://doi.org/10.1007/s11187-014-9584-2

Dyck, A. and Zingales, L. (2004) 'Private benefits of control: An international comparison', *Journal of Finance*, 59(2), pp. 537–600. https://doi.org/10.1111/j.1540-6261.2004.00642.x

Dyck, A., Fang, F., Hébert, C. and Xu, T. (2026) 'Venture Fraud', *NBER Working Paper No. 34868*. https://doi.org/10.3386/w34868

Easterby-Smith, M., Jaspersen, L.J., Thorpe, R. and Valizade, D. (2021) *Management and business research*. 7th edn. Sage Publications.

Eckhardt, J.T., Shane, S. and Delmar, F. (2006) 'Multistage selection and the financing of new ventures', *Management Science*, 52(2), pp. 220–232. https://doi.org/10.1287/mnsc.1050.0478

Edmans, A. (2014) 'Blockholders and corporate governance', *Annual Review of Financial Economics*, 6(1), pp. 23–50. https://doi.org/10.1146/annurev-financial-110613-034455

Edmans, A. and Holderness, C.G. (2017) 'Blockholders: A survey of theory and evidence', in Hermalin, B.E. and Weisbach, M.S. (eds.) *The Handbook of the Economics of Corporate Governance, Volume 1*. North-Holland, pp. 541–636. https://doi.org/10.1016/bs.hecg.2017.11.002

Edmans, A. and Manso, G. (2011) 'Governance through trading and intervention: A theory of multiple blockholders', *Review of Financial Studies*, 24(7), pp. 2395–2428. https://doi.org/10.1093/rfs/hhq145

Edwards, A. and Todtenhaupt, M. (2020) 'Capital gains taxation and funding for start-ups', *Journal of Financial Economics*, 138(2), pp. 549–571. https://doi.org/10.1016/j.jfineco.2020.06.009

Eisenhardt, K. (1989) 'Agency theory: an assessment and review', *Academy of Management Review*, 14(1), pp. 57–74. https://doi.org/10.5465/amr.1989.4279003

Elkinawy, S. (2005) 'Mutual fund preferences for Latin American equities surrounding financial crises', *Emerging Markets Review*, 6, pp. 211–237. https://doi.org/10.1016/j.ememar.2005.05.001

Ellili, N.O.D. (2022) 'Bibliometric analysis on corporate governance topics published in the journal of corporate governance: the international journal of business in society', *Corporate Governance: The International Journal of Business in Society*, 23(1), pp. 262–286. https://doi.org/10.1108/cg-03-2022-0135

Eng, L.L. and Shackell, M. (2001) 'The implications of long-term performance plans and institutional ownership for firms' research and development (R&D) investments', *Journal of Accounting, Auditing and Finance*, 16(2), pp. 117–139. https://doi.org/10.1177/0148558X0101600204

Enterprise Research Centre (2024) 'Understanding Equity Access and Use in Early-Stage Ventures*', ERC Research report, Warwick: Enterprise Research Centre*. https://www.enterpriseresearch.ac.uk/publications/understanding-equity-access-and-use-in-early-stage-ventures/

Eshraghi, F. (2025) 'The relationship between entrepreneurial finance and success of high tech young entrepreneurial firms focusing on funding and ownership structures', *New Vistas*, 11(1). https://doi.org/10.36828/newvistas.301

European Commission (2018) 'General data protection regulation (GDPR)', *Official Journal of the European Union*, L 119/1. https://eur-lex.europa.eu/eli/reg/2016/679/oj

Ewens, M. and Farre-Mensa, J. (2022) 'Private or public equity? The evolving entrepreneurial finance landscape', *Annual Review of Financial Economics*, 14(1), pp. 271–293. https://doi.org/10.1146/annurev-financial-101821-121115

Faccio, M. and Lang, L.H. (2002) 'The ultimate ownership of Western European corporations', *Journal of Financial Economics*, 65(3), pp. 365–395. https://doi.org/10.1016/S0304-405X(02)00146-0

Fama, E. F. (2009) 'Agency problems and the theory of the firm', *The Economic Nature of the Firm*, 270-282. https://doi.org/10.1017/cbo9780511817410.022

Fama, E.F. and Jensen, M.C. (1983) 'Separation of ownership and control', *Journal of Law and Economics*, 26(2), pp. 301–325. https://doi.org/10.1086/467037

Farah, M.R. and Sönmezer, S. (2022) 'The effects of private equity on the financial performance of firms', *International Journal of Social Science and Human Research*, 5(8). https://doi.org/10.47191/ijsshr/v5-i8-68

Farooque, O., Buachoom, W. and Sun, L. (2019) 'Board, audit committee, ownership and financial performance – emerging trends from Thailand', *Pacific Accounting Review*, 32(1), pp. 54–81. https://doi.org/10.1108/par-10-2018-0079

Fernandes, A. J. C. and Ferreira, J. J. (2021) 'Entrepreneurial ecosystems and networks: a literature review and research agenda', Review of Managerial Science, 16(1), 189-247. https://doi.org/10.1007/s11846-020-00437-6

Ferrati, F. and Muffatto, M. (2021) 'Entrepreneurial finance: Emerging approaches using machine learning and big data', *Foundations and Trends® in Entrepreneurship*, 17(3), pp. 232–329. https://doi.org/10.1561/0300000099

Ferreira, J. J., Fernandes, A. J. C. and Ramírez-Pasillas, M. (2024) 'Start-ups and entrepreneurial ecosystems in the circular economy: A multi-level approach for safe and just planetary boundaries', *International Small Business Journal Researching Entrepreneurship*, 42(4), 416-445. https://doi.org/10.1177/02662426231210765

Field, A. (2024) *Discovering statistics using IBM SPSS statistics*. 6th edn. Sage Publications.

Filatotchev, I. and Nakajima, C. (2014) 'Corporate governance, responsible managerial behaviour, and corporate social responsibility: Organisational efficiency versus organisational legitimacy?', *The Academy of Management Perspectives*, 28(3), pp. 289–306. https://doi.org/10.5465/amp.2014.0014

Filatotchev, I. and Wright, M. (2011) 'Agency perspectives on corporate governance of multinational enterprises', *Journal of Management Studies*, 48(2), pp. 471–486. https://doi.org/10.1111/j.1467-6486.2010.00921.x

Fiorentino, R., Parmentola, A., Sapio, A. and Capurro, R. (2022) 'Entrepreneurial team heterogeneity and performance of academic spin-offs: a pre and postfoundation analysis', *Studies in Higher Education*, 47(10), pp. 2039–2055. https://doi.org/10.1080/03075079.2022.2122658

Firdaus, N. and Kusumastuti, R. (2012) 'How ownership structure influences firm performance in relation to its life cycle', *International Research Journal of Business Studies*, 5(3), pp. 17–29. https://doi.org/10.21632/irjbs.5.3.17-29

Forbes, D., Korsgaard, M.A. and Sapienza, H.J. (2010) 'Financing decisions as a source of conflict in venture boards', *Journal of Business Venturing*, 25(6), pp. 579–592. https://doi.org/10.1016/j.jbusvent.2009.03.001

Fougère, M. and Solitander, N. (2020) 'Dissent in consensusland: An agonistic problematization of multi-stakeholder governance', *Journal of Business Ethics*, 164(4), pp. 683–699. https://doi.org/10.1007/s10551-019-04398-z

Fox, M.B., Gilson, R.J. and Palia, D. (2016) 'Corporate governance changes as a signal: Contextualizing the performance link', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2807926

Francis, J. and Smith, A. (1995) 'Agency costs and innovation some empirical evidence', *Journal of Accounting and Economics*, 19(2), pp. 383–409. https://doi.org/10.1016/0165-4101(94)00389-M

Fraser, S., Bhaumik, S. and Wright, M. (2015) 'What do we know about entrepreneurial finance and its relationship with growth?', *International Small Business Journal: Researching Entrepreneurship*, 33(1), pp. 70–88. https://doi.org/10.1177/0266242614547827

Fu, R., Tang, Y. and Chen, G. (2019) 'Chief sustainability officers and corporate social (ir)responsibility', *Strategic Management Journal*, 41(4), pp. 656–680. https://doi.org/10.1002/smj.3113

Gabrielsson, J. and Huse, M. (2002) 'The venture capitalist and the board of directors in SMEs: roles and processes', *Venture Capital*, 4(2), pp. 125–146. https://doi.org/10.1080/13691060110094397

Gang, K.W., Kim, Y., Kim, B. and Kim, S. (2025) ‘Comparing venture capital syndication and its outcomes in the USA and China: an institutional theory perspective’, *Journal of Enterprising Communities: People and Places in the Global Economy,* 17(6), 1511. https://doi.org/10.1108/jeee-04-2025-0198

Ganotakis, P. and Love, J.H. (2011) 'R&D, product innovation, and exporting: Evidence from UK new technology based firms', *Oxford Economic Papers*, 63(2), pp. 279–306. https://doi.org/10.1093/oep/gpq027

Gantenbein, P., Kind, A. and Volonté, C. (2019) 'Individualism and venture capital: a cross-country study', *Management International Review*, 59(5), pp. 741–777. https://doi.org/10.2139/ssrn.3400870

Garcia-Vega, M. (2006) 'Does technological diversification promote innovation?: An empirical analysis for European firms', *Research Policy*, 35(2), pp. 230–246. https://doi.org/10.1016/j.respol.2005.09.006

Ghio, N., Guerini, M. and Rossi-Lamastra, C. (2017) 'The creation of high-tech ventures in entrepreneurial ecosystems: exploring the interactions among university knowledge, cooperative banks, and individual attitudes', *Small Business Economics*, 52(2), pp. 523–543. https://doi.org/10.1007/s11187-017-9958-3

Ghosh, S. (2020) 'Funding for start-ups in India: what shakes it?', *Journal of Entrepreneurship in Emerging Economies*, 13(5), pp. 1215–1234. https://doi.org/10.1108/jeee-05-2020-0142

Gilson, R. and Black, B. (1996) 'Venture capital and the structure of capital markets: banks versus stock markets', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.46909

Giones, F. and Miralles, F. (2015) 'Do actions matter more than resources? A signalling theory perspective on the technology entrepreneurship process', *Technology Innovation Management Review*, 5(3), pp. 39–45. https://doi.org/10.22215/timreview/880

Giones, F. and Miralles, F. (2015) 'Strategic signaling in dynamic technology markets: lessons from three IT startups in Spain', *Global Business and Organisational Excellence*, 34(6), pp. 42–50. https://doi.org/10.1002/joe.21634

Giudici, G. and Paleari, S. (2000) 'The optimal staging of venture capital financing when entrepreneurs extract private benefits from their firms', *Enterprise and Innovation Management Studies*, 1(2), pp. 153–174. https://doi.org/10.1080/14632440050119578

Giudici, G., Sannajust, A. and Auken, H.E.V. (2021) 'Special issue on small business financing: New actors, new opportunities, new challenges', *Journal of Small Business Management*, 59(1), pp. 1–15. https://doi.org/10.1080/00472778.2020.1865540

Goenawan, H. and Wasistha, G. (2019) 'Analysis of correlation between internal financing and external financing (empirical study on manufacturing companies listed on Indonesia stock exchange during 2010–2015)'. https://doi.org/10.2991/apbec-18.2019.4

Gogineni, S., Linn, S.C. and Yadav, P.K. (2022) 'Vertical and horizontal agency problems in private firms: Ownership structure and operating performance', *Journal of Financial and Quantitative Analysis*, 57(4), pp. 1237–1278. https://doi.org/10.1017/S0022109021000363

Golden, B.R. (1992) 'The past is the past—or is it? The use of retrospective accounts as indicators of past strategy', *Academy of Management Journal*, 35(4), pp. 848–860. https://doi.org/10.5465/256318

Gompers, P. (1995) 'Optimal investment, monitoring, and the staging of venture capital', *The Journal of Finance*, 50(5), p. 1461. https://doi.org/10.2307/2329323

Gompers, P. A., Ishii, J. and Metrick, A. (2001) 'Corporate Governance and Equity Prices'. *The quarterly journal of economics*, 118(1), pp.107-156. https://doi.org/10.3386/w8449

Gompers, P. and Lerner, J. (2001) 'The venture capital revolution', *Journal of Economic Perspectives*, 15(2), pp. 145–168. https://doi.org/10.1257/jep.15.2.145

Gompers, P.A., Gornall, W., Kaplan, S.N. and Strebulaev, I.A. (2020) 'How do venture capitalists make decisions?', *Journal of Financial Economics*, 135(1), pp. 169–190. https://doi.org/10.1016/j.jfineco.2019.06.011

Gormley, T.A. and Matsa, D.A. (2014) 'Common errors: How to (and not to) control for unobserved heterogeneity', *Review of Financial Studies*, 27(2), pp. 617–661. https://doi.org/10.1093/rfs/hht047

Greene, W.H. (2020) *Econometric analysis*. 8th edn. New York: Pearson.

Greenwood, J., Han, P. and Sánchez, J. M. (2022) 'Financing Ventures', *International Economic Review*, 63(3), 1021-1053. https://doi.org/10.1111/iere.12561

Griliches, Z. (1990) 'Patent statistics as economic indicators: A survey', *Journal of Economic Literature*, 28(4), pp. 1661–1707. https://doi.org/10.3386/w3301

Grossman, S.J. and Hart, O.D. (1980) 'Takeover bids, the free-rider problem, and the theory of the corporation', *Bell Journal of Economics*, 11(1), pp. 42–64. https://doi.org/10.2307/3003400

Guerzoni, M., Riso, L. and Vivarelli, M. (2023) 'Was Robert Gibrat right? A test based on the graphical model methodology', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4387928

Guo, D. and Jiang, K. (2022) 'Venture capital investment, intellectual property rights protection and firm innovation: evidence from China', Entrepreneurship *& Regional Development,* 34(5–6). https://doi.org/10.1080/08985626.2022.2062618

Hackett, S.M. and Dilts, D.M. (2004) 'A systematic review of business incubation research', *Journal of Technology Transfer*, 29(1), pp. 55–82. https://doi.org/10.1023/b:jott.0000011181.11952.0f

Hagedoorn, J. (1996) 'Innovation and entrepreneurship: Schumpeter revisited', *Industrial and Corporate Change*, 5(3), pp. 883–896. https://doi.org/10.1093/icc/5.3.883

Hagedoorn, J. and Cloodt, M. (2003) 'Measuring innovative performance: Is there an advantage in using multiple indicators?', *Research Policy*, 32(8), pp. 1365–1379. https://doi.org/10.1016/S0048-7333(02)00137-3

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010) *Multivariate data analysis*. 7th edn. Upper Saddle River, NJ: Prentice Hall.

Haley, C., Van Blitterswijk, D. and Febvre, J. (2019) 'Paths to scale: Finance lessons from European entrepreneurs', NESTA. https://www.nesta.org.uk/documents/1328/Nesta_Scaling_Stories_Update_Web.pdf

Hall, B. (1990) 'The impact of corporate restructuring on industrial research and development', *Economics Working Paper*. University of California, Berkeley. https://doi.org/10.2307/2534781

Hall, B. (2002) 'The financing of research and development', *Oxford Review of Economic Policy*, 18(1), pp. 35–51. https://doi.org/10.1093/oxrep/18.1.35

Hall, B. H., Berndt, E. R. and Levin, R. C. (1990) 'The Impact of Corporate Restructuring on Industrial Research and Development', *Brookings Papers on Economic Activity. Microeconomics*, 1990, 85. https://doi.org/10.2307/2534781

Hall, B.H. and Lerner, J. (2010) 'The financing of R&D and innovation', in Hall, B.H. and Rosenberg, N. (eds.) *Handbook of the economics of innovation*. Vol. 1. Amsterdam: North-Holland, pp. 609–639. https://doi.org/10.1016/S0169-7218(10)01014-2

Hall, B.H. and Ziedonis, R.H. (2001) 'The patent paradox revisited: An empirical study of patenting in the U.S. semiconductor industry, 1979–1995', *RAND Journal of Economics*, 32(1), pp. 101–128. https://www.jstor.org/stable/2696400

Hall, B.H., Jaffe, A.B. and Trajtenberg, M. (2000) 'Market value and patent citations: A first look', *NBER Working Paper 7741*. https://doi.org/10.3386/w7741

Hallen, B. L., Cohen, S. L. and Bingham, C. B. (2020). 'Do Accelerators Work? If So, How?', *Organization Science,* 31(2), 378-414. https://doi.org/10.1287/orsc.2019.1304

Hallen, B.L. and Eisenhardt, K.M. (2012) 'Catalysing strategies and efficient tie formation: How entrepreneurial firms obtain investment ties', *Academy of Management Journal*, 55(1), pp. 35–70. https://doi.org/10.5465/amj.2009.0620

Haltiwanger, J., Jarmin, R.S. and Miranda, J. (2013) 'Who creates jobs? Small versus large versus young', *Review of Economics and Statistics*, 95(2), pp. 347–361. https://doi.org/10.1162/REST_a_00288

Halvorsen, R. and Palmquist, R. (1980) 'The interpretation of dummy variables in semilogarithmic equations', *American Economic Review*, 70(3), pp. 474–475.

Hamdan, A., Khamis, R., Hawaj, A. and Barone, E. (2019) 'The mediation role of public governance in the relationship between entrepreneurship and economic growth', *International Journal of Managerial Finance*, 16(3), pp. 316–333. https://doi.org/10.1108/IJMF-04-2018-0111

Hamelin, A. (2013) 'Influence of family ownership on small business growth: Evidence from French SMEs', *Small Business Economics*, 41, pp. 563–579. https://doi.org/10.1007/s11187-012-9452-x

Han, K. and Suk, D. (1998) 'Insider ownership and signals: Evidence from stock split announcement effects', *Financial Review*, 33(2), pp. 1–18. https://doi.org/10.1111/j.1540-6288.1998.tb01365.x

Hao, H., Guo, L. and Dong, J. (2022) 'How does venture capital cross-border syndication spur corporate innovation? Evidence from China', *Frontiers in Psychology*, 13, 921168. https://doi.org/10.3389/fpsyg.2022.921168

Harrison, J.S., Hitt, M.A., Hoskisson, R.E. and Ireland, R.D. (2001) 'Resource complementarity in business combinations: Extending the logic to organisational alliances', *Journal of Management*, 27(6), pp. 679–690. https://doi.org/10.1177/014920630102700605

Harrison, R.L. (2013) 'Using mixed methods designs in the Journal of Business Research, 1990–2010', *Journal of Business Research*, 66(11), pp. 2153–2162. https://doi.org/10.1016/j.jbusres.2012.01.006

Harrison, R.T. and Mason, C.M. (2000) 'Venture capital market complementarities: The links between business angels and venture capital funds in the United Kingdom', *Venture Capital*, 2(3), pp. 223–242. https://doi.org/10.1080/136910600501350 91

Hausman, J., Hall, B.H. and Griliches, Z. (1984) 'Econometric models for count data with an application to the patents–R&D relationship', *Econometrica*, 52(4), pp. 909–938. https://doi.org/10.3386/t0017

Hausman, J.A. (1978) 'Specification tests in econometrics', *Econometrica*, 46(6), pp. 1251–1271. https://doi.org/10.2307/1913827

Hawas, A. and Tse, C. (2016) 'How corporate governance affects investment decisions of major shareholders in UK listed companies', *Journal of Accounting, Auditing and Finance*, 31(1), pp. 100–133. https://doi.org/10.1177/0148558X15590226

Heaton, J. and Lucas, D. (1995) 'The importance of investor heterogeneity and financial market imperfections for the behaviour of asset prices', *Carnegie–Rochester Conference Series on Public Policy*, 42, pp. 1–32. https://doi.org/10.1016/0167-2231(95)00026-v

Heckman, J.J. (1979) 'Sample selection bias as a specification error', *Econometrica*, 47(1), pp. 153–161. https://doi.org/10.2307/1912352

Hellmann, T. and Puri, M. (2002) 'Venture capital and the professionalisation of start-up firms: Empirical evidence', *Journal of Finance*, 57(1), pp. 169–197. https://doi.org/10.1111/1540-6261.00419

Henderson, R.M. (1993) 'Underinvestment and incompetence as responses to radical innovation: Evidence from the photolithographic alignment equipment industry', *RAND Journal of Economics*, 24(2), pp. 248–270. https://www.jstor.org/stable/2555761

Henrekson, M. and Johansson, D. (2009) 'Gazelles as job creators: A survey and interpretation of the evidence', *Small Business Economics*, 35(2), pp. 227–244. https://doi.org/10.1007/s11187-009-9172-z

Hessels, J. and van Stel, A. (2009) 'Entrepreneurship, export orientation, and economic growth', *Small Business Economics*, 37(2), pp. 255–268. https://doi.org/10.1007/s11187-009-9233-3

Hill, C.W.L. and Snell, S.A. (1988) 'External control, corporate strategy, and firm performance in research-intensive industries', *Strategic Management Journal*, 9(6), pp. 577–590. https://doi.org/10.1002/smj.4250090605

Hill, J.G. (2024) 'Hidden fallacies in the agency theory of the corporation', *ECGI Law Working Paper*, 799. https://doi.org/10.2139/ssrn.4948212

Hill, S.A. and Birkinshaw, J. (2014) 'Ambidexterity and survival in corporate venture units', *Journal of Management*, 40(7), pp. 1899–1931. https://doi.org/10.1177/0149206312445925

Himmelberg, C.P., Hubbard, R.G. and Palia, D. (1999) 'Understanding the determinants of managerial ownership and the link between ownership and performance', *Journal of Financial Economics*, 53(3), pp. 353–384. https://doi.org/10.1016/S0304-405X(99)00025-2

Hirsch, P.M., Michaels, S. and Friedman, R. (1987) '"Dirty hands" versus "clean models": Is sociology in danger of being seduced by economics?', *Theory and Society*, 16(3), pp. 317–336. https://doi.org/10.1007/bf00139485

Hochberg, Y., Ljungqvist, A. and Lu, Y. (2007) 'Whom you know matters: Venture capital networks and investment performance', *Journal of Finance*, 62(1), pp. 251–301. https://doi.org/10.1111/j.1540-6261.2007.01207.x

Hoenig, D. and Henkel, J. (2015) 'Quality signals? The role of patents, alliances, and team experience in venture capital financing', *Research Policy*, 44(5), pp. 1049–1064. https://doi.org/10.1016/j.respol.2014.11.011

Holderness, C.G. (2003) 'A survey of blockholders and corporate control', *Economic Policy Review*, 9(1), pp. 51–64. https://ssrn.com/abstract=281952 or http://dx.doi.org/10.2139/ssrn.281952

Holderness, C.G. (2009) 'The myth of diffuse ownership in the United States', *Review of Financial* Studies, 22(4), pp. 1377–1408. https://doi.org/10.1093/rfs/hhm069

Holmström, B. (1979) 'Moral Hazard and Observability', *The Bell Journal of Economics*, 10(1), 74. https://doi.org/10.2307/3003320

Holmström, B. (1989) 'Agency costs and innovation', *Journal of Economic Behaviour and Organisation*, 12(3), pp. 305–327. https://doi.org/10.1016/0167-2681(89)90025-5

Hong, S., Guerini, M. and Park, H.D. (2025) 'Global connections, local impacts: The enduring effects of international syndication experience on venture capital investments', Entrepreneurship Theory and Practice. https://doi.org/10.1177/10422587251362900

Hornuf, L. and Schwienbacher, A. (2018) ‘Market mechanisms and funding dynamics in equity crowdfunding’, *Journal of Corporate Finance*, 50, pp. 556–574. https://doi.org/10.1016/j.jcorpfin.2017.08.009

Hruskova, M. (2024) ‘Ecosystem pipelines: Collective action in entrepreneurial ecosystems’, *International Small Business Journal*, 42(3). https://doi.org/10.1177/02662426231178381

Hsiao, C. (2022) *Analysis of panel data*. 4th edn. Cambridge: Cambridge University Press.

Hsu, D. and Ziedonis, R. (2013) ‘Resources as dual sources of advantage: Implications for valuing entrepreneurial-firm patents’, *Strategic Management Journal*, 34(7), pp. 761–781. https://doi.org/10.1002/smj.2037

Hsu, D.H. (2004) ‘What do entrepreneurs pay for venture capital affiliation?’, *Journal of Finance*, 59(4), pp. 1805–1844. https://doi.org/10.1111/j.1540-6261.2004.00680.x

Huang, S. and Thakor, A.V. (2013) ‘Investor heterogeneity, investor–management disagreement and share repurchases’, *Review of Financial Studies*, 26(10), pp. 2453–2491. https://doi.org/10.1093/rfs/hht043

Huang, S., Pickernell, D., Battisti, M. and Nguyen, T. (2021) ‘Signalling entrepreneurs’ credibility and project quality for crowdfunding success: Cases from the Kickstarter and Indiegogo environments’, *Small Business Economics*, 58(4), pp. 1801–1821. https://doi.org/10.1007/s11187-021-00477-6

Huang, W., Boateng, A. and Newman, A. (2016) ‘Capital structure of Chinese listed SMEs: An agency theory perspective’, *Small Business Economics*, 47(2), pp. 535–550. https://doi.org/10.1007/s11187-016-9729-6

Huergo, E. and Jaumandreu, J. (2004) ‘How does the probability of innovation change with firm age?’, *Small Business Economics*, 22(3–4), pp. 193–207. https://doi.org/10.1023/B:SBEJ.0000022220.07366.b5

Hyytinen, A. and Pajarinen, M. (2005) ‘External finance, firm growth and the benefits of information disclosure: Evidence from Finland’, *European Journal of Law and Economics*, 19(1), pp. 69–93. https://doi.org/10.1007/s10657-005-5276-3

Ireland, N. (1994) ‘A theory of incentives in procurement and regulation’, *International Journal of Industrial Organisation*, 12(1), pp. 135–136. https://doi.org/10.1016/0167-7187(94)90034-5

Jacobsen, B. (2014) ‘Some research and writing tips (Part 1: Research)’, *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2541366

Janney, J.J. and Folta, T.B. (2003) ‘Signaling through private equity placements and its impact on the valuation of biotechnology firms’, *Journal of Business Venturing*, 18(3), pp. 361–380. https://doi.org/10.1016/S0883-9026(02)00100-3

Janney, J.J. and Folta, T.B. (2006) ‘Moderating effects of investor experience on the signaling value of private equity placements’, *Journal of Business Venturing*, 21(1), pp. 27–44. https://doi.org/10.1016/j.jbusvent.2005.02.008

Jara-Bertín, M., López-Iturriaga, F.J. and López-de-Foronda, Ó. (2008) 'The contest to the control in European family firms: How other shareholders affect firm value', *Corporate Governance: An International Review*, 16(3), pp. 146–159. https://doi.org/10.1111/j.1467-8683.2008.00677.x

Jensen, G.R., Solberg, D.P. and Zorn, T.S. (1992) 'Simultaneous determination of insider ownership, debt, and dividend policies', *Journal of Financial and Quantitative Analysis*, 27(2), pp. 247–263. https://doi.org/10.2307/2331370

Jensen, M. C. (1998) 'Organization Theory and Methodology', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.94036

Jensen, M.C. (1986) 'Agency costs of free cash flow, corporate finance, and takeovers', *American Economic Review*, 76(2), pp. 323–329. https://www.jstor.org/stable/1818789

Jensen, M.C. (2003) *A theory of the firm: Governance, residual claims and organisational forms*. Cambridge, MA: Harvard University Press.

Jensen, M.C. and Meckling, W.H. (1976) 'Theory of the firm: Managerial behaviour, agency costs and ownership structure', *Journal of Financial Economics*, 3(4), pp. 305–360. https://doi.org/10.1016/0304-405X(76)90026-X

Jiang, X. and Yuan, Q. (2018) 'Institutional investors' corporate site visits and corporate innovation', *Journal of Corporate Finance*, 48, pp. 148–168. https://doi.org/10.1016/j.jcorpfin.2017.09.019

Jing, L. and Zhang, H. (2023) 'Venture capitalists on boards and corporate innovation', *Journal of Risk and Financial Management*, 16(3), p. 143. https://doi.org/10.3390/jrfm16030143

Johnson, W. and Sohl, J. (2012) 'Angels and venture capitalists in the initial public offering market', *Venture Capital*, 14(1), pp. 27–42. https://doi.org/10.1080/13691066.2012.660743

Johnston, M.P. (2017) 'Secondary data analysis: A method of which the time has come', *Qualitative and Quantitative Methods in Libraries*, 3(3), pp. 619–626. http://www.qqml-journal.net/index.php/qqml/article/download/169/170

Kahneman, D. and Tversky, A. (1979) 'Prospect theory: An analysis of decision under risk', *Econometrica*, 47(2), pp. 263–291. https://doi.org/10.2307/1914185

Kahneman, D., Slovic, P. and Tversky, A. (1982) *Judgment under uncertainty: Heuristics and biases*. Cambridge: Cambridge University Press.

Kalnins, A. (2018) 'Multicollinearity: How common factors cause Type I errors in multivariate regression', *Strategic Management Journal*, 39(8), pp. 2362–2385. https://doi.org/10.1002/smj.2783

Kaminski, J., Hopp, C. and Tykvová, T. (2019) 'New technology assessment in entrepreneurial financing: Does crowdfunding predict venture capital investments?', *Technological Forecasting and Social* Change, 139, pp. 287–302. https://doi.org/10.1016/j.techfore.2018.11.015

Kang, J., Li, Y. and Oh, S. (2022) 'Venture Capital Coordination in Syndicates, Corporate Monitoring, and Firm Performance', *Journal of Financial Intermediation, 50, 100948*. https://doi.org/10.1016/j.jfi.2022.100948

Kao, M.-F., Hodgkinson, L. and Jaafar, A. (2019) 'Ownership structure, board of directors and firm performance: Evidence from Taiwan', *Corporate Governance: The International Journal of Business in Society*, 19(1), pp. 189–216. https://doi.org/10.1108/CG-04-2018-0144

Kaplan, S. and Strömberg, P. (2003) ‘Financial contracting theory meets the real world: An empirical analysis of venture capital contracts’, *Review of Economic Studies*, 70(2), pp. 281–315. https://doi.org/10.1111/1467-937X.00245

Kaplan, S.N. and Schoar, A. (2005) ‘Private equity performance: Returns, persistence, and capital flows’, *Journal of Finance*, 60(4), pp. 1791–1823. https://doi.org/10.1111/j.1540-6261.2005.00780.x

Kaplan, S.N. and Strömberg, P. (2004) ‘Characteristics, contracts, and actions: Evidence from venture capitalist analyses’, *Journal of Finance*, 59(5), pp. 2177–2210. https://doi.org/10.1111/j.1540-6261.2004.00696.x

Kaplan, S.N. and Strömberg, P. (2009) ‘Leveraged buyouts and private equity’, *Journal of Economic Perspectives*, 23(1), pp. 121–146. https://doi.org/10.1257/jep.23.1.121

Karasek, R. and Bryant, P.C. (2012) ‘Signaling theory: Past, present, and future’, *Academy of Strategic Management Journal*, 11(1), pp. 91–100.

Kaserer, C. and Moldenhauer, B. (2007) ‘Insider ownership and corporate performance: Evidence from Germany’, *Review of Managerial Science*, 2(1), pp. 1–35. https://doi.org/10.1007/s11846-007-0009-3

Katila, R. and Shane, S. (2005) ‘When does lack of resources make new firms innovative?’, *Academy of Management Journal*, 48(5), pp. 814–829. https://doi.org/10.5465/amj.2005.18803924

Kaur, P., Kaur, N. and Kanojia, P. (2021) ‘Firm innovation and access to finance: Firm-level evidence from India’, *Journal of Financial Economic Policy*, 14(1), pp. 93–112. https://doi.org/10.1108/JFEP-07-2020-0161

Kaya, P.H. (2015) ‘Joseph A. Schumpeter’s perspective on innovation’, *International Journal of Economics, Commerce and Management*, 3(8), pp. 25-37. https://ijecm.co.uk/wp-content/uploads/2015/08/383.pdf

Kelly, P. and Hay, M. (2002) ‘Helping hand or watchful eye: An agency theory perspective on private investor–entrepreneur relations’, in Bygrave, W.D. *et al*. (eds.) *Frontiers of entrepreneurship research 2001*: *Proceedings of the 21st Annual Entrepreneurship Research Conference*. Babson College: Babson College Center for Entrepreneurship.

Kerr, W. and Nanda, R. (2015) ‘Financing innovation’, *Annual Review of Financial Economics*, 7(1), pp. 445–462. https://doi.org/10.1146/annurev-financial-111914-041825

Kerr, W. R., Lerner, J. and Schoar, A. (2010) ‘The Consequences of Entrepreneurial Finance: A Regression Discontinuity Analysis’, SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1574358

Kerr, W. R., Lerner, J. and Schoar, A. (2011) ‘The Consequences of Entrepreneurial Finance: Evidence from Angel Financings. Review of Financial Studies, 27(1), 20-55. https://doi.org/10.1093/rfs/hhr098

Ketkar, H. and Roche, M. (2025) ‘Too Much, Too Soon? Early Funding, Technological Unconventionality, and Innovation Capabilities’ *Harvard Business School Strategy Unit Working Paper No. 25-032, Harvard Business School Working Paper No. 25*-032. http://dx.doi.org/10.2139/ssrn.5054860

Ketokivi, M. and Mantere, S. (2010) ‘Two strategies for inductive reasoning in organisational research’, *Academy of Management Review*, 35(2), pp. 315–333. https://doi.org/10.5465/amr.35.2.zok315

Khalidi, M.A., Mohd Saat, N.A., Lau, Y.W. and Abdul Hamid, F. (2025) 'Beyond administration: Unveiling the strategic role of company secretaries in corporate governance – A systematic literature review', *Corporate Board: Role, Duties and Composition*, 21(3), pp. 8–23. https://doi.org/10.22495/cbv21i3art1

Khan, H.u.R., Khidmat, W.B., Al-Hares, O.M., Muhammad, N. and Saleem, K. (2020) 'Corporate governance quality, ownership structure, agency costs and firm performance: Evidence from an emerging economy', *Journal of Risk and Financial Management*, 13(7), p. 154. https://doi.org/10.3390/jrfm13070154

Khattak, S.M., Anwar, M. and Clauss, T. (2021) 'The role of entrepreneurial finance in corporate social responsibility and new venture performance in an emerging market', *Global Business Review*. https://doi.org/10.1177/09713557211025655

Kim, S., Lee, H. and Kim, J. (2016) 'Divergent effects of external financing on technology innovation activity: Korean evidence', *Technological Forecasting and Social Change*, 106, pp. 22–30. https://doi.org/10.1016/j.techfore.2016.02.002

Kim, W.S., Lee, J.W. and Francis, J.C. (1988) 'Investment performance of common stocks in relation to insider ownership', *Financial Review*, 23(1), pp. 53–64. https://doi.org/10.1111/j.1540-6288.1988.tb00774.x

Kiser, E. (1999) 'Comparing Varieties of Agency Theory in Economics, Political Science, and Sociology: An Illustration from State Policy Implementation', *Sociological Theory*, 17(2), 146-170. https://doi.org/10.1111/0735-2751.00073

Klevorick, A.K., Levin, R.C., Nelson, R.R. and Winter, S.G. (1995) 'On the sources and significance of interindustry differences in technological opportunities', *Research Policy*, 24(2), pp. 185–205. https://doi.org/10.1016/0048-7333(93)00762-I

Kline, R.B. (2015) *Principles and practice of structural equation modeling*. 4th edn. New York: Guilford Press.

Knockaert, M., Clarysse, B. and Wright, M. (2010) 'The extent and nature of heterogeneity of venture capital selection behaviour in new technology-based firms', *R&D Management*, 40(4), pp. 357–371. https://doi.org/10.1111/j.1467-9310.2010.00607.x

Knowles, C., Hansen, E. and Shook, S. (2008) 'Assessing innovativeness in the North American softwood sawmilling industry using three methods', *Canadian Journal of Forest Research*, 38(2), pp. 363–375. https://doi.org/10.1139/X07-140

Knyazeva, A., Knyazeva, D. and Masulis, R.W. (2013) 'The supply of corporate directors and board independence', *Review of Financial Studies*, 26(6), pp. 1561–1605. https://doi.org/10.1093/rfs/hht020

Konijn, S.J.J., Kräussl, R. and Lucas, A. (2011) 'Blockholder dispersion and firm value', *Journal of Corporate Finance*, 17(5), pp. 1330–1339. https://doi.org/10.1016/j.jcorpfin.2011.06.005

Kor, Y.Y. and Sundaramurthy, C. (2009) 'Experience-based human capital and social capital of outside directors', *Journal of Management*, 35(4), pp. 981–1004. https://doi.org/10.1177/0149206308321551

Kor, Y.Y., Mahoney, J.T. and Michael, S.C. (2007) 'Resources, capabilities and entrepreneurial perceptions', *Journal of Management Studies*, 44(7), pp. 1187–1212. https://doi.org/10.1111/j.1467-6486.2007.00727.x

Kortum, S. and Lerner, J. (2000) 'Assessing the contribution of venture capital to innovation', *RAND Journal of Economics*, 31(4), pp. 674–692. https://www.jstor.org/stable/2696354

Kothari, C.R. (2004) *Research methodology: Methods and techniques*. 2nd rev. edn. New Delhi: New Age International.

Kowalkowski, C., Wirtz, J. and Ehret, M. (2023) 'Digital service innovation in B2B markets', *Journal of Service Management*, 35(2), pp. 280–305. https://doi.org/10.1108/JOSM-12-2022-0403

Kraemer-Eis, H., Lang, F., Torfs, W. and Gvetadze, S. (2016) *European small business finance outlook June 2016*. EIF Working Paper 2016/35.

Kurlat, P. and Scheuer, F. (2020) 'Signalling to experts'. *The Review of Economic Studies*, *88*(2), pp.800-850. https://doi.org/10.1093/restud/rdaa068

Kutner, M.H., Nachtsheim, C.J., Neter, J. and Li, W. (2005) *Applied linear statistical models*. 5th edn. New York: McGraw-Hill/Irwin.

La Porta, R., Lopez-de-Silanes, F. and Shleifer, A. (1999) 'Corporate ownership around the world', *Journal of Finance*, 54(2), pp. 471–517. https://doi.org/10.1111/0022-1082.00115

La Porta, R., López-de-Silanes, F., Shleifer, A. and Vishny, R.W. (1997) 'Legal determinants of external finance', *Journal of Finance*, 52(3), pp. 1131–1150. https://doi.org/10.1111/j.1540-6261.1997.tb02727.x

Laeven, L. and Levine, R. (2008) 'Complex ownership structures and corporate valuations', *Review of Financial Studies*, 21(2), pp. 579–604. https://doi.org/10.1093/rfs/hhm068

Laino, A. (2011) 'Innovation and monopoly: The position of Schumpeter', paper presented at International Conference, Naples, Italy. https://EconPapers.repec.org/RePEc:pra:mprapa:35321

Lambert, T., Liebau, D. and Roosenboom, P. (2021) 'Security token offerings', *Small Business Economics*, 59(1), pp. 299–325. https://doi.org/10.1007/s11187-021-00539-9

Landström, H. (2023) *Advanced introduction to entrepreneurial finance*. Cheltenham: Edward Elgar.

Lange, J., Leleux, B. and Surlemont, B. (2003) 'Angel networks for the 21st century', *Journal of Private Equity*, 6(2), pp. 18–28. https://doi.org/10.3905/jpe.2003.320036

Leach, J.C. and Melicher, R.W. (2011) *Entrepreneurial finance*. 3rd edn. South-Western Cengage Learning.

Lebret, H. (2018) 'Are biotechnology startups different?', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3161914

Lee, D.S. and Lemieux, T. (2010) 'Regression discontinuity designs in economics', *Journal of Economic Literature*, 48(2), pp. 281–355. https://doi.org/10.1257/jel.48.2.281

Lehnertz, N., Plagmann, C. and Lutz, E. (2022) 'Why deep pockets make great borrowers: An empirical analysis of venture loans', *Journal of Business Economics*, 92(9), pp. 1431–1453. https://doi.org/10.1007/s11573-022-01084-x

Leland, H.E. and Pyle, D.H. (1977) ‘Informational asymmetries, financial structure, and financial intermediation’, *Journal of Finance*, 32(2), pp. 371–387. https://doi.org/10.2307/2326770

Lerner, J. (2022) *Venture capitalists and the oversight of private firms. In Venture capital* (pp. 267-284). Routledge.

Lerner, J. and Nanda, R. (2020) ‘Venture capital’s role in financing innovation: What we know and how much we still need to learn’, *Journal of Economic Perspectives*, 34(3), pp. 237–261. https://doi.org/10.1257/jep.34.3.237

Lerner, J., Sørensen, M. and Strömberg, P. (2011) ‘Private equity and long-run investment: The case of innovation’, *Journal of Finance*, 66(2), pp. 445–477. https://doi.org/10.1111/j.1540-6261.2010.01639.x

Levratto, N., Tessier, L. and Fonrouge, C. (2018) ‘Business performance and angels presence: A fresh look from France 2008–2011’, *Small Business Economics*, 50(2), pp. 339–356. https://doi.org/10.1007/s11187-016-9827-5

Lewis, S. (2015) ‘Qualitative inquiry and research design: Choosing among five approaches’, *Health* Promotion Practice, 16(4), pp. 473–475. https://doi.org/10.1177/1524839915580941

Li, H., Terjesen, S. and Umans, T. (2020) ‘Corporate governance in entrepreneurial firms: a systematic review and research agenda’, *Small Bus Econ* **54**, 43–74 (2020). https://doi.org/10.1007/s11187-018-0118-1

Li, Q., Zhou, W., Zhou, H. and Chen, J. (2021) ‘Do Board Characteristics Matter for Growth Firms? Evidence from China’, *Journal of Risk and Financial Management,* 14(8), 380. https://doi.org/10.3390/jrfm14080380

Lin, Z.J., Liu, S. and Sun, F. (2017) ‘The impact of financing constraints and agency costs on corporate R&D investment: Evidence from China’, *International Review of Finance*, *17*(1), pp.3-42. https://doi.org/10.1111/irfi.12108

Link, A. (2021) ‘Investments in R&D and innovative behaviour: An exploratory cross-country study’, *International Entrepreneurship and Management Journal*, 17(2), pp. 731–739. https://doi.org/10.1007/s11365-020-00703-9

Long, J.S. and Ervin, L.H. (2000) ‘Using heteroscedasticity consistent standard errors in the linear regression model’, *American Statistician*, 54(3), pp. 217–224. https://doi.org/10.2307/2685594

Love, I. (2020) ‘Entrepreneurial access to finance in the US’, *University of Hawai‘i at Mānoa, Department of Economics Working Paper 2020-04*. https://www.economics.hawaii.edu/research/workingpapers/WP_20-04.pdf

Lutz, E., Nörthemann, A. (2025) *Venture Capital Syndication*. In: Cumming, D.J., Hammer, B. (eds) The Palgrave Encyclopedia of Private Equity. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-81653-6_34

Ma, S., Naughton, T. and Tian, G. (2010) ‘Ownership and ownership concentration: Which is important in determining the performance of China’s listed firms?’, *Accounting and Finance*, 50(4), pp. 871–897. https://doi.org/10.1111/j.1467-629X.2010.00353.x

Makhija, P. and Goel, A. (2019) ‘Measuring organizational performance in Indian MSMEs: A qualitative study’, *Journal of Management Research and Analysis*, 6(1), pp. 45–53. https://doi.org/10.18231/j.jmra.2019.009

Manigart, S. and Wright, M. (2013) ‘Venture capital investors and portfolio firms’, *Foundations and Trends in Entrepreneurship*, 9(4–5), pp. 365–570. https://doi.org/10.1561/0300000059

March, J.G. and Shapira, Z. (1987) ‘Managerial perspectives on risk and risk taking’, *Management Science*, 33(11), pp. 1404–1418. https://doi.org/10.1287/mnsc.33.11.1404

Markman, G.D., Balkin, D.B. and Schjoedt, L. (2001) ‘Governing the innovation process in entrepreneurial firms’, *Journal of High Technology Management Research*, 12(2), pp. 273–293. https://doi.org/10.1016/S1047-8310(01)00040-2

Marlow, S. and Patton, D. (2005) ‘All credit to men? Entrepreneurship, finance, and gender’, *Entrepreneurship Theory and Practice*, 29(6), pp. 717–735. https://doi.org/10.1111/j.1540-6520.2005.00105.x

Marquis, C. and Tilcsik, A. (2013) ‘Imprinting: Toward a multilevel theory’, *Academy of Management Annals*, 7(1), pp. 195–245. https://doi.org/10.5465/19416520.2013.766076

Martínez-Fierro, S., Biedma-Ferrer, J. and Ruíz-Navarro, J. (2019) ‘Impact of high-growth start-ups on entrepreneurial environment based on the level of national economic development’, *Business Strategy and the Environment*, 29(3), pp. 1007–1020. https://doi.org/10.1002/bse.2413

Mason, C. (2010) ‘Entrepreneurial finance in a regional economy’, *Venture Capital*, 12(3), pp. 167–172. https://doi.org/10.1080/13691066.2010.507033

Mason, C. and Brown, R. (2013) ‘Creating good public policy to support high-growth firms’, *Small Business Economics*, 40(2), pp. 211–225. https://doi.org/10.1007/s11187-011-9369-9

Mason, C.M. and Harrison, R.T. (2015) ‘Business angel investment activity in the financial crisis: UK evidence and policy implications’, *Environment and Planning C: Government and Policy*, 33(1), pp. 43–60. https://doi.org/10.1068/c12324b

Maury, B. and Pajuste, A. (2005) ‘Multiple large shareholders and firm value’, *Journal of Banking and Finance*, 29(7), pp. 1813–1834. https://doi.org/10.1016/j.jbankfin.2004.07.002

McConnell, J.J. and Servaes, H. (1990) ‘Additional evidence on equity ownership and corporate value’, *Journal of Financial Economics*, 27(2), pp. 595–612. https://doi.org/10.1016/0304-405X(90)90069-C

Megginson, W.L. and Weiss, K.A. (1991) ‘Venture capitalist certification in initial public offerings’, *Journal of Finance*, 46(3), pp. 879–903. https://doi.org/10.1111/j.1540-6261.1991.tb03770.x

Menard, S. (2001) *Applied logistic regression analysis*. 2nd edn. Thousand Oaks, CA: Sage Publications.

Ménière, Y., Grilli, M., Rudyk, I., Terzić, K., Wajsman, N. and Kazimierczak, M. (2023) *Patents, trademarks and startup finance: Funding and exit performance of European startups.* Alicante: European Union Intellectual Property Office (EUIPO).

Mercer, M. (2004) ‘How do investors assess the credibility of management disclosures?’, *Accounting Horizons*, 18(3), pp. 185–196. https://doi.org/10.2308/acch.2004.18.3.185

Mersland, R. (2009) 'The governance of non-profit micro finance institutions: Lessons from history', Journal of Management and Governance, 15(3), pp. 327–348. https://doi.org/10.1007/s10997-009-9116-7

Meuleman, M., Wright, M., Manigart, S. and Lockett, A. (2009) 'Private Equity Syndication: Agency Costs, Reputation and Collaboration', *Journal of Business Finance & Accounting*, 36(5-6), 616-644. https://doi.org/10.1111/j.1468-5957.2009.02124.x

Miguel, A., Pindado, J. and de la Torre, C. (2004) 'Ownership structure and firm value: New evidence from Spain', *Strategic Management Journal*, 25(12), pp. 1199–1207. https://doi.org/10.1002/smj.430

Mikhailov, A., Wegner, D. and Thomas, E. (2024) 'The Micro-Governance of Collaborative Networks: Promoting Entrepreneurial Ecosystems', *Journal of Technology Management & Innovation*, 19(4). https://doi.org/10.4067/s0718-27242024000400064

Miller, C.C., Cardinal, L.B. and Glick, W.H. (1997) 'Retrospective reports in organizational research: A reexamination of recent evidence', *Academy of Management Journal*, 40(1), pp. 189–204. https://doi.org/10.5465/257026

Miller, T. and Triana, M. (2009) 'Demographic diversity in the boardroom: Mediators of the board diversity–firm performance relationship', *Journal of Management Studies*, 46(5), pp. 755–786. https://doi.org/10.1111/j.1467-6486.2009.00839.x

Millot, V. (2009) 'Trademarks as an indicator of product and marketing innovations', *OECD Science, Technology and Industry Working Papers*, 2009/06. https://doi.org/10.1787/224428874418

Miloud, T., Aspelund, A. and Cabrol, M. (2012) 'Startup valuation by venture capitalists: An empirical study', *Venture Capital*, 14(2–3), pp. 151–174. https://doi.org/10.1080/13691066.2012.667907

Mitnick, B.M. (1975) 'The Theory of Agency: A Framework'. *In: Barry M. Mitnick, The Theory of Agency (Cambridge University Press, Forthcoming)*. http://dx.doi.org/10.2139/ssrn.1021642

Mitteness, C., Sudek, R. and Cardon, M.S. (2012) 'Angel investor characteristics that determine whether perceived passion leads to higher evaluations of funding potential', *Journal of Business Venturing*, 27(5), pp. 592–606. https://doi.org/10.1016/j.jbusvent.2011.11.003

Modigliani, F. and Miller, M.H. (1958) 'The cost of capital, corporation finance and the theory of investment', *American Economic Review*, 48(3), pp. 261–297.

Mollick, E. (2014) 'The dynamics of crowdfunding: An exploratory study', *Journal of Business Venturing*, 29(1), pp. 1–16. https://doi.org/10.1016/j.jbusvent.2013.06.005

Mönkemeyer, M., Rennertseder, K. and Schröder, H. (2026) 'Investor heterogeneity and venture performance', *Journal of Business Venturing*, 41(1), 106524. https://doi.org/10.1016/j.jbusvent.2025.106524

Moon, C. and Acquaah, M. (2020) 'Performance implications of combining creative and imitative innovation strategies', *European Journal of Innovation Management*, 25(1), pp. 214–232. https://doi.org/10.1108/EJIM-06-2020-0213

Morales, P., Flikkema, M., Castaldi, C. and den Man, A.P. (2024) 'When do trademarks improve the measurement of innovation? An analysis of innovations from Dutch SMEs', *Science and Public Policy*, 51(5), pp. 923–938. https://doi.org/10.1093/scipol/scae035

Morck, R., Shleifer, A. and Vishny, R.W. (1988) ‘Management ownership and market valuation: An empirical analysis’, *Journal of Financial Economics*, 20, pp. 293–315. https://doi.org/10.1016/0304-405X(88)90048-7

Moreno, J.D.J. and Castillo, L.L. (2011) ‘Corporate growth, age and ownership structure: empirical evidence in Spanish firms’, *Journal of Business Economics and Management*, *12*(1), pp.164-196. https://doi.org/10.3846/16111699.2011.555449

Moritz, A. and Block, J.H. (2016) ‘Crowdfunding: A literature review and research directions’, in Brüntje, D. and Gajda, O. (eds.) *Crowdfunding in Europe: State of the art in theory and practice*. Cham: Springer, pp. 25–53. https://doi.org/10.1007/978-3-319-18017-5_3

Morris, R.D. (1987) ‘Signalling, agency theory and accounting policy choice’, *Accounting and Business Research*, 18(69), pp. 47–56. https://doi.org/10.1080/00014788.1987.9729347

Mousa, F.-T. and Wales, W.J. (2012) ‘Founder effectiveness in leveraging entrepreneurial orientation’, *Management Decision*, 50(2), pp. 305–324. https://doi.org/10.1108/00251741211203588

Mudambi, R. and Nicosia, C. (1998) ‘Ownership structure and firm performance: evidence from the UK financial services industry’, *Applied Financial Economics*, 8(2), 175-180. https://doi.org/10.1080/096031098333159

Murphy, G.B., Trailer, J.W. and Hill, R.C. (1996) ‘Measuring business performance in entrepreneurship research’, *Journal of Business Venturing*, 11(5), pp. 403–423. https://doi.org/10.1016/0148-2963(95)00159-X

Musso, P. and Schiavo, S. (2008) ‘The impact of financial constraints on firm survival and growth’, *Journal of Evolutionary Economics*, 18(2), pp. 135–149. https://doi.org/10.1007/s00191-007-0087-z

Myers, R.H. (1990) *Classical and modern regression with applications*. 2nd edn. Boston, MA: Duxbury.

Myers, S.C. (1984) ‘The capital structure puzzle’, *Journal of Finance*, 39(3), pp. 574–592. https://doi.org/10.1111/j.1540-6261.1984.tb03646.x

Myers, S.C. and Majluf, N.S. (1984) ‘Corporate financing and investment decisions when firms have information that investors do not have’, *Journal of Financial Economics*, 13(2), pp. 187–221. https://doi.org/10.1016/0304-405X(84)90023-0

Nadeau, P. (2010) ‘Venture capital investment selection: Do patents attract investors?’, *Strategic Change*, 19(7–8), pp. 325–342. https://doi.org/10.1002/jsc.879

Nadeau, P. (2011) ‘Innovation and venture capital exit performance’, *Strategic Change*, 20(7–8), pp. 233–252. https://doi.org/10.1002/jsc.898

Naqshbandi, M.M. (2016) ‘Managerial ties and open innovation: Examining the role of absorptive capacity’, *Management Decision*, 54(9), pp. 2256–2276. https://doi.org/10.1108/MD-03-2016-0161

National Science Foundation (2014) *National survey of industrial research and development (NSIRD)*. Washington, DC: NSF.

Neckebrouck, J., Manigart, S. and Meuleman, M. (2019) ‘Attitudes of family firms toward outside investors: The importance of organisational identification’, *Entrepreneurship Theory and Practice*, 43(3), pp. 567–593. https://doi.org/10.4324/9781351202152-3

Nelson, R.R. and Winter, S.G. (1982) *An evolutionary theory of economic change*. Cambridge, MA: Harvard University Press.

NESTA (2006) *The innovation gap: Why policy needs to reflect the reality of innovation in the UK*. London: NESTA.

Nguyen, D.N., Tran, Q. and Truong, Q. (2021) 'The ownership concentration–innovation nexus: Evidence from SMEs around the world', *Emerging Markets Finance and Trade*, 57(11), pp. 3171–3190. https://doi.org/10.1080/1540496X.2020.1870954

Nguyen, M., Pham, T., Ho, M., Huyền, N.T.T. and Vuong, Q.-H. (2020) 'On the social and conceptual structure of the 50-year research landscape in entrepreneurial finance', *SN Business & Economics*, 1(1), 2. https://doi.org/10.1007/s43546-020-00002-z

Nofsinger, J.R. and Wang, W. (2011) 'Determinants of start-up firm external financing worldwide', *Journal of Banking and Finance*, 35(9), pp. 2282–2294. https://doi.org/10.1016/j.jbankfin.2011.01.024

North, D., Baldock, R. and Ullah, F. (2013) 'Funding the growth of UK technology-based small firms since the financial crash: Are there breakages in the finance escalator?', *Venture Capital*, 15(3), pp. 237–260. https://doi.org/10.1080/13691066.2013.804755

O'Reilly, C.A. and Tushman, M.L. (2013) 'Organizational ambidexterity: Past, present, and future', *Academy of Management Perspectives*, 27(4), pp. 324–338. https://doi.org/10.5465/amp.2013.0025

Oakey, R.P. (2003) 'Technical entrepreneurship in high technology small firms: Some observations on the implications for management', *Technovation*, 23(8), pp. 679–688. https://doi.org/10.1016/S0166-4972(03)00045-2

OECD (2014) *OECD science, technology and industry outlook 2014*. Paris: OECD.

OECD (2024) *Financing high-growth enterprises: The role of government venture capital*. OECD SME and Entrepreneurship Papers, No. 42. Paris: OECD Publishing.

Office for National Statistics (ONS) (2021) 'UK trade in goods, year in review: 2021', *ONS Article*. https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/articles/uktradeingoodsyearinreview/2021

Office for National Statistics (ONS) (2022) 'How the COVID-19 pandemic shocked the UK economy', *ONS Article*. https://www.ons.gov.uk/economy/grossdomesticproductgdp/articles/gdpandeventsinhistoryhowthecovid19pandemicshockedtheukeconomy/2022-05-24

Osborne, J.W. (2002) 'Notes on the use of data transformations', *Practical Assessment, Research, and Evaluation*, 8(6), pp. 1–7. https://doi.org/10.7275/4VNG-5608

O'Sullivan, M. (2009) 'Finance and Innovation; *The Oxford Handbook of Innovation*. Oxford: Oxford University Press, 240-265. https://doi.org/10.1093/oxfordhb/9780199286805.003.0009

Owen, R. and Mason, C. (2016) 'The role of government co-investment funds in the supply of entrepreneurial finance: An assessment of the early operation of the UK Angel Co-investment Fund', *Environment and Planning C: Government and Policy*, 35(3), pp. 434–456. https://doi.org/10.1177/0263774X16667072

Pagano, M. and Röell, A. (1998) 'The choice of stock ownership structure: Agency costs, monitoring, and the decision to go public', *Quarterly Journal of Economics*, 113(1), pp. 187–225. https://doi.org/10.1162/003355398555568

Palia, D. and Lichtenberg, F. (1999) 'Managerial ownership and firm performance: A re-examination using productivity measurement', *Journal of Corporate Finance*, 5(4), pp. 323–339. https://doi.org/10.1016/s0929-1199(99)00009-7

Pallathadka, H. (2022) 'Challenges for financing startups in China: A quantitative investigation of small and medium ventures', *Integrated Journal for Research in Arts and Humanities*, 2(6), pp. 232–238. https://doi.org/10.55544/IJRAH.2.6.31

Panda, B. and Leepsa, N.M. (2017) 'Agency theory: Review of theory and evidence on problems and perspectives', *Indian Journal of Corporate Governance*, 10(1), pp. 74–95. https://doi.org/10.1177/0974686217701467

Pandher, G.S. (2018) 'Financier search and boundaries of the angel and VC markets', *Entrepreneurship Theory and Practice*, 43(6), pp. 1223–1249. https://doi.org/10.1177/1042258718780476

Pantea, S. and Tkáčik, M. (2024) 'Venture capital and high-tech start-ups in Europe: A systematic review of the empirical evidence', *Venture Capital*, 27(4), pp. 435–458. https://doi.org/10.1080/13691066.2024.2315069

Papke, L.E. and Wooldridge, J.M. (1996) 'Econometric methods for fractional response variables with an application to 401(k) plan participation rates', *Journal of Applied Econometrics*, 11(6), pp. 619–632. https://doi.org/10.1002/(SICI)1099-1255(199611)11:6<619::AID-JAE418>3.0.CO;2-1

Park, J.S. (2005) 'Opportunity recognition and product innovation in entrepreneurial hi-tech start-ups: A new perspective and supporting case study', *Technovation*, 25(7), pp. 739–752. https://doi.org/10.1016/j.technovation.2004.01.006

Park, S. (2023) 'Internationalization and firm performance: moderating role of multi-stakeholder initiatives', *Multinational Business Review*, 31(4), 518-544. https://doi.org/10.1108/mbr-10-2022-0168

Park, S., LiPuma, J. and Park, S. (2019) 'Concentrating too hard? Foreign and corporate venture capital involvement in syndicates', *Journal of Small Business Management*, 57(2), pp. 327–342. https://doi.org/10.1111/jsbm.12322

Parker, D., Dressel, U., Chevers, D. and Zeppetella, L. (2018) 'Agency theory perspective on public-private-partnerships: International development project', *International Journal of Productivity and Performance Management*, 67(2), pp. 239–259. https://doi.org/10.1108/IJPPM-09-2016-0191

Pasanen, M. (2003) *In search of factors affecting SME performance: The case of Eastern Finland*. Kuopio: University of Kuopio.

Pauwels, C., Clarysse, B., Wright, M. and Van Hove, J. (2016) 'Understanding a new generation incubation model: The accelerator', *Technovation*, 50–51, pp. 13–24. https://doi.org/10.1016/j.technovation.2015.09.003

Peasnell, K.V., Pope, P.F. and Young, S. (2001) 'Board monitoring and earnings management: Do outside directors influence abnormal accruals?', *Journal of Business Finance & Accounting*, 32(7–8), pp. 1311–1346. https://doi.org/10.1111/j.0306-686x.2005.00630.x

Penrose, E. (1995) *The theory of the growth of the firm*. 3rd edn. Oxford: Oxford University Press.

Perrow, C. (1986) *Complex organisations: A critical essay*. 3rd edn. New York: McGraw-Hill.

Piazza, A. (2018) 'Essays on angel investing in the entrepreneurial ecosystem', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3367653

Pollock, T.G. and Gulati, R. (2007) 'Standing out from the crowd: The visibility-enhancing effects of IPO-related signals on alliance formation by entrepreneurial firms', *Strategic Organisation*, 5(4), pp. 339–372. https://doi.org/10.1177/1476127007083346

Pomponi, F., Fratocchi, L. and Tafuri, S.R. (2015) 'Trust development and horizontal collaboration in logistics: A theory-based evolutionary framework', *Supply Chain Management: An International Journal*, 20(1), pp. 83–97. https://doi.org/10.1108/SCM-02-2014-0078

Pontoh, W. and Budiarso, N. (2018) 'Firm characteristics and capital structure adjustment', *Investment Management and Financial Innovations*, 15(2), pp. 129–144. https://doi.org/10.21511/imfi.15(2).2018.12

Popa, F. (2016) 'Aspects concerning endogenous growth in the macroeconomic theories', *Economics, Management and Financial Markets*, 11(1). P. 231

Portal, M., Zani, J. and Silva, C. (2012) 'Financial frictions and substitution between internal and external funds in publicly traded Brazilian companies', *Revista Contabilidade & Finanças*, 23(58), pp. 19–32. https://doi.org/10.1590/S1519-70772012000100002

Proença, S. and Soukiazis, E. (2022) 'The importance of entrepreneurship on economic development: Evidence from the OECD countries', in *European Conference on Innovation and Entrepreneurship*, 17(1), pp. 416–422. https://doi.org/10.34190/ECIE.17.1.664

Prugsamatz, N. (2021) 'CEO dominance and firm innovation effort', *Managerial Finance*, 47(7), pp. 998–1015. https://doi.org/10.1108/MF-05-2020-0235

Puri, M. and Zarutskie, R. (2012) 'On the life cycle dynamics of venture-capital- and non-venture-capital-financed firms', *Journal of Finance*, 67(6), pp. 2247–2293. https://doi.org/10.1111/j.1540-6261.2012.01786.x

Putri, I. (2023) 'Financial performance and firm value: The role of signaling theory', *International Journal of Scientific Research and Management*, 11(4), pp. 4776–4783. https://doi.org/10.18535/ijsrm/v11i04.em01

Puyvelde, S., Caers, R., Bois, C. and Jegers, M. (2014) 'Managerial objectives and the governance of public and non-profit organisations', *Public Management Review*, 18(2), pp. 221–237. https://doi.org/10.1080/14719037.2014.969760

Pyka, A. and Burghof, H.-P. (2013) *Innovation and Finance*. London: Routledge.

Qiao, H., Zhang, S. and Xiao, Y. (2021) 'Modeling the Impacts of Venture Capital Investment on Firm Innovation', *Discrete Dynamics in Nature and Society*, 2021, 8661152. https://doi.org/10.1155/2021/8661152

Ragozzino, R. and Reuer, J.J. (2007) 'Initial public offerings and the acquisition of entrepreneurial firms', *Strategic Organisation*, 5(2), pp. 155–176. https://doi.org/10.1177/1476127007079139

Rashid, N., Ismail, W.N.S.W., Rahman, M.S.A. and Afthanorhan, A. (2018) 'Conceptual analysis on performance measurement used in SMEs research: The effectiveness of firm's overall performance', *International Journal of Academic Research in Business and Social Sciences*, 8(11), pp. 1401–1412. https://doi.org/10.6007/ijarbss/v8-i11/5199

Reeb, D.M. and Zhao, W. (2020) 'Patents do not measure innovation success', *Critical Finance Review*. https://doi.org/10.1561/104.00000087

Reed, W.R. and Ye, H. (2011) 'Which panel data estimator should I use?', *Applied Economics*, 43(8), pp. 985–1000. https://doi.org/10.1080/00036840802600087

Rhoades, S.A. (1993) 'The Herfindahl–Hirschman index', *Federal Reserve Bulletin*, 79, p. 188.

Rin, M., Nicodano, G. and Sembenelli, A. (2006) 'Public policy and the creation of active venture capital markets', *Journal of Public Economics*, 90(8–9), pp. 1699–1723. https://doi.org/10.1016/j.jpubeco.2005.09.013

Rindfleisch, A., Malter, A.J., Ganesan, S. and Moorman, C. (2008) 'Cross-sectional versus longitudinal survey research: Concepts, findings, and guidelines', *Journal of Marketing Research*, 45(3), pp. 261–279. https://doi.org/10.1509/jmkr.45.3.261

Rita, M. and Muharam, H. (2018) 'Entrepreneurial finance perspective: Highlighting from the supply side', *Jurnal Keuangan Dan Perbankan*, 22(3). https://doi.org/10.26905/jkdp.v22i3.2096

Robb, A.M. and Robinson, D.T. (2014) 'The capital structure decisions of new firms', *Review of Financial Studies*, 27(1), pp. 153–179. https://doi.org/10.1093/rfs/hhs072

Rosopa, P.J., Schaffer, M.M. and Schroeder, A.N. (2013) 'Managing heteroscedasticity in general linear models', *Psychological Methods*, 18(3), pp. 335–351. https://doi.org/10.1037/a0032553

Ross, S.A. (1973) 'The economic theory of agency: The principal's problem', *American Economic Review*, 63(2), pp. 134–139. https://www.jstor.org/stable/1817064

Rusnaeni, N., Gursinda, H., Sasongko, H. and Hakim, D. (2022) 'Financial performance, institutional ownership, size, and firm value: A structural equation modeling approach', *International Journal of Economics, Business and Accounting Research*, 6(1), p. 799. https://doi.org/10.29040/ijebar.v6i1.3856

Ryu, S. and Won, J. (2022) 'The value relevance of operational innovation: Insights from the perspective of firm life cycle', *Sustainability*, 14(4), p. 2058. https://doi.org/10.3390/su14042058

Sahlman, W.A. (1990) 'The structure and governance of venture-capital organisations', *Journal of Financial Economics*, 27(2), pp. 473–521. https://doi.org/10.1016/0304-405X(90)90065-8

Sampat, B.N. (2018) 'A survey of empirical evidence on patents and innovation', *NBER Working Paper 25383*. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w25383

Sánchez-Ballesta, J.P. and García-Meca, E. (2007) 'A meta-analytic vision of the effect of ownership structure on firm performance', *Corporate Governance: An International Review*, 15(5), pp. 879–892. https://doi.org/10.1111/j.1467-8683.2007.00604.x

Sanders, M., Stenkula, M., Dunstan, J., Estrin, S., Herrmann, A.M., Páger, B., Szerb, L. and Terragno Bogliaccini, E. (2020) 'A reform strategy for the UK', in Fritsch, M. (ed.) *The entrepreneurial society:*

A reform strategy for Italy, Germany and the UK. Berlin: Springer, pp. 203–246. https://doi.org/10.1007/978-3-662-61007-7_8

Santos, A.M., Cincera, M. and Cerulli, G. (2024) ‘Sources of financing: Which ones are more effective in innovation–growth linkage?’, *Economic Systems*, *48*(2), p.101177. https://doi.org/10.1016/j.ecosys.2023.101177

Sapienza, H.J., Manigart, S. and Vermeir, W. (1996) 'Venture capitalist governance and value added in four countries', *Journal of Business Venturing*, 11(6), pp. 439–469. https://doi.org/10.1016/S0883-9026(96)00052-3

Sardo, F. and Serrasqueiro, Z. (2021) 'Intellectual capital and high-tech firms' financing choices in the European context: A panel data analysis', *Quantitative Finance and Economics*, 5(1), pp. 1–18. https://doi.org/10.3934/QFE.2021001

Sasse, R., Mladenow, A., Strauß, C. and Schaffhauser-Linzatti, M. (2018) 'Public initiatives to improve conditions for high tech start-ups', in *Proceedings of the 20th International Conference on Information Integration and Web-Based Applications and Services*. New York: ACM, pp. 381–390. https://doi.org/10.1145/3282373.3282425

Saty Kouame, D. and Ivanaj, S. (2017) 'French technology start-ups: How and why are they succeeding?', *HAL Archives Ouvertes*. https://www.inderscienceonline.com/doi/abs/10.1504/IJESB.2017.082908

Saunders, M., Lewis, P. and Thornhill, A. (2019) *Research methods for business students*. 8th edn. Harlow: Pearson.

Schiehll, E. (2006) 'Ownership structure, large inside/outside shareholders, and firm performance: Evidence from Canada', *Corporate Ownership and Control*, 3(3), pp. 96–112. https://doi.org/10.22495/cocv3i3p8

Schilirò, D. (2019) 'The growth conundrum: Paul Romer's endogenous growth', *International Business Research*, 12(10), p. 75. https://doi.org/10.5539/ibr.v12n10p75

Schillemans, T. and Bjurstrøm, K. (2019) 'Trust and verification: Balancing agency and stewardship theory in the governance of agencies', *International Public Management Journal*, 23(5), pp. 650–676. https://doi.org/10.1080/10967494.2018.1553807

Schmidheiny, K. and Basel, U. (2011) 'Panel data: Fixed and random effects', *Short Guides to Microeconometrics*, 7(1), pp. 2–7.

Schückes, M. and Gutmann, T. (2020) 'Why do startups pursue initial coin offerings (ICOs)? The role of economic drivers and social identity on funding choice', *Small Business Economics*, 57(2), pp. 1027–1052. https://doi.org/10.1007/s11187-020-00337-9

Schumpeter, J.A. (1934) *The theory of economic development*. Cambridge, MA: Harvard University Press.

Schumpeter, J.A. (1976) *Capitalism, Socialism and Democracy*. London: Routledge.

Schwandt, T.A. (1994) 'Constructivist, interpretivist approaches to human inquiry', in Denzin, N.K. and Lincoln, Y.S. (eds.) *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications, pp. 118–137.

Selling, T.I. and Stickney, C.P. (1989) 'The effects of business environment and strategy on a firm's rate of return on assets', *Financial Analysts Journal*, 45(1), pp. 43–52. https://doi.org/10.2469/faj.v45.n1.43

Shadish, W.R., Cook, T.D. and Campbell, D.T. (2002) *Experimental and quasi-experimental designs for generalised causal inference*. Boston, MA: Houghton Mifflin.

Shah, D. and Zaveri, T. (2021) 'Hyperspectral endmember extraction using Pearson's correlation coefficient', *International Journal of Computational Science and Engineering*, 24(1), p. 89. https://doi.org/10.1504/IJCSE.2021.113656

Shane, S. (2012) 'The importance of angel investing in financing the growth of entrepreneurial ventures', *Quarterly Journal of Finance*, 2(2), 1250009. https://doi.org/10.1142/S2010139212500097

Shleifer, A. and Vishny, R.W. (1986) 'Large shareholders and corporate control', *Journal of Political Economy*, 94(3), pp. 461–488. https://doi.org/10.1086/261385

Shleifer, A. and Vishny, R.W. (1989) 'Management entrenchment: The case of manager-specific investments', *Journal of Financial Economics*, 25(1), pp. 123–139. https://doi.org/10.1016/0304-405x(89)90099-8

Shleifer, A. and Vishny, R.W. (1997) 'A survey of corporate governance', *Journal of Finance*, 52(2), pp. 737–783. https://doi.org/10.1111/j.1540-6261.1997.tb04820.x

Shneor, R. and Munim, Z.H. (2019) 'Reward crowdfunding contribution as planned behaviour: An extended framework', *Journal of Business Research*, 103, pp. 56–70. https://doi.org/10.1016/j.jbusres.2019.06.013

Short, H. and Keasey, K. (1999) 'Managerial ownership and the performance of firms: Evidence from the UK', *Journal of Corporate Finance*, 5(1), pp. 79–101. https://doi.org/10.1016/s0929-1199(98)00016-9

Sidek, S., Mohamad, M. and Nasir, W. (2016) 'Entrepreneurial orientation, access to finance and business performance: A preliminary analysis', *International Journal of Academic Research in Business and Social Sciences*, 6(11). https://doi.org/10.6007/IJARBSS/V6-I11/2452

Siedschlag, I., Kaitila, V., McQuinn, J. and Zhang, X. (2014) 'International investment and firm performance: Empirical evidence from small open economies', *Jahrbücher Für Nationalökonomie Und Statistik*, 234(6), pp. 662–687. https://doi.org/10.1515/jbnst-2014-0603

Siedschlag, I., O'Toole, C., Murphy, G. and O'Connell, B. (2014a) 'Access to external financing and firm growth', *Background Study for the European Competitiveness Report*, 1(4). https://www.esri.ie/system/files/publications/BKMNEXT287%20%281%29.pdf

Sieger, P. and Minola, T. (2016) 'The family's financial support as a "poisoned gift": A family embeddedness perspective on entrepreneurial intentions', *Journal of Small Business Management*, 55, pp. 179–204. https://doi.org/10.1111/jsbm.12273

Sijabat, Y., Sinabutar, M., Hirawati, H. and Giovanni, A. (2020) 'The determination of concentration and type of ownership on bank performance and risks in Indonesia', *Society*, 8(1), pp. 191–203. https://doi.org/10.33019/society.v8i1.152

Singh, S. and Subrahmanya, M. (2021) 'Sources of finance for tech startups over its lifecycle: What determines their approach of sources and its success?', *International Journal of Emerging Markets*, 18(8), pp. 1766–1787. https://doi.org/10.1108/IJOEM-06-2020-0705

Smith, E. (2008) *Using secondary data in educational and social research*. Maidenhead: Open University Press.

Sorenson, O. and Stuart, T. (2000) 'Syndication networks and the spatial distribution of venture capital investments', *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.220451

Sorescu, A.B., Chandy, R.K. and Prabhu, J.C. (2003) 'Sources and financial consequences of radical innovation: Insights from pharmaceuticals', *Journal of Marketing*, 67(4), pp. 82–102. https://doi.org/10.1509/jmkg.67.4.82.18687

Sørheim, R. (2005) 'Business angels as facilitators for further finance: An exploratory study', *Journal of Small Business and Enterprise Development*, 12(2), pp. 178–191. https://doi.org/10.1108/14626000510594593

Spence, M. (1973) 'Job market signaling', *Quarterly Journal of Economics*, 87(3), pp. 355–374. https://doi.org/10.2307/1882010

Spence, M. (1976) 'Informational aspects of market structure: An introduction', *Quarterly Journal of Economics*, 90(4), pp. 591–597. https://doi.org/10.2307/1885323

Spence, M. (2002) 'Signaling in retrospect and the discovery of pooling equilibria', *American Economic Review*, 92(3), pp. 434–442. https://doi.org/10.1257/00028280260136200

Stam, E. (2015) 'Entrepreneurial ecosystems and regional policy: A sympathetic critique', *European Planning Studies*, 23(9), pp. 1759–1769. https://doi.org/10.1080/09654313.2015.1061484

Stam, E. and Ven, A. V. d. (2021) 'Entrepreneurial ecosystem elements', *Small Business Economics*, 56(2), 809-832. https://doi.org/10.1007/s11187-019-00270-6

Stevens, J.P. (2009) *Applied multivariate statistics for the social sciences*. 5th edn. New York: Routledge.

Stevenson, R., McMahon, S., Letwin, C. and Ciuchta, M. (2021) 'Entrepreneur fund-seeking: Toward a theory of funding fit in the era of equity crowdfunding', *Small Business Economics*, 58(4), pp. 2061–2086. https://doi.org/10.1007/s11187-021-00499-0

Stinchcombe, A.L. (1965) 'Social structure and organisations', in March, J.G. (ed.) *Handbook of organisations*. Chicago: Rand McNally, pp. 142–193.

Stuart, T.E., Hoang, H. and Hybels, R.C. (1999) 'Interorganisational endorsements and the performance of entrepreneurial ventures', *Administrative Science Quarterly*, 44(2), pp. 315–349. https://doi.org/10.2307/2666998

Stulz, R. (1988) 'Managerial control of voting rights: Financing policies and the market for corporate control', *Journal of Financial Economics*, 20, pp. 25–54. https://doi.org/10.1016/0304-405x(88)90039-6

Subrahmanya, M. (2022) 'Competitiveness of high-tech start-ups and entrepreneurial ecosystems: An overview', *International Journal of Global Business and Competitiveness*, 17(1), pp. 1–10. https://doi.org/10.1007/s42943-022-00056-w

Sureiman, O. and Mangera, C. (2020) 'F-test of overall significance in regression analysis simplified', *Journal of the Practice of Cardiovascular Sciences*, 6(2), p. 116. https://doi.org/10.4103/jpcs.jpcs_18_20

Susilowati, R.Y.N., Alvia, L. and Desriani, N. (2023) 'Performance evaluation model of startup companies in ASEAN countries', in *Proceedings of the 6th International Conference of Economics, Business, and Entrepreneurship (ICEBE 2023)*. https://doi.org/10.4108/eai.13-9-2023.2341230

Sutton, R.I. and Staw, B.M. (1995) 'What theory is not', *Administrative Science Quarterly*, 40(3), pp. 371–384. https://doi.org/10.2307/2393788

Svetek, M. (2022) 'Signaling in the context of early-stage equity financing: Review and directions', *Venture Capital*, 24(1), pp. 71–104. https://doi.org/10.1080/13691066.2022.2063092

Swiercz, P.M. and Lydon, S.R. (2002) 'Entrepreneurial leadership in high-tech firms: A field study', *Leadership & Organisation Development Journal*, 23(7), pp. 380–389. https://doi.org/10.1108/01437730210445810

Sydow, J., Schreyögg, G. and Koch, J. (2009) 'Organisational path dependence: Opening the black box', *Academy of Management Review*, 34(4), pp. 689–709. https://doi.org/10.5465/amr.34.4.zok689

Tabachnick, B.G. and Fidell, L.S. (2013) *Using multivariate statistics*. 6th edn. Boston: Pearson.

Taj, S.A. (2016) 'Application of signaling theory in management research: Addressing major gaps in theory', *European Management Journal*, 34(4), pp. 338–348. https://doi.org/10.1016/j.emj.2016.02.001

Tan, Y., Tian, X., Zhang, X. and Zhao, H. (2020) 'The real effect of partial privatization on corporate innovation: Evidence from China's split share structure reform', *Journal of Corporate Finance*, 64, 101661. https://doi.org/10.1016/j.jcorpfin.2020.101661

Taques, F. H., González-López, M., Basso, L. F. C. and Areal, N. (2021) 'Indicators used to measure service innovation and manufacturing innovation', Journal *of Innovation & Knowledge*, 6(1), 11-26. https://doi.org/10.1016/j.jik.2019.12.001

Tarillon, C. (2022) 'The centrality of organisational factors in the growth of new technology-based firms', *Journal of Small Business and Enterprise Development*, 29(5), pp. 825–844. https://doi.org/10.1108/JSBED-03-2019-0088

Teece, D.J. (1986) 'Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy', *Research Policy*, 15(6), pp. 285–305. https://doi.org/10.1016/0048-7333(86)90027-2

Teece, D.J., Pisano, G. and Shuen, A. (1997) 'Dynamic capabilities and strategic management', *Strategic Management Journal*, 18(7), pp. 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Tenca, F., Butticè, V., Colombo, M.G., Croce, A., Guerini, M. and Giudici, G. (2021) *Entrepreneurial finance: A definitive guide*. Vol. 2. Hackensack, NJ: World Scientific.

Thomas, L.D.W. and Autio, E. (2020) 'Innovation ecosystems in management: An organising typology', *Oxford Research Encyclopedia of Business and Management*. https://doi.org/10.1093/acrefore/9780190224851.013.203

Thomsen, S. and Pedersen, T. (2000) 'Ownership structure and economic performance in the largest European companies', *Strategic Management Journal*, 21(6), pp. 689–705. https://doi.org/10.1002/(SICI)1097-0266(200006)21:6<689::AID-SMJ115>3.0.CO;2-Y

Thomsen, S., Pedersen, T. and Kvist, H.K. (2006) 'Block holder ownership: Effects on firm value in market and control-based governance systems', *Journal of Corporate Finance*, 12(2), pp. 246–269. https://doi.org/10.1016/j.jcorpfin.2005.03.001

Tian, X. (2012) 'The Role of Venture Capital Syndication in Value Creation for Entrepreneurial Firms', *Review of Finance*, 16(1), 245-283. https://doi.org/10.1093/rof/rfr019

Ting, I.W.K. (2015) 'Does government ownership matter? Comparative study between GLCs and NGLCs in Malaysia', *Singapore Economic Review*, 60(2), 1550019. https://doi.org/10.1142/S0217590815500198

Tingvall, P.G. and Videnord, J. (2020) 'Regional differences in effects of publicly sponsored R&D grants on SME performance', *Small Business Economics*, 54(4), pp. 951–969. https://doi.org/10.1007/s11187-018-0085-6

Tornikoski, E.T., Rannikko, H. and Heimonen, T.P. (2017) 'Technology-based competitive advantages of young entrepreneurial firms: Conceptual development and empirical exploration', *Journal of Small Business Management*, 55(2), pp. 200–215. https://doi.org/10.1111/jsbm.12315

Tripathy, J.P. (2013) 'Secondary data analysis: Ethical issues and challenges', *Iranian Journal of Public Health*, 42(12), pp. 1478–1479.

Truong, T.T. and Heaney, R. (2013) 'The determinants of equity agency conflicts between managers and shareholders: Evidence from Australia', *Journal of Multinational Financial Management*, 23(4), pp. 314–326. https://doi.org/https://doi.org/10.1016/j.mulfin.2013.05.001

Tsionas, M. (ed.) (2019) *Panel data econometrics: Empirical applications*. London: Academic Press.

Tuğran, E., Koçak, M., Mirtagioglu, H., Yiğit, S. and Mendeş, M. (2015) 'A simulation based comparison of correlation coefficients with regard to Type I error rate and power', *Journal of Data Analysis and Information Processing*, 3(3), pp. 87–101. https://doi.org/10.4236/jdaip.2015.33010

Ughetto, E. (2015) 'Growth of born globals: The role of the entrepreneur's personal factors and venture capital', *International Entrepreneurship and Management Journal*, 12(3), pp. 839–857. https://doi.org/10.1007/s11365-015-0368-1

van Osnabrugge, M. (2000) 'A comparison of business angel and venture capitalist investment procedures: An agency theory-based analysis', *Venture Capital*, 2(2), pp. 91–109. https://doi.org/10.1080/136910600295729

Vanacker, T., Forbes, D., Knockaert, M. and Manigart, S. (2020) 'Signal strength, media attention, and resource mobilization: Evidence from new private equity firms', *Academy of Management Journal*, 63(4), pp. 1082–1105. https://doi.org/10.5465/amj.2018.0356

Vandenbroucke, E., Knockaert, M. and Ucbasaran, D. (2016) 'Outside board human capital and early stage high-tech firm performance', *Entrepreneurship Theory and Practice*, 40(4), pp. 759–779. https://doi.org/10.1111/etap.12141

Venkatraman, N. and Ramanujam, V. (1986) 'Measurement of business performance in strategy research: A comparison of approaches', *Academy of Management Review*, 11(4), pp. 801–814. https://doi.org/10.5465/amr.1986.4283976

Verbouw, J., Vanacker, T. and Manigart, S. (2024) 'Divide and conquer. Investor type diversity in entrepreneurial ventures', Academy *of Management Annual Meeting Proceedings*. https://www.ecgi.global/sites/default/files/Paper%3A%20Divide%20and%20Conquer%20Investor%20Type%20Diversity%20in%20Entrepreneurial%20Ventures.pdf

Vidal-Suñé, A. and López-Panisello, M.B. (2013) 'Institutional and economic determinants of the perception of opportunities and entrepreneurial intention'. *Investigaciones Regionales-Journal of Regional Research*, (26), pp.75-96. https://www.redalyc.org/pdf/289/28928246004.pdf

Villalonga, B. and Amit, R. (2006) 'How do family ownership, control and management affect firm value?', *Journal of Financial Economics*, 80(2), pp. 385–417. https://doi.org/10.1016/j.jfineco.2004.12.005

Vismara, S. (2018) 'Information cascades among investors in equity crowdfunding', *Entrepreneurship Theory and Practice*, 42(3), pp. 467–497. https://doi.org/10.1111/etap.1226

Walsh, J.P. and Seward, J.K. (1990) 'On the efficiency of internal and external corporate control mechanisms', *Academy of Management Review*, 15(3), pp. 421–458. https://doi.org/10.5465/amr.1990.4308826

Walthoff-Borm, X., Schwienbacher, A. and Vanacker, T. (2018) 'Equity crowdfunding: First resort or last resort?', *Journal of Business Venturing*, 33(4), pp. 513–533. https://doi.org/10.1016/j.jbusvent.2018.04.001

Wang, K.T. and Shailer, G. (2013) 'Ownership concentration and firm performance in emerging markets: A meta-analysis', *Journal of Economic Surveys*, 29(2), pp. 199–229. https://doi.org/10.1111/joes.12048

Wang, N. and Hagedoorn, J. (2014) 'The lag structure of the relationship between patenting and internal R&D revisited', *Research Policy*, 43, pp. 1275–1285. https://doi.org/10.1016/j.respol.2014.03.010

Wang, W., Mahmood, A., Sismeiro, C. and Vulkan, N. (2019) 'The evolution of equity crowdfunding: Insights from co-investments of angels and the crowd', *Research Policy*, 48(8), 103727. https://doi.org/10.1016/j.respol.2019.01.003

Wang, Y. and Bathala, C. (2010) 'Inter-dependencies between insider ownership, capital structure, investment decisions and corporate valuation', *Metamorphosis*, 9(1), pp. 46–65. https://doi.org/10.1177/0972622520100106

Ward, A.J., Brown, J.A. and Rodriguez, D. (2009) 'Governance bundles, firm performance, and the substitutability and complementarity of governance mechanisms', *Corporate Governance: An International Review*, 17(5), pp. 646–660. https://doi.org/10.1111/j.1467-8683.2009.00766.x

Ward, D. and Filatotchev, I. (2010) 'Principal-principal-agency relationships and the role of external governance', *Managerial and Decision Economics*, 31(4), pp. 249–261. https://doi.org/10.1002/mde.1473

Warhuus, J.P., Frid, C.J. and Gartner, W.B. (2021) 'Ready or not? Nascent entrepreneurs' actions and the acquisition of external financing', *International Journal of Entrepreneurial Behaviour and Research*, 27(6), pp. 1605–1628. https://doi.org/10.1108/IJEBR-09-2020-0586

Warren, L. and Hutchinson, W.E. (2000) 'Success factors for high-technology SMEs: A case study from Australia', *Journal of Small Business Management*, 38(3), pp. 86–91.

Watson, R. (1991) 'Modelling directors' remuneration decisions in small and closely-held UK companies', *Journal of Business Finance & Accounting*, 18(1), pp. 85–98. https://doi.org/10.1111/j.1468-5957.1991.tb00580.x

Weinzimmer, L.G., Nystrom, P.C. and Freeman, S.J. (1998) 'Measuring organisational growth: Issues, consequences and guidelines', *Journal of Management*, 24(2), pp. 235–262. https://doi.org/10.1177/014920639802400205

Welsh, D.H., Memili, E., Rosplock, K., Roure, J. and Segurado, J.L. (2013) 'Perceptions of entrepreneurship across generations in family offices: A stewardship theory perspective', *Journal of Family Business Strategy*, 4(3), pp. 213–226. https://doi.org/10.1016/j.jfbs.2013.07.003

Wennberg, K., Wiklund, J., DeTienne, D.R. and Cardon, M.S. (2010) 'Reconceptualizing entrepreneurial exit: Divergent exit routes and their drivers', *Journal of Business Venturing*, 25(4), pp. 361–375. https://doi.org/10.1016/j.jbusvent.2009.01.001

Westhead, P. and Cowling, M. (1995) 'Employment change in independent owner-managed high-technology firms in Great Britain', *Small Business Economics*, 7(2), pp. 111–140. https://doi.org/10.1007/BF01108686

Whetten, D.A. (1989) 'What constitutes a theoretical contribution?', *Academy of Management Review*, 14(4), pp. 490–495. https://doi.org/10.5465/amr.1989.4308371

White, H. (1980) 'A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity', *Econometrica*, 48(4), pp. 817–838. https://doi.org/10.2307/1912934

Wiklund, J., Patzelt, H. and Shepherd, D.A. (2007) 'Building an integrative model of small business growth', *Small Business Economics*, 32(4), pp. 351–374. https://doi.org/10.1007/s11187-007-9084-8

Wilson, J. (2010) *Essentials of business research: A guide to doing your research project*. London: Sage Publications.

Wilson, N., Wright, M. and Kacer, M. (2018) 'The equity gap and knowledge-based firms', *Journal of Corporate Finance*, 50, pp. 626–649. https://doi.org/10.1016/j.jcorpfin.2017.12.008

Wilson, R.C. (2012) *The family office book: Investing capital for the ultra-affluent*. John Wiley & Sons.

Winborg, J. and Landström, H. (2001) 'Financial bootstrapping in small businesses: Examining small business managers' resource acquisition behaviours', *Journal of Business Venturing*, 16(3), pp. 235–254. https://doi.org/10.1016/S0883-9026(99)00055-5

Wiseman, R., Cuevas-Rodríguez, G. and Gómez-Mejía, L. (2011) 'Towards a social theory of agency', *Journal of Management Studies*, 49(1), pp. 202–222. https://doi.org/10.1111/j.1467-6486.2011.01016.x

Wiseman, R.M. and Gomez-Mejia, L.R. (1998) 'A behavioural agency model of managerial risk taking', *Academy of Management Review*, 23(1), pp. 133–153. https://doi.org/10.5465/amr.1998.192967

Wong, A. (2002) 'Angel finance: The other venture capital', *University of Chicago Working Paper*.

Wong, A., Bhatia, M. and Freeman, Z. (2009) 'Angel finance: The other venture capital', *Strategic Change*, 18(7–8), pp. 221–230. https://doi.org/10.1002/jsc.849

Wooldridge, J.M. (2020) *Introductory econometrics: A modern approach*. 7th edn. Boston, MA: Cengage Learning.

Wright, M., Amess, K., Weir, C. and Girma, S. (2009) 'Private equity and corporate governance: Retrospect and prospect', *Corporate Governance: An International Review*, 17(3), pp. 353–375. https://doi.org/10.1111/j.1467-8683.2009.00744.x

Wright, M., Hart, M. and Fu, K. (2015) 'A nation of angels: Assessing the impact of angel investing across the UK', *Enterprise Research Centre Report*. https://hdl.handle.net/2134/12200363

Wu, C., Liu, J. and Lin, F. (2021) 'Institutional investor heterogeneity and innovation', *International Journal of Social Science and Economic Research*, 6(3), pp. 806–815. https://doi.org/10.46609/IJSSER.2021.v06i03.004

Wu, J., Si, S. and Wu, X. (2016) 'Entrepreneurial finance and innovation: Informal debt as an empirical case', *Strategic Entrepreneurship Journal*, 10(3), pp. 257–273. https://doi.org/10.1002/sej.1214

Wurth, B., Stam, E. and Spigel, B. (2021) 'Toward an Entrepreneurial Ecosystem Research Program', *Entrepreneurship Theory and Practice*, 46(3), 729-778. https://doi.org/10.1177/1042258721998948

Yasser, Q. and Mamun, A. (2017) 'The impact of ownership concentration on firm performance: Evidence from an emerging market', *Emerging Economy Studies*, 3(1), pp. 34–53. https://doi.org/10.1177/2394901517696647

Yimfor, E. and Garfinkel, J.A. (2023) 'Predicting success in entrepreneurial finance research', *Journal of Corporate Finance*, 81, 102359. https://doi.org/10.2139/ssrn.4273219

Young, M.N., Peng, M.W., Ahlstrom, D., Bruton, G.D. and Jiang, Y. (2008) 'Corporate governance in emerging economies: A review of the principal-principal perspective', *Journal of Management Studies*, 45(1), pp. 196–220. https://doi.org/10.1111/j.1467-6486.2007.00752.x

Zahra, S. and Filatotchev, I. (2004) 'Governance of the entrepreneurial threshold firm: A knowledge-based perspective', *Journal of Management Studies*, 41(5), pp. 885–897. https://doi.org/10.1111/j.1467-6486.2004.00458.x

Zahra, S.A. (1996) 'Governance, ownership, and corporate entrepreneurship: The moderating impact of industry technological opportunities', *Academy of Management Journal*, 39(6), pp. 1713–1735. https://doi.org/10.5465/257076

Zahra, S.A., Neubaum, D.O. and Huse, M. (2000) 'Entrepreneurship in medium-size companies: Exploring the effects of ownership and governance systems', *Journal of Management*, 26(5), pp. 947–976. https://doi.org/10.1177/014920630002600509

Zandi, G., Singh, J., Mohamad, S. and Ehsanullah, S. (2020) 'Ownership structure and firm performance', *International Journal of Financial Research*, 11(2), p. 293. https://doi.org/10.5430/ijfr.v11n2p293

Zeckhauser, R.J. and Pound, J. (1990) 'Are large shareholders effective monitors? An investigation of share ownership and corporate performance', in Hubbard, R.G. (ed.) *Asymmetric information, corporate finance, and investment*. Chicago: University of Chicago Press, pp. 149–180. https://www.nber.org/system/files/chapters/c11471/c11471.pdf

Zeitun, R. and Tian, G. (2007) 'Does ownership affect a firm's performance and default risk in Jordan?', *Corporate Governance*, 7(1), pp. 66–82. https://doi.org/10.1108/14720700710727122

Zheng, L., Bai, T. and Cross, A. (2021) 'Signaling information management in entrepreneurial firms' financing acquisition', *Journal of Global Information Management*, 29(6), pp. 1–31. https://doi.org/10.4018/jgim.287590

Zhou, X. (2001) 'Understanding the determinants of managerial ownership and the link between ownership and performance: Comment', *Journal of Financial Economics*, 62(3), pp. 559–571. https://doi.org/10.1016/s0304-405x(01)00085-x

Zu Knyphausen-Aufseß, D. (2005) ‘Corporate venture capital: Who adds value?’, *Venture Capital*, 7(1), pp. 23–49. https://doi.org/10.1080/1369106042000335610

Appendices

SPSS Output

Model 1- IHI

Employment

Regression

Notes

Output Created		02-SEP-2025 10:04:46
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\emply\emply_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1800
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.

Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT LN_EMPLY /METHOD=ENTER AGE LIQR LN_INVEST YEAR_CAT SECTOR ACTIVE IHI /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:00.34
	Elapsed Time	00:00:00.30
	Memory Required	7472 bytes
	Additional Memory Required for Residual Plots	800 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	IHI, ACTIVE, LIQR, SECTOR, YEAR_CAT, LN_INVEST, AGE[b]	.	Enter

a. Dependent Variable: LN_EMPLY

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.685[a]	.469	.467	.871282	.555

a. Predictors: (Constant), IHI, ACTIVE, LIQR, SECTOR, YEAR_CAT, LN_INVEST, AGE

b. Dependent Variable: LN_EMPLY

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1202.996	7	171.857	226.386	<.001[b]
	Residual	1360.365	1792	.759		
	Total	2563.361	1799			

a. Dependent Variable: LN_EMPLY

b. Predictors: (Constant), IHI, ACTIVE, LIQR, SECTOR, YEAR_CAT, LN_INVEST, AGE

Coefficients[a]

		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.040	.141		7.389	<.001
	AGE	.088	.009	.215	9.623	<.001

	LIQR	-.005	.002	-.052	-2.935	.003
	LN_INVEST	.399	.016	.464	25.431	<.001
	YEAR_CAT	.127	.015	.182	8.487	<.001
	SECTOR	-.017	.006	-.053	-3.048	.002
	ACTIVE	.164	.078	.037	2.120	.034
	IHI	-8.421E-5	.000	-.171	-8.777	<.001

Coefficients[a]

Model		95.0% Confidence Interval for B		Correlations			Collinearity Statistics
		Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance
1	(Constant)	.764	1.316				
	AGE	.070	.106	.374	.222	.166	.594
	LIQR	-.008	-.002	-.059	-.069	-.051	.954
	LN_INVEST	.368	.430	.515	.515	.438	.889
	YEAR_CAT	.098	.156	.355	.197	.146	.647
	SECTOR	-.028	-.006	-.138	-.072	-.052	.975
	ACTIVE	.012	.316	.045	.050	.036	.992
	IHI	.000	.000	-.428	-.203	-.151	.780

Coefficients[a]

Model	Collinearity Statistics

		VIF
1	(Constant)	
	AGE	1.685
	LIQR	1.048
	LN_INVEST	1.125
	YEAR_CAT	1.545
	SECTOR	1.026
	ACTIVE	1.008
	IHI	1.282

a. Dependent Variable: LN_EMPLY

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	AGE	LIQR	LN_INVEST
1	1	6.447	1.000	.00	.00	.01	.00
	2	.665	3.114	.00	.00	.89	.00
	3	.302	4.620	.00	.03	.00	.11
	4	.242	5.163	.00	.04	.03	.49
	5	.177	6.034	.00	.00	.00	.07

	6	.082	8.872	.00	.00	.01	.15
	7	.069	9.692	.00	.67	.02	.00
	8	.017	19.318	.99	.25	.05	.19

Collinearity Diagnostics[a]

		Variance Proportions			
Model	Dimension	YEAR_CAT	SECTOR	ACTIVE	IHI
1	1	.00	.00	.00	.00
	2	.00	.00	.00	.00
	3	.07	.19	.00	.12
	4	.12	.02	.01	.01
	5	.00	.72	.02	.21
	6	.13	.00	.60	.28
	7	.68	.00	.08	.00
	8	.00	.06	.29	.39

a. Dependent Variable: LN_EMPLY

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_EMPLY	Predicted Value	Residual
103	-3.305	.000	2.87924	-2.879240
151	-3.540	1.792	4.87602	-3.084260

152	-3.292	1.792	4.66012	-2.868361
153	-3.252	1.609	4.44285	-2.833408
154	-3.205	1.386	4.17839	-2.792100
643	3.258	7.241	4.40172	2.838930
644	3.202	6.895	4.10459	2.790082
811	-3.399	.000	2.96145	-2.961448
1066	-3.234	.000	2.81811	-2.818106
1067	-3.005	.000	2.61829	-2.618288
1087	3.087	5.438	2.74826	2.689824
1089	3.110	4.754	2.04372	2.709866
1090	3.016	4.443	1.81450	2.628155
1381	3.084	6.098	3.41094	2.687132
1517	-3.490	.000	3.04087	-3.040873
1518	-3.300	.000	2.87555	-2.875553
1541	3.145	4.934	2.19416	2.740310
1542	3.553	5.075	1.97936	3.095818

a. Dependent Variable: LN_EMPLY

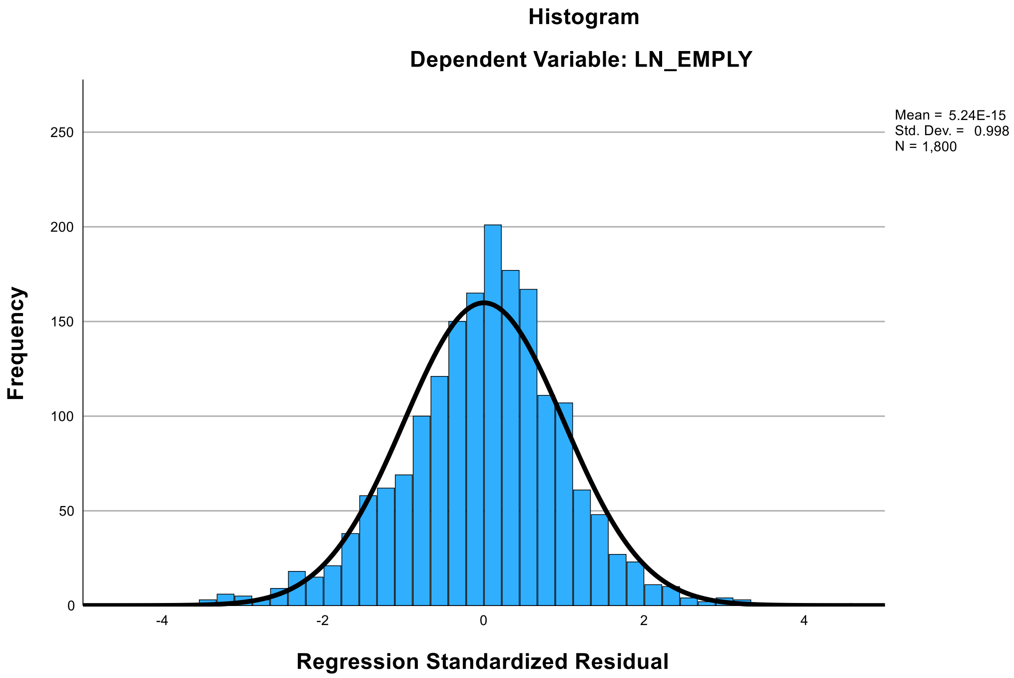
Residuals Statistics[a]

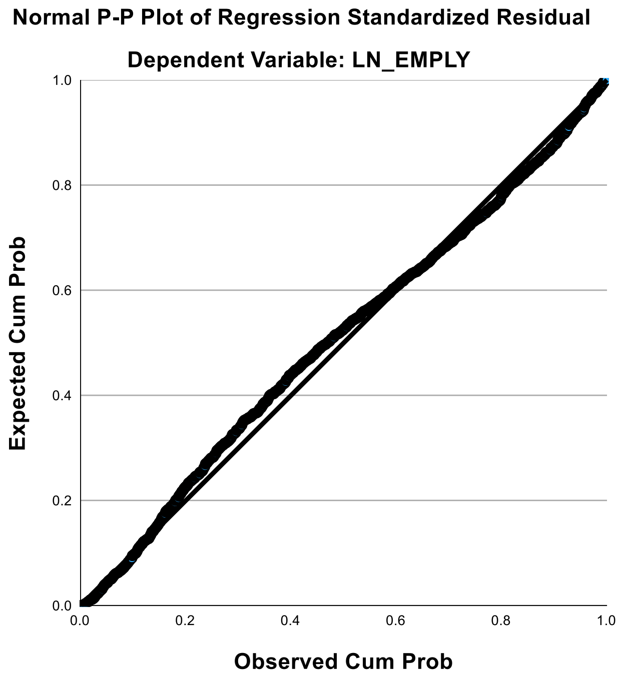
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.42143	5.21856	2.64779	.817742	1800
Residual	-3.084260	3.095818	.000000	.869585	1800
Std. Predicted Value	-2.723	3.144	.000	1.000	1800

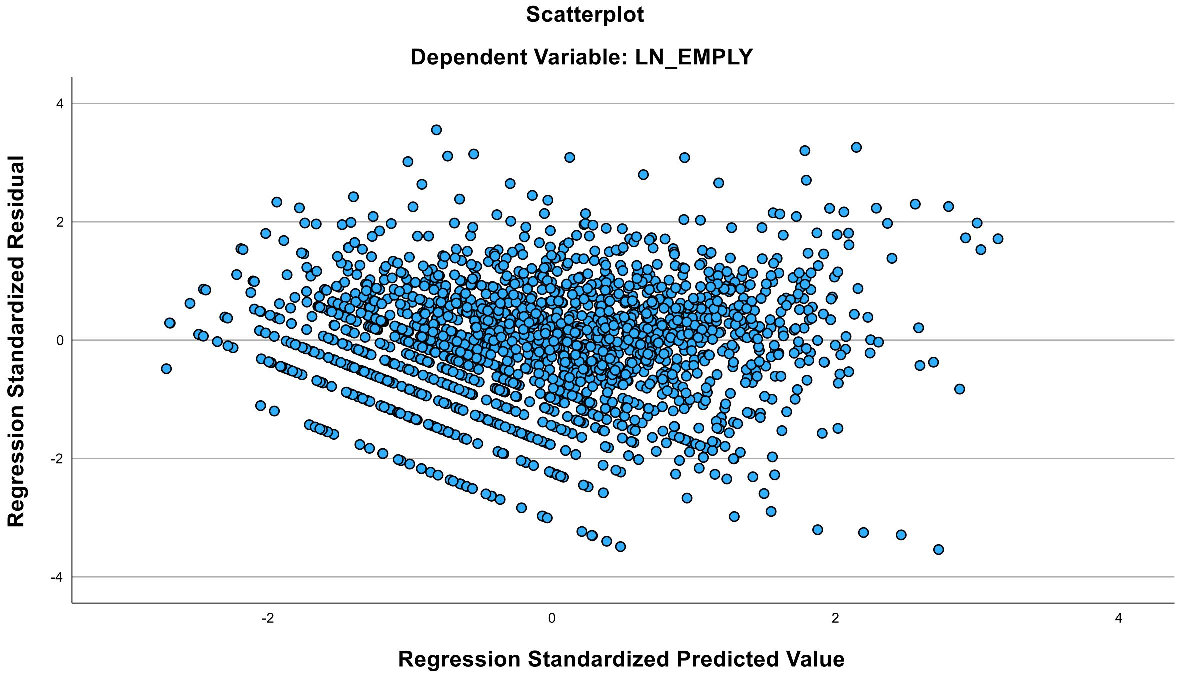
Std. Residual	-3.540	3.553	.000	.998	1800

a. Dependent Variable: LN_EMPLY

Charts




Normal P-P Plot of Regression Standardized Residual
Dependent Variable: LN_EMPLY
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Scatterplot
Dependent Variable: LN_EMPLY
Regression Standardized Residual
Regression Standardized Predicted Value
4
2
0
-2
-4

Mixed Model Analysis (Fixed Effects)

Notes

Output Created		02-SEP-2025 12:26:05
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\emply\emply_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1800
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_EMPLY BY SECTOR WITH AGE ACTIVE LIQR IHI LN_INVEST YEAR_CAT /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001

		) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR AGE ACTIVE LIQR IHI LN_INVEST YEAR_CAT | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	AGE	1		1	
	ACTIVE	1		1	
	LIQR	1		1	
	IHI	1		1	
	LN_INVEST	1		1	
	YEAR_CAT	1		1	
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		27		26	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	AGE	
	ACTIVE	
	LIQR	
	IHI	
	LN_INVEST	
	YEAR_CAT	
Repeated Effects	YEAR	300
Total		

a. Dependent Variable: LN_EMPLY.

Information Criteria[a]

-2 Log Likelihood	4489.95323262
Akaike's Information Criterion (AIC)	4541.95323262
Hurvich and Tsai's Criterion (AICC)	4542.74511079

Bozdogan's Criterion (CAIC)	4710.83732316
Schwarz's Bayesian Criterion (BIC)	4684.83732316

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_EMPLY.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	1779.663	52.585	<.001
SECTOR	13	1788.862	9.431	<.001
AGE	1	1779.543	85.091	<.001
ACTIVE	1	1788.476	6.028	.014
LIQR	1	1701.101	6.001	.014
IHI	1	1763.853	89.071	<.001
LN_INVEST	1	1792.618	712.455	<.001
YEAR_CAT	1	1430.597	76.884	<.001

a. Dependent Variable: LN_EMPLY.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval
						Lower Bound
Intercept	1.053	.182	1794.492	5.792	<.001	.697
[SECTOR=1]	.000	.145	1788.395	.003	.998	-.284
[SECTOR=2]	-.198	.147	1788.382	-1.350	.177	-.486
[SECTOR=3]	-.062	.151	1788.994	-.410	.682	-.357
[SECTOR=4]	.018	.154	1788.781	.119	.905	-.283
[SECTOR=5]	.102	.162	1788.098	.630	.529	-.216
[SECTOR=6]	.303	.151	1788.698	2.011	.044	.007
[SECTOR=7]	-.530	.144	1787.997	-3.691	<.001	-.812
[SECTOR=8]	-.137	.144	1788.733	-.953	.341	-.420
[SECTOR=9]	.055	.162	1788.773	.338	.735	-.263
[SECTOR=10]	-.082	.144	1788.220	-.569	.570	-.364
[SECTOR=11]	-.431	.145	1788.391	-2.980	.003	-.714
[SECTOR=12]	-.172	.152	1788.942	-1.129	.259	-.470
[SECTOR=13]	-.160	.191	1788.243	-.833	.405	-.535
[SECTOR=14]	0[b]	0	.	.	.	.
AGE	.083	.009	1779.543	9.224	<.001	.065
ACTIVE	.186	.076	1788.476	2.455	.014	.037
LIQR	-.004	.002	1701.101	-2.450	.014	-.007
IHI	-8.860E-5	9.388E-6	1763.853	-9.438	<.001	.000

LN_INVEST	.409	.015	1792.618	26.692	<.001	.379
YEAR_CAT	.131	.015	1430.597	8.768	<.001	.101

Estimates of Fixed Effects[a]

Parameter	95% Confidence Interval Upper Bound
Intercept	1.410
[SECTOR=1]	.285
[SECTOR=2]	.090
[SECTOR=3]	.234
[SECTOR=4]	.320
[SECTOR=5]	.420
[SECTOR=6]	.598
[SECTOR=7]	-.248
[SECTOR=8]	.145
[SECTOR=9]	.372
[SECTOR=10]	.201
[SECTOR=11]	-.147
[SECTOR=12]	.127
[SECTOR=13]	.216
[SECTOR=14]	.

AGE	.101
ACTIVE	.335
LIQR	-.001
IHI	-7.019E-5
LN_INVEST	.439
YEAR_CAT	.160

a. Dependent Variable: LN_EMPLY.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound
Repeated Measures	Var: [YEAR=2018]	.797	.067	11.933	<.001	.676
	Var: [YEAR=2019]	.704	.058	12.114	<.001	.599
	Var: [YEAR=2020]	.647	.053	12.211	<.001	.551

	Var: [YEAR=2021]	.649	.053	12.193	<.001	.552
	Var: [YEAR=2022]	.696	.057	12.105	<.001	.592
	Var: [YEAR=2023]	.779	.065	11.983	<.001	.661

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval Upper Bound
Repeated Measures	Var: [YEAR=2018]	.939
	Var: [YEAR=2019]	.827
	Var: [YEAR=2020]	.759
	Var: [YEAR=2021]	.762
	Var: [YEAR=2022]	.818
	Var: [YEAR=2023]	.917

a. Dependent Variable: LN_EMPLY.

Mixed Model Analysis (Random Effects)

Notes

Output Created		02-SEP-2025 12:35:20
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\emply\emply_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1800
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_EMPLY BY SECTOR WITH AGE ACTIVE LIQR IHI LN_INVEST YEAR_CAT /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR AGE ACTIVE

		LIQR IHI LN_INVEST YEAR_CAT | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /RANDOM=INTERCEPT | SUBJECT(COMPID) COVTYPE(AR1) /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.33
	Elapsed Time	00:00:00.31

Warnings

The covariance structure for random effect with only one level will be changed to Identity.

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	AGE	1		1	
	ACTIVE	1		1	
	LIQR	1		1	
	IHI	1		1	
	LN_INVEST	1		1	

	YEAR_CAT	1		1	
Random Effects	Intercept	1	Identity	1	COMPID
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		28		27	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	AGE	
	ACTIVE	
	LIQR	
	IHI	
	LN_INVEST	
	YEAR_CAT	
Random Effects	Intercept	
Repeated Effects	YEAR	300
Total		

a. Dependent Variable: LN_EMPLY.

Information Criteria[a]

-2 Log Likelihood	3122.70066305
Akaike's Information Criterion (AIC)	3176.70066305
Hurvich and Tsai's Criterion (AICC)	3177.55393619
Bozdogan's Criterion (CAIC)	3352.08029553
Schwarz's Bayesian Criterion (BIC)	3325.08029553

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_EMPLY.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	390.763	16.040	<.001
SECTOR	13	296.113	2.229	.009
AGE	1	300.474	11.738	<.001
ACTIVE	1	295.855	.703	.402
LIQR	1	1144.530	1.008	.316
IHI	1	1295.671	72.173	<.001
LN_INVEST	1	305.779	190.078	<.001
YEAR_CAT	1	404.952	56.931	<.001

a. Dependent Variable: LN_EMPLY.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval
						Lower Bound
Intercept	.937	.339	329.302	2.769	.006	.271
[SECTOR=1]	-.039	.315	295.923	-.122	.903	-.659
[SECTOR=2]	-.205	.319	296.059	-.644	.520	-.832
[SECTOR=3]	-.084	.327	296.180	-.256	.798	-.727
[SECTOR=4]	.014	.334	295.976	.042	.967	-.644
[SECTOR=5]	.167	.353	295.961	.472	.637	-.528
[SECTOR=6]	.316	.327	296.164	.966	.335	-.328
[SECTOR=7]	-.539	.312	296.272	-1.731	.084	-1.153
[SECTOR=8]	-.142	.313	295.992	-.454	.650	-.759
[SECTOR=9]	.088	.352	295.941	.249	.803	-.605
[SECTOR=10]	-.088	.313	295.912	-.281	.779	-.704
[SECTOR=11]	-.472	.314	295.923	-1.502	.134	-1.091
[SECTOR=12]	-.144	.331	295.977	-.435	.664	-.795
[SECTOR=13]	-.300	.417	295.859	-.720	.472	-1.120
[SECTOR=14]	0[b]	0	.	.	.	.
AGE	.064	.019	300.474	3.426	<.001	.027

ACTIVE	.138	.165	295.855	.839	.402	-.186
LIQR	-.001	.001	1144.530	-1.004	.316	-.003
IHI	-6.618E-5	7.790E-6	1295.671	-8.495	<.001	-8.146E-5
LN_INVEST	.443	.032	305.779	13.787	<.001	.379
YEAR_CAT	.154	.020	404.952	7.545	<.001	.114

Estimates of Fixed Effects[a]

	95% Confidence Interval
Parameter	Upper Bound
Intercept	1.603
[SECTOR=1]	.582
[SECTOR=2]	.422
[SECTOR=3]	.560
[SECTOR=4]	.672
[SECTOR=5]	.861
[SECTOR=6]	.960
[SECTOR=7]	.074
[SECTOR=8]	.474
[SECTOR=9]	.781
[SECTOR=10]	.529
[SECTOR=11]	.147

[SECTOR=12]	.507
[SECTOR=13]	.520
[SECTOR=14]	.
AGE	.101
ACTIVE	.463
LIQR	.001
IHI	-5.090E-5
LN_INVEST	.506
YEAR_CAT	.194

a. Dependent Variable:
LN_EMPLY.

b. This parameter is set to zero
because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.
Repeated Measures	Var: [YEAR=2018]	.635	.056	11.239	<.001

	Var: [YEAR=2019]	.383	.036	10.778	<.001
	Var: [YEAR=2020]	.143	.015	9.452	<.001
	Var: [YEAR=2021]	.049	.008	6.218	<.001
	Var: [YEAR=2022]	.122	.014	8.934	<.001
	Var: [YEAR=2023]	.263	.025	10.445	<.001
Intercept [subject = COMPID]	Variance	.535	.046	11.607	<.001

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval	
		Lower Bound	Upper Bound
Repeated Measures	Var: [YEAR=2018]	.533	.756
	Var: [YEAR=2019]	.319	.459
	Var: [YEAR=2020]	.116	.176
	Var: [YEAR=2021]	.036	.067
	Var: [YEAR=2022]	.098	.152
	Var: [YEAR=2023]	.218	.317
Intercept [subject = COMPID]	Variance	.452	.634

a. Dependent Variable: LN_EMPLY.

Assets

Regression

Notes

Output Created		02-SEP-2025 10:47:42
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\assets\assets_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1860
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE

		/STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT LN_ASSETS /METHOD=ENTER AGE LN_INVEST LIQR YEAR_CAT SECTOR ACTIVE IHI /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:00.37
	Elapsed Time	00:00:00.32
	Memory Required	7424 bytes
	Additional Memory Required for Residual Plots	800 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	IHI, ACTIVE, LIQR, SECTOR, YEAR_CAT, LN_INVEST, AGE[b]	.	Enter

a. Dependent Variable: LN_ASSETS

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.696[a]	.485	.483	1.352002	.846

a. Predictors: (Constant), IHI, ACTIVE, LIQR, SECTOR, YEAR_CAT, LN_INVEST, AGE

b. Dependent Variable: LN_ASSETS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3182.809	7	454.687	248.747	<.001[b]
	Residual	3385.286	1852	1.828		
	Total	6568.096	1859			

a. Dependent Variable: LN_ASSETS

b. Predictors: (Constant), IHI, ACTIVE, LIQR, SECTOR, YEAR_CAT, LN_INVEST, AGE

Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	12.115	.213		56.765	<.001
	AGE	.137	.014	.210	9.711	<.001
	LN_INVEST	.641	.024	.472	26.736	<.001
	LIQR	.017	.002	.120	7.031	<.001

	YEAR_CAT	.183	.023	.166	7.992	<.001
	SECTOR	-.010	.009	-.020	-1.203	.229
	ACTIVE	-.059	.118	-.008	-.504	.614
	IHI	.000	.000	-.197	-10.496	<.001

Coefficients[a]

		95.0% Confidence Interval for B		Correlations			Collinearity Statistics
Model		Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance
1	(Constant)	11.696	12.534				
	AGE	.109	.164	.343	.220	.162	.593
	LN_INVEST	.594	.688	.533	.528	.446	.892
	LIQR	.012	.022	.111	.161	.117	.956
	YEAR_CAT	.138	.228	.335	.183	.133	.643
	SECTOR	-.027	.007	-.101	-.028	-.020	.980
	ACTIVE	-.290	.171	.009	-.012	-.008	.993
	IHI	.000	.000	-.455	-.237	-.175	.789

Coefficients[a]

		Collinearity Statistics
Model		VIF
1	(Constant)	

	AGE	1.686
	LN_INVEST	1.121
	LIQR	1.046
	YEAR_CAT	1.555
	SECTOR	1.020
	ACTIVE	1.007
	IHI	1.267

a. Dependent Variable: LN_ASSETS

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	AGE	LN_INVEST	LIQR
1	1	6.445	1.000	.00	.00	.00	.01
	2	.664	3.115	.00	.00	.00	.90
	3	.299	4.646	.00	.03	.12	.00
	4	.243	5.150	.00	.04	.50	.03
	5	.180	5.980	.00	.00	.04	.00
	6	.084	8.756	.00	.00	.15	.01
	7	.068	9.770	.00	.68	.00	.02

8	.017	19.194	.99	.24	.19	.04

Collinearity Diagnostics[a]

Model	Dimension	Variance Proportions YEAR_CAT	SECTOR	ACTIVE	IHI
1	1	.00	.00	.00	.00
	2	.00	.00	.00	.00
	3	.07	.19	.00	.12
	4	.12	.01	.00	.00
	5	.00	.73	.02	.21
	6	.11	.00	.60	.27
	7	.69	.00	.07	.00
	8	.00	.06	.30	.39

a. Dependent Variable: LN_ASSETS

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_ASSETS	Predicted Value	Residual
61	-4.173	7.447	13.08963	-5.642458
78	-3.283	9.763	14.20263	-4.439213
157	-4.258	11.932	17.68885	-5.756403
158	-3.787	12.253	17.37336	-5.119904

159	-3.239	12.684	17.06283	-4.378473
161	-3.256	11.859	16.26190	-4.402557
425	-4.820	6.912	13.42799	-6.516240
426	-7.966	1.609	12.37948	-10.770046
516	-4.305	6.960	12.78006	-5.819711
552	-3.476	7.989	12.68778	-4.699236
882	-5.520	4.605	12.06799	-7.462815
1062	-3.636	8.468	13.38409	-4.916082
1073	-4.514	6.153	12.25632	-6.103590
1074	-3.364	7.046	11.59364	-4.547859
1134	-4.257	7.090	12.84508	-5.755007
1147	4.402	20.353	14.40254	5.950839
1148	4.298	19.899	14.08825	5.810921
1149	6.168	21.632	13.29379	8.338629
1150	5.377	20.295	13.02638	7.269067
1321	-3.319	10.289	14.77621	-4.487461
1363	-3.739	10.808	15.86216	-5.054517
1392	-3.684	7.796	12.77614	-4.980489
1476	-5.668	4.605	12.26877	-7.663603
1512	-3.189	7.924	12.23535	-4.311638
1674	-7.045	4.605	14.13059	-9.525419

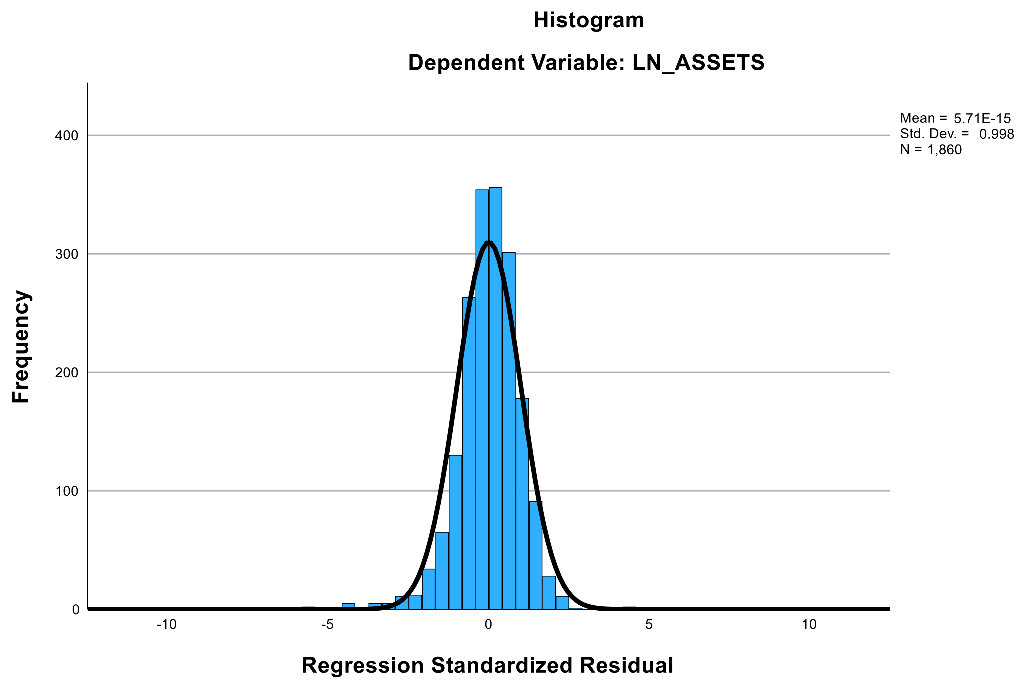
a. Dependent Variable: LN_ASSETS

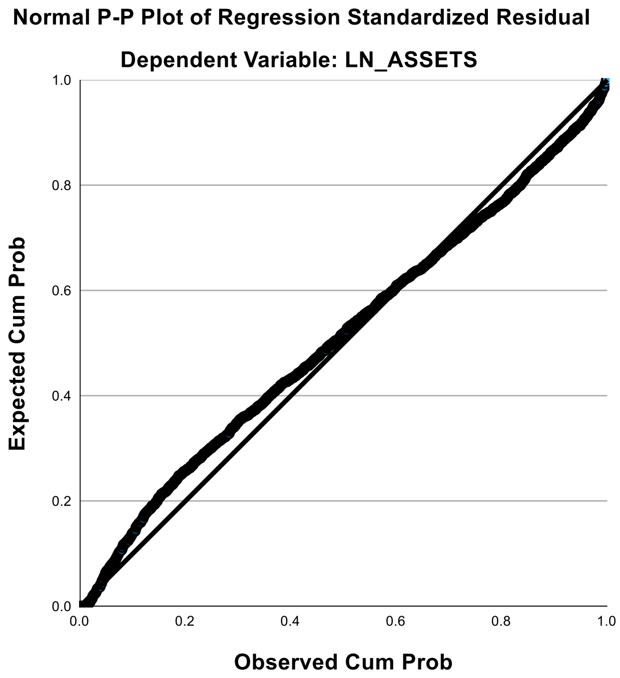
Residuals Statistics[a]

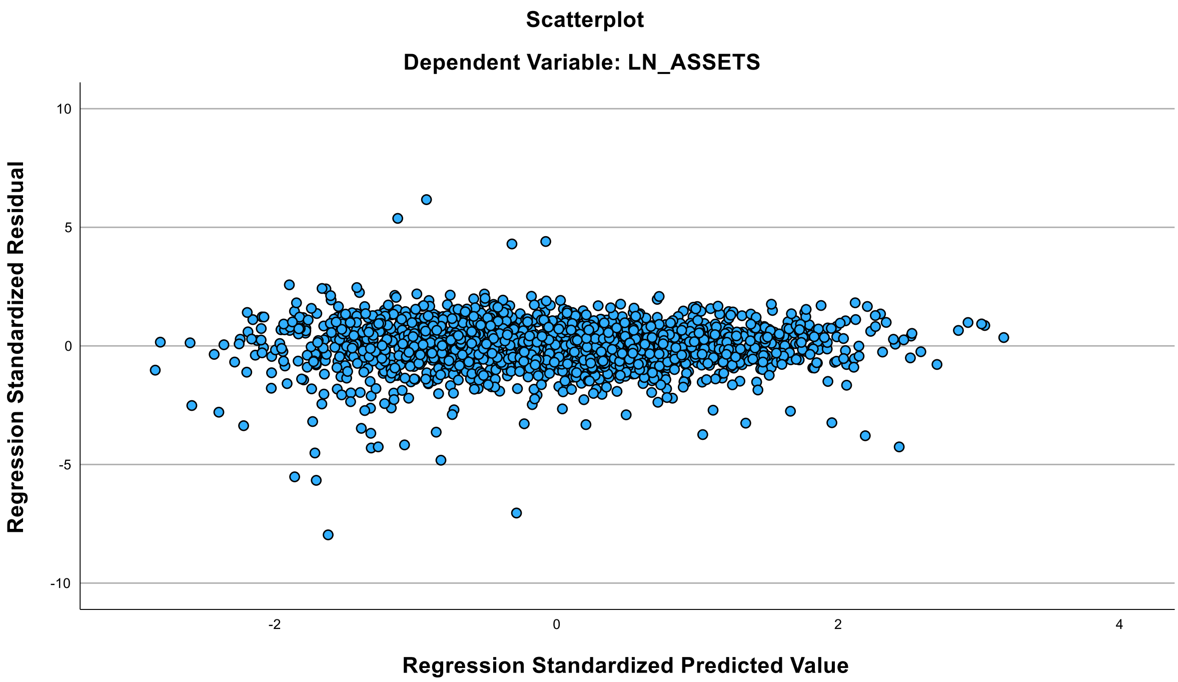
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	10.77204	18.66088	14.50781	1.308476	1860
Residual	-10.770045	8.338629	.000000	1.349454	1860
Std. Predicted Value	-2.855	3.174	.000	1.000	1860
Std. Residual	-7.966	6.168	.000	.998	1860

a. Dependent Variable: LN_ASSETS

Charts







Mixed Model Analysis (Fixed Effects)

Notes

Output Created		02-SEP-2025 14:03:25
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\assets\assets_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
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	Split File	<none>
	N of Rows in Working Data File	1860
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_ASSETS BY SECTOR WITH LIQR LN_INVEST ACTIVE YEAR_CAT AGE IHI /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE)

		/FIXED=SECTOR LIQR LN_INVEST ACTIVE YEAR_CAT AGE IHI	SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /REPEATED=YEAR	SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.03

[DataSet1] D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\assets\assets_dataset.sav

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	ACTIVE	1		1	
	YEAR_CAT	1		1	
	AGE	1		1	
	IHI	1		1	
Repeated Effects	YEAR	6	Diagonal	6	COMPID

Total	27		26	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	
	LN_INVEST	
	ACTIVE	
	YEAR_CAT	
	AGE	
	IHI	
Repeated Effects	YEAR	310
Total		

a. Dependent Variable: LN_ASSETS.

Information Criteria[a]

-2 Log Likelihood	6227.13107943
Akaike's Information Criterion (AIC)	6279.13107943

Hurvich and Tsai's Criterion (AICC)	6279.89703687
Bozdogan's Criterion (CAIC)	6448.86770536
Schwarz's Bayesian Criterion (BIC)	6422.86770536

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_ASSETS.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	1813.571	3736.606	<.001
SECTOR	13	1720.907	3.892	<.001
LIQR	1	1674.056	55.894	<.001
LN_INVEST	1	1740.857	880.670	<.001
ACTIVE	1	1721.487	1.468	.226
YEAR_CAT	1	1550.085	75.620	<.001
AGE	1	1691.025	66.411	<.001
IHI	1	1768.053	78.174	<.001

a. Dependent Variable: LN_ASSETS.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval
						Lower Bound
Intercept	12.333	.271	1778.634	45.427	<.001	11.800
[SECTOR=1]	-.551	.216	1721.155	-2.552	.011	-.974
[SECTOR=2]	.032	.219	1720.442	.148	.883	-.397
[SECTOR=3]	-.387	.224	1722.469	-1.732	.083	-.826
[SECTOR=4]	-.223	.226	1722.651	-.984	.325	-.666
[SECTOR=5]	.156	.239	1719.648	.651	.515	-.314
[SECTOR=6]	-.111	.223	1721.690	-.499	.618	-.548
[SECTOR=7]	-.480	.213	1720.983	-2.254	.024	-.897
[SECTOR=8]	-.119	.215	1721.816	-.551	.581	-.541
[SECTOR=9]	-.206	.242	1721.296	-.853	.394	-.681
[SECTOR=10]	-.482	.215	1720.901	-2.238	.025	-.904
[SECTOR=11]	-.320	.216	1720.883	-1.480	.139	-.743
[SECTOR=12]	-.468	.227	1721.263	-2.058	.040	-.914
[SECTOR=13]	-.442	.286	1720.723	-1.545	.123	-1.003
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	.017	.002	1674.056	7.476	<.001	.013
LN_INVEST	.672	.023	1740.857	29.676	<.001	.627
ACTIVE	-.135	.111	1721.487	-1.212	.226	-.353
YEAR_CAT	.200	.023	1550.085	8.696	<.001	.155

AGE	.108	.013	1691.025	8.149	<.001	.082
IHI	.000	1.385E-5	1768.053	-8.842	<.001	.000

Estimates of Fixed Effects[a]

	95% Confidence Interval
Parameter	Upper Bound
Intercept	12.865
[SECTOR=1]	-.127
[SECTOR=2]	.462
[SECTOR=3]	.051
[SECTOR=4]	.221
[SECTOR=5]	.625
[SECTOR=6]	.326
[SECTOR=7]	-.062
[SECTOR=8]	.304
[SECTOR=9]	.268
[SECTOR=10]	-.060
[SECTOR=11]	.104
[SECTOR=12]	-.022
[SECTOR=13]	.119
[SECTOR=14]	.

LIQR	.022
LN_INVEST	.716
ACTIVE	.083
YEAR_CAT	.246
AGE	.134
IHI	-9.532E-5

a. Dependent Variable: LN_ASSETS.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound
Repeated Measures	Var: [YEAR=2018]	3.561	.294	12.119	<.001	3.029
	Var: [YEAR=2019]	1.709	.139	12.321	<.001	1.458
	Var: [YEAR=2020]	1.378	.111	12.399	<.001	1.176

	Var: [YEAR=2021]	1.349	.109	12.340	<.001	1.151
	Var: [YEAR=2022]	1.229	.100	12.296	<.001	1.048
	Var: [YEAR=2023]	1.535	.127	12.123	<.001	1.306

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval
		Upper Bound
Repeated Measures	Var: [YEAR=2018]	4.186
	Var: [YEAR=2019]	2.004
	Var: [YEAR=2020]	1.614
	Var: [YEAR=2021]	1.582
	Var: [YEAR=2022]	1.441
	Var: [YEAR=2023]	1.804

a. Dependent Variable: LN_ASSETS.

Mixed Model Analysis (Random Effects)

Notes

Output Created		02-SEP-2025 14:09:52
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\assets\assets_dataset.sav
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	Filter	<none>
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	N of Rows in Working Data File	1860
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_ASSETS BY SECTOR WITH LIQR LN_INVEST ACTIVE YEAR_CAT AGE IHI /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR

		LN_INVEST ACTIVE YEAR_CAT AGE IHI | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /RANDOM=INTERCEPT | SUBJECT(COMPID) COVTYPE(AR1) /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.31
	Elapsed Time	00:00:00.28

Warnings

The covariance structure for random effect with only one level will be changed to Identity.

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	ACTIVE	1		1	
	YEAR_CAT	1		1	
	AGE	1		1	

	IHI	1		1	
Random Effects	Intercept	1	Identity	1	COMPID
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		28		27	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	
	LN_INVEST	
	ACTIVE	
	YEAR_CAT	
	AGE	
	IHI	
Random Effects	Intercept	
Repeated Effects	YEAR	310
Total		

a. Dependent Variable: LN_ASSETS.

Information Criteria[a]

-2 Log Likelihood	5232.76896669
Akaike's Information Criterion (AIC)	5286.76896669
Hurvich and Tsai's Criterion (AICC)	5287.59429420
Bozdogan's Criterion (CAIC)	5463.03392439
Schwarz's Bayesian Criterion (BIC)	5436.03392439

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_ASSETS.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	457.423	1741.127	<.001
SECTOR	13	307.596	1.109	.351
LIQR	1	1348.116	276.464	<.001
LN_INVEST	1	322.543	258.036	<.001
ACTIVE	1	307.284	.418	.518
YEAR_CAT	1	484.131	52.771	<.001
AGE	1	312.883	12.108	<.001
IHI	1	1569.780	73.805	<.001

a. Dependent Variable: LN_ASSETS.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound
Intercept	12.376	.466	358.227	26.573	<.001	11.460
[SECTOR=1]	-.667	.428	307.384	-1.558	.120	-1.509
[SECTOR=2]	-.066	.434	307.566	-.152	.879	-.920
[SECTOR=3]	-.507	.443	307.803	-1.146	.253	-1.378
[SECTOR=4]	-.215	.448	307.453	-.480	.632	-1.097
[SECTOR=5]	.057	.474	307.469	.120	.904	-.876
[SECTOR=6]	-.197	.441	307.878	-.448	.654	-1.065
[SECTOR=7]	-.611	.421	307.798	-1.450	.148	-1.439
[SECTOR=8]	-.162	.427	307.460	-.380	.704	-1.002
[SECTOR=9]	-.279	.480	307.331	-.581	.562	-1.222
[SECTOR=10]	-.528	.427	307.386	-1.238	.217	-1.368
[SECTOR=11]	-.398	.428	307.357	-.930	.353	-1.241
[SECTOR=12]	-.504	.451	307.362	-1.120	.264	-1.391
[SECTOR=13]	-.505	.567	307.284	-.889	.375	-1.621
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	.028	.002	1348.116	16.627	<.001	.025

LN_INVEST	.694	.043	322.543	16.064	<.001	.609
ACTIVE	-.143	.220	307.284	-.647	.518	-.576
YEAR_CAT	.207	.029	484.131	7.264	<.001	.151
AGE	.089	.025	312.883	3.480	<.001	.038
IHI	.000	1.324E-5	1569.780	-8.591	<.001	.000

Estimates of Fixed Effects[a]

	95% Confidence Interval
Parameter	Upper Bound
Intercept	13.292
[SECTOR=1]	.175
[SECTOR=2]	.788
[SECTOR=3]	.364
[SECTOR=4]	.667
[SECTOR=5]	.990
[SECTOR=6]	.670
[SECTOR=7]	.218
[SECTOR=8]	.678
[SECTOR=9]	.665
[SECTOR=10]	.312
[SECTOR=11]	.444

[SECTOR=12]	.382
[SECTOR=13]	.612
[SECTOR=14]	.
LIQR	.031
LN_INVEST	.779
ACTIVE	.291
YEAR_CAT	.263
AGE	.139
IHI	-8.774E-5

a. Dependent Variable: LN_ASSETS.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.
Repeated Measures	Var: [YEAR=2018]	3.051	.259	11.762	<.001

	Var: [YEAR=2019]	1.080	.097	11.133	<.001
	Var: [YEAR=2020]	.510	.051	9.966	<.001
	Var: [YEAR=2021]	.286	.032	8.990	<.001
	Var: [YEAR=2022]	.258	.032	8.054	<.001
	Var: [YEAR=2023]	.540	.055	9.767	<.001
Intercept [subject = COMPID]	Variance	.955	.084	11.403	<.001

Estimates of Covariance Parameters[a]

		95% Confidence Interval	
Parameter		Lower Bound	Upper Bound
Repeated Measures	Var: [YEAR=2018]	2.582	3.604
	Var: [YEAR=2019]	.906	1.288
	Var: [YEAR=2020]	.419	.621
	Var: [YEAR=2021]	.230	.356
	Var: [YEAR=2022]	.202	.329
	Var: [YEAR=2023]	.442	.660
Intercept [subject = COMPID]	Variance	.804	1.134

a. Dependent Variable: LN_ASSETS.

Model 2- INOWN

Employment

Regression

Notes

Output Created		02-SEP-2025 10:09:47
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\emply\emply_dataset.sav
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	Filter	<none>
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	Split File	<none>
	N of Rows in Working Data File	1800
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE

		/STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT LN_EMPLY /METHOD=ENTER AGE LIQR LN_INVEST YEAR_CAT SECTOR ACTIVE INOWN /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
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	Memory Required	7472 bytes
	Additional Memory Required for Residual Plots	800 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	INOWN, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE[b]	.	Enter

a. Dependent Variable: LN_EMPLY

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.670[a]	.449	.447	.888045	.544

a. Predictors: (Constant), INOWN, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE

b. Dependent Variable: LN_EMPLY

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1150.148	7	164.307	208.346	<.001[b]
	Residual	1413.213	1792	.789		
	Total	2563.361	1799			

a. Dependent Variable: LN_EMPLY

b. Predictors: (Constant), INOWN, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE

Coefficients[a]

		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	.476	.134		3.542	<.001
	AGE	.099	.010	.241	10.207	<.001
	LIQR	-.003	.002	-.036	-2.020	.044

	LN_INVEST	.429	.016	.499	27.044	<.001
	YEAR_CAT	.137	.015	.195	8.989	<.001
	SECTOR	-.020	.006	-.063	-3.534	<.001
	ACTIVE	.155	.079	.035	1.965	.050
	INOWN	-.002	.001	-.055	-2.674	.008

Coefficients[a]

Model		95.0% Confidence Interval for B		Correlations			Collinearity Statistics
		Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance
1	(Constant)	.212	.739				
	AGE	.080	.118	.374	.234	.179	.551
	LIQR	-.007	.000	-.059	-.048	-.035	.965
	LN_INVEST	.398	.461	.515	.538	.474	.903
	YEAR_CAT	.107	.166	.355	.208	.158	.651
	SECTOR	-.031	-.009	-.138	-.083	-.062	.977
	ACTIVE	.000	.310	.045	.046	.034	.992
	INOWN	-.004	-.001	-.353	-.063	-.047	.730

Coefficients[a]

Model		Collinearity Statistics
		VIF

1	(Constant)	
	AGE	1.816
	LIQR	1.036
	LN_INVEST	1.108
	YEAR_CAT	1.537
	SECTOR	1.023
	ACTIVE	1.008
	INOWN	1.369

a. Dependent Variable: LN_EMPLY

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	AGE	LIQR	LN_INVEST
1	1	6.253	1.000	.00	.00	.01	.00
	2	.661	3.076	.00	.00	.89	.00
	3	.457	3.701	.00	.02	.02	.03
	4	.245	5.049	.00	.02	.03	.54
	5	.201	5.572	.00	.02	.00	.04
	6	.096	8.071	.01	.00	.00	.21

	7	.067	9.639	.01	.61	.01	.00
	8	.019	17.972	.98	.32	.03	.17

Collinearity Diagnostics[a]

		Variance Proportions			
Model	Dimension	YEAR_CAT	SECTOR	ACTIVE	INOWN
1	1	.00	.00	.00	.00
	2	.01	.00	.00	.00
	3	.03	.02	.00	.39
	4	.06	.13	.00	.01
	5	.08	.73	.00	.15
	6	.24	.04	.48	.15
	7	.60	.00	.15	.02
	8	.00	.08	.36	.28

a. Dependent Variable: LN_EMPLY

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_EMPLY	Predicted Value	Residual
103	-3.132	.000	2.78116	-2.781159
151	-3.769	1.792	5.13879	-3.347028
152	-3.503	1.792	4.90273	-3.110973

153	-3.442	1.609	4.66572	-3.056280
154	-3.407	1.386	4.41213	-3.025833
155	-3.137	1.386	4.17199	-2.785693
156	-3.190	1.099	3.93189	-2.833281
606	-3.004	.000	2.66744	-2.667435
640	-3.064	.000	2.72083	-2.720826
643	3.230	7.241	4.37192	2.868734
644	3.119	6.895	4.12485	2.769821
811	-3.289	.000	2.92073	-2.920727
1066	-3.232	.000	2.87039	-2.870392
1067	-3.036	.000	2.69578	-2.695782
1087	3.029	5.438	2.74861	2.689468
1517	-3.271	.000	2.90462	-2.904617
1518	-3.002	.000	2.66633	-2.666329
1542	3.255	5.075	2.18465	2.890525

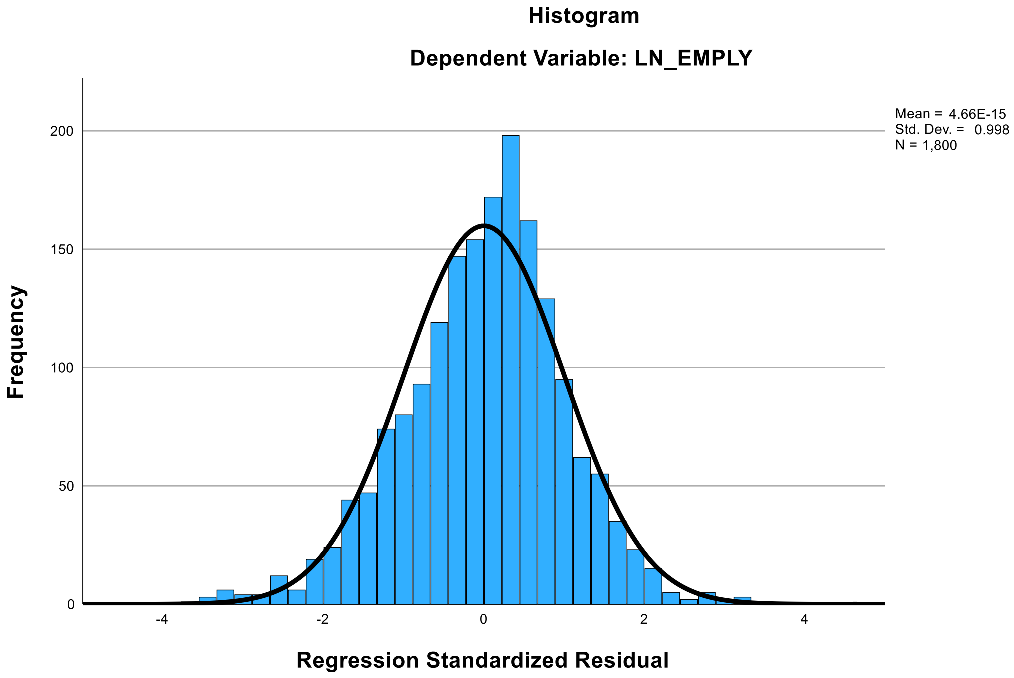
a. Dependent Variable: LN_EMPLY

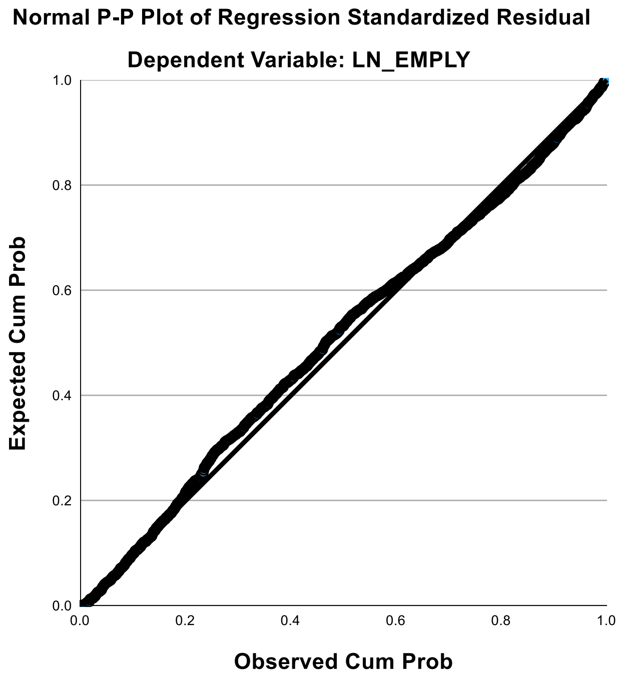
Residuals Statistics[a]

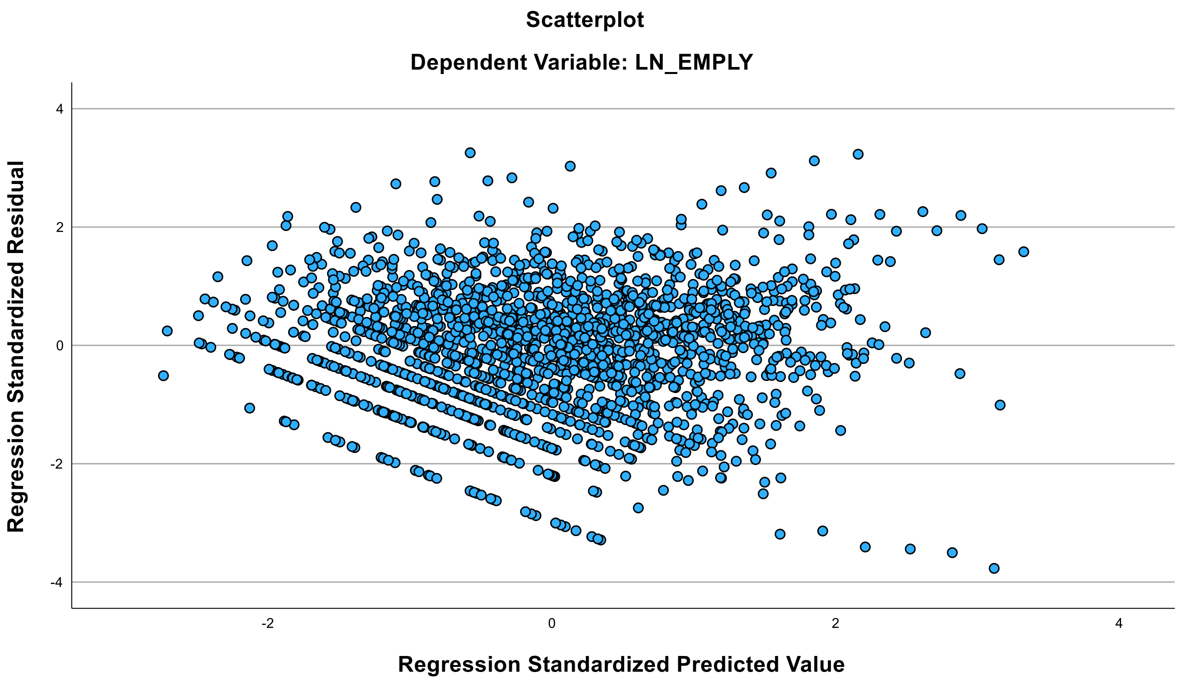
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.45531	5.30564	2.64779	.799579	1800
Residual	-3.347028	2.890525	.000000	.886315	1800
Std. Predicted Value	-2.742	3.324	.000	1.000	1800
Std. Residual	-3.769	3.255	.000	.998	1800

a. Dependent Variable: LN_EMPLY

Charts







Mixed Model Analysis (Fixed Effects)

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_EMPLY BY SECTOR WITH LIQR LN_INVEST AGE YEAR_CAT ACTIVE INOWN /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR

		LN_INVEST AGE YEAR_CAT ACTIVE INOWN | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	AGE	1		1	
	YEAR_CAT	1		1	
	ACTIVE	1		1	
	INOWN	1		1	
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		27		26	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	
	LN_INVEST	
	AGE	
	YEAR_CAT	
	ACTIVE	
	INOWN	
Repeated Effects	YEAR	300
Total		

a. Dependent Variable: LN_EMPLY.

Information Criteria[a]

-2 Log Likelihood	4567.43049532
Akaike's Information Criterion (AIC)	4619.43049532
Hurvich and Tsai's Criterion (AICC)	4620.22237349
Bozdogan's Criterion (CAIC)	4788.31458586

Schwarz's Bayesian Criterion (BIC)	4762.31458586

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_EMPLY.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	1757.808	8.324	.004
SECTOR	13	1790.355	9.062	<.001
LIQR	1	1706.948	2.293	.130
LN_INVEST	1	1795.041	800.123	<.001
AGE	1	1773.339	94.420	<.001
YEAR_CAT	1	1420.689	87.215	<.001
ACTIVE	1	1790.020	5.111	.024
INOWN	1	1760.703	9.061	.003

a. Dependent Variable: LN_EMPLY.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval

						Lower Bound
Intercept	.407	.175	1788.954	2.330	.020	.064
[SECTOR=1]	.054	.148	1790.021	.364	.716	-.237
[SECTOR=2]	-.139	.150	1790.084	-.930	.353	-.433
[SECTOR=3]	.025	.154	1790.068	.165	.869	-.276
[SECTOR=4]	.054	.157	1790.191	.346	.729	-.254
[SECTOR=5]	.164	.166	1790.084	.989	.323	-.161
[SECTOR=6]	.382	.154	1790.023	2.488	.013	.081
[SECTOR=7]	-.461	.147	1790.166	-3.144	.002	-.748
[SECTOR=8]	-.090	.147	1789.847	-.613	.540	-.380
[SECTOR=9]	.067	.166	1790.512	.403	.687	-.258
[SECTOR=10]	-.039	.147	1789.804	-.264	.791	-.327
[SECTOR=11]	-.382	.148	1789.904	-2.579	.010	-.672
[SECTOR=12]	-.170	.156	1790.349	-1.087	.277	-.476
[SECTOR=13]	-.084	.196	1789.911	-.428	.669	-.469
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	-.002	.002	1706.948	-1.514	.130	-.006
LN_INVEST	.441	.016	1795.041	28.286	<.001	.410
AGE	.092	.010	1773.339	9.717	<.001	.074
YEAR_CAT	.141	.015	1420.689	9.339	<.001	.112
ACTIVE	.175	.078	1790.020	2.261	.024	.023
INOWN	-.003	.001	1760.703	-3.010	.003	-.004

Estimates of Fixed Effects[a]

Parameter	95% Confidence Interval
	Upper Bound
Intercept	.750
[SECTOR=1]	.345
[SECTOR=2]	.154
[SECTOR=3]	.327
[SECTOR=4]	.363
[SECTOR=5]	.489
[SECTOR=6]	.683
[SECTOR=7]	-.173
[SECTOR=8]	.199
[SECTOR=9]	.392
[SECTOR=10]	.250
[SECTOR=11]	-.091
[SECTOR=12]	.137
[SECTOR=13]	.301
[SECTOR=14]	.
LIQR	.001
LN_INVEST	.471
AGE	.111

YEAR_CAT	.171
ACTIVE	.327
INOWN	-.001

a. Dependent Variable:
LN_EMPLY.

b. This parameter is set to zero
because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound
Repeated Measures	Var: [YEAR=2018]	.840	.071	11.839	<.001	.712
	Var: [YEAR=2019]	.735	.061	12.085	<.001	.625
	Var: [YEAR=2020]	.698	.057	12.210	<.001	.594
	Var: [YEAR=2021]	.672	.055	12.181	<.001	.572
	Var: [YEAR=2022]	.722	.060	12.066	<.001	.614
	Var: [YEAR=2023]	.789	.066	11.944	<.001	.669

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval Upper Bound
Repeated Measures	Var: [YEAR=2018]	.991
	Var: [YEAR=2019]	.865
	Var: [YEAR=2020]	.819
	Var: [YEAR=2021]	.789
	Var: [YEAR=2022]	.850
	Var: [YEAR=2023]	.929

a. Dependent Variable: LN_EMPLY.

Mixed Model Analysis (random Effects)

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_EMPLY BY SECTOR WITH LIQR LN_INVEST AGE YEAR_CAT ACTIVE INOWN /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR LN_INVEST AGE YEAR_CAT ACTIVE INOWN | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /RANDOM=INTERCEPT | SUBJECT(COMPID) COVTYPE(AR1) /REPEATED=YEAR |

		SUBJECT(COMPID) COVTYPE(DIAG).
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Warnings

The covariance structure for random effect with only one level will be changed to Identity.

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	AGE	1		1	
	YEAR_CAT	1		1	
	ACTIVE	1		1	
	INOWN	1		1	
Random Effects	Intercept	1	Identity	1	COMPID
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		28		27	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	
	LN_INVEST	
	AGE	
	YEAR_CAT	
	ACTIVE	
	INOWN	
Random Effects	Intercept	
Repeated Effects	YEAR	300
Total		

a. Dependent Variable: LN_EMPLY.

Information Criteria[a]

-2 Log Likelihood	3144.37690363
Akaike's Information Criterion (AIC)	3198.37690363
Hurvich and Tsai's Criterion (AICC)	3199.23017677

Bozdogan's Criterion (CAIC)	3373.75653612
Schwarz's Bayesian Criterion (BIC)	3346.75653612

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_EMPLY.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	374.902	11.287	<.001
SECTOR	13	295.043	2.126	.013
LIQR	1	1114.811	.286	.593
LN_INVEST	1	304.347	181.018	<.001
AGE	1	305.766	8.312	.004
YEAR_CAT	1	396.002	55.924	<.001
ACTIVE	1	294.486	.506	.477
INOWN	1	1554.383	48.108	<.001

a. Dependent Variable: LN_EMPLY.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval

						Lower Bound
Intercept	.781	.349	319.263	2.237	.026	.094
[SECTOR=1]	.025	.327	294.709	.076	.939	-.619
[SECTOR=2]	-.181	.331	294.550	-.547	.585	-.831
[SECTOR=3]	-.014	.339	294.618	-.041	.967	-.681
[SECTOR=4]	.056	.347	294.710	.163	.871	-.626
[SECTOR=5]	.190	.366	294.511	.519	.604	-.530
[SECTOR=6]	.356	.339	294.523	1.051	.294	-.311
[SECTOR=7]	-.523	.323	294.754	-1.618	.107	-1.159
[SECTOR=8]	-.095	.325	294.704	-.291	.771	-.735
[SECTOR=9]	.125	.365	294.761	.343	.732	-.594
[SECTOR=10]	-.061	.325	294.473	-.189	.851	-.701
[SECTOR=11]	-.420	.326	294.674	-1.289	.199	-1.062
[SECTOR=12]	-.085	.343	295.328	-.249	.804	-.761
[SECTOR=13]	-.206	.432	294.868	-.477	.634	-1.057
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	-.001	.001	1114.811	-.535	.593	-.002
LN_INVEST	.448	.033	304.347	13.454	<.001	.383
AGE	.057	.020	305.766	2.883	.004	.018
YEAR_CAT	.157	.021	396.002	7.478	<.001	.116
ACTIVE	.122	.171	294.486	.712	.477	-.215
INOWN	-.006	.001	1554.383	-6.936	<.001	-.007

Estimates of Fixed Effects[a]

Parameter	95% Confidence Interval
	Upper Bound
Intercept	1.468
[SECTOR=1]	.669
[SECTOR=2]	.470
[SECTOR=3]	.653
[SECTOR=4]	.739
[SECTOR=5]	.910
[SECTOR=6]	1.024
[SECTOR=7]	.113
[SECTOR=8]	.545
[SECTOR=9]	.845
[SECTOR=10]	.578
[SECTOR=11]	.222
[SECTOR=12]	.591
[SECTOR=13]	.645
[SECTOR=14]	.
LIQR	.001
LN_INVEST	.514
AGE	.095

YEAR_CAT	.198
ACTIVE	.459
INOWN	-.004

a. Dependent Variable: LN_EMPLY.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.
Repeated Measures	Var: [YEAR=2018]	.643	.057	11.314	<.001
	Var: [YEAR=2019]	.391	.036	10.981	<.001
	Var: [YEAR=2020]	.153	.015	9.908	<.001
	Var: [YEAR=2021]	.042	.007	5.890	<.001
	Var: [YEAR=2022]	.122	.013	9.288	<.001
	Var: [YEAR=2023]	.259	.025	10.588	<.001
Intercept [subject = COMPID]	Variance	.579	.050	11.647	<.001

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval Lower Bound	Upper Bound
Repeated Measures	Var: [YEAR=2018]	.541	.765
	Var: [YEAR=2019]	.327	.468
	Var: [YEAR=2020]	.125	.186
	Var: [YEAR=2021]	.030	.059
	Var: [YEAR=2022]	.099	.150
	Var: [YEAR=2023]	.216	.312
Intercept [subject = COMPID]	Variance	.490	.685

a. Dependent Variable: LN_EMPLY.

Assets

Regression

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT LN_ASSETS /METHOD=ENTER AGE LN_INVEST LIQR YEAR_CAT SECTOR ACTIVE INOWN /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN

		HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
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	Additional Memory Required for Residual Plots	800 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	INOWN, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE[b]	.	Enter

a. Dependent Variable: LN_ASSETS

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.692[a]	.479	.477	1.359629	.833

a. Predictors: (Constant), INOWN, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE

b. Dependent Variable: LN_ASSETS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3144.507	7	449.215	243.004	<.001[b]
	Residual	3423.588	1852	1.849		
	Total	6568.096	1859			

a. Dependent Variable: LN_ASSETS

b. Predictors: (Constant), INOWN, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE

Coefficients[a]

		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	11.770	.202		58.331	<.001
	AGE	.123	.015	.189	8.346	<.001
	LN_INVEST	.653	.024	.482	27.277	<.001
	LIQR	.019	.002	.132	7.703	<.001
	YEAR_CAT	.192	.023	.174	8.346	<.001
	SECTOR	-.013	.009	-.025	-1.464	.143
	ACTIVE	-.078	.118	-.011	-.660	.509
	INOWN	-.012	.001	-.184	-9.392	<.001

Coefficients[a]

Model		95.0% Confidence Interval for B		Correlations			Collinearity Statistics
		Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance
1	(Constant)	11.374	12.165				
	AGE	.094	.151	.343	.190	.140	.549
	LN_INVEST	.606	.700	.533	.535	.458	.903
	LIQR	.014	.024	.111	.176	.129	.965
	YEAR_CAT	.147	.237	.335	.190	.140	.646
	SECTOR	-.029	.004	-.101	-.034	-.025	.983
	ACTIVE	-.310	.154	.009	-.015	-.011	.992
	INOWN	-.015	-.010	-.444	-.213	-.158	.731

Coefficients[a]

Model		Collinearity Statistics
		VIF
1	(Constant)	
	AGE	1.821
	LN_INVEST	1.107
	LIQR	1.036
	YEAR_CAT	1.548
	SECTOR	1.017
	ACTIVE	1.008

	INOWN	1.368

a. Dependent Variable: LN_ASSETS

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	AGE	LN_INVEST	LIQR
1	1	6.254	1.000	.00	.00	.00	.01
	2	.661	3.077	.00	.00	.00	.90
	3	.452	3.720	.00	.02	.03	.02
	4	.245	5.048	.00	.02	.57	.03
	5	.205	5.529	.00	.02	.02	.00
	6	.097	8.021	.01	.00	.20	.00
	7	.066	9.709	.01	.62	.00	.01
	8	.019	17.931	.98	.32	.17	.03

Collinearity Diagnostics[a]

		Variance Proportions			
Model	Dimension	YEAR_CAT	SECTOR	ACTIVE	INOWN
1	1	.00	.00	.00	.00

	2	.00	.00	.00	.00
	3	.03	.02	.00	.39
	4	.07	.08	.00	.00
	5	.06	.78	.00	.14
	6	.22	.04	.49	.15
	7	.61	.00	.14	.02
	8	.00	.07	.36	.29

a. Dependent Variable: LN_ASSETS

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_ASSETS	Predicted Value	Residual
61	-4.454	7.447	13.50274	-6.055570
78	-3.403	9.763	14.38968	-4.626263
157	-4.305	11.932	17.78575	-5.853299
158	-3.841	12.253	17.47574	-5.222285
159	-3.300	12.684	17.17118	-4.486818
161	-3.380	11.859	16.45528	-4.595935
425	-4.583	6.912	13.14245	-6.230704
426	-7.896	1.609	12.34508	-10.735642
516	-4.531	6.960	13.12019	-6.159842
552	-3.391	7.989	12.59927	-4.610728

882	-5.441	4.605	12.00270	-7.397528
1062	-3.586	8.468	13.34352	-4.875522
1073	-4.254	6.153	11.93686	-5.784125
1074	-3.227	7.046	11.43375	-4.387973
1134	-4.220	7.090	12.82799	-5.737911
1147	4.646	20.353	14.03710	6.316279
1148	4.532	19.899	13.73783	6.161340
1149	5.997	21.632	13.47820	8.154218
1150	5.412	20.295	12.93717	7.358271
1321	-3.267	10.289	14.73081	-4.442062
1363	-3.967	10.808	16.20090	-5.393254
1392	-3.621	7.796	12.71844	-4.922794
1393	-3.118	9.620	13.85969	-4.239627
1398	-3.027	9.428	13.54338	-4.115190
1476	-5.599	4.605	12.21794	-7.612773
1487	-3.725	11.223	16.28795	-5.065265
1512	-3.122	7.924	12.16871	-4.244997
1674	-7.529	4.605	14.84211	-10.236942

a. Dependent Variable: LN_ASSETS

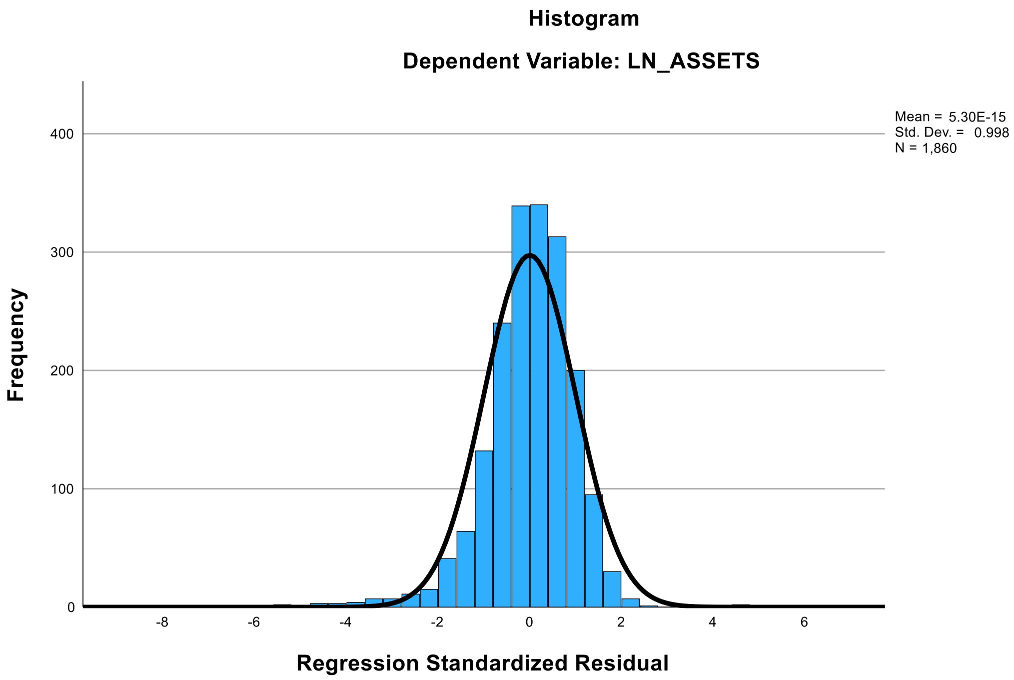
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	10.69449	18.63783	14.50781	1.300579	1860

Residual	-10.735641	8.154218	.000000	1.357066	1860
Std. Predicted Value	-2.932	3.176	.000	1.000	1860
Std. Residual	-7.896	5.997	.000	.998	1860

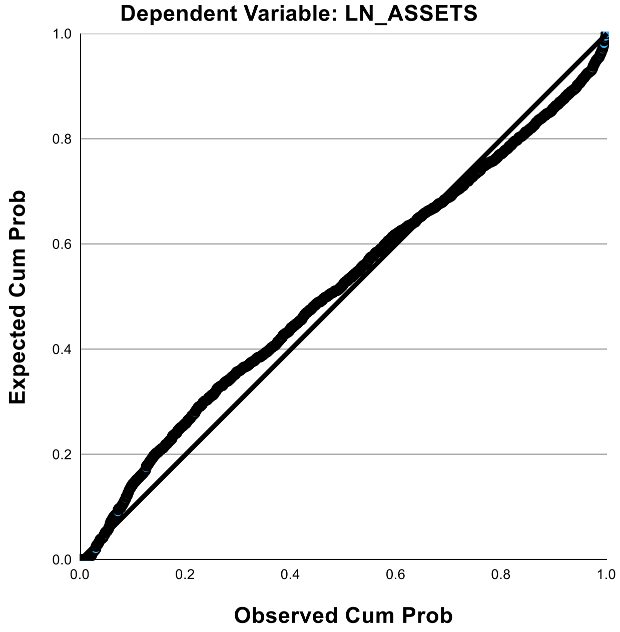
a. Dependent Variable: LN_ASSETS

Charts



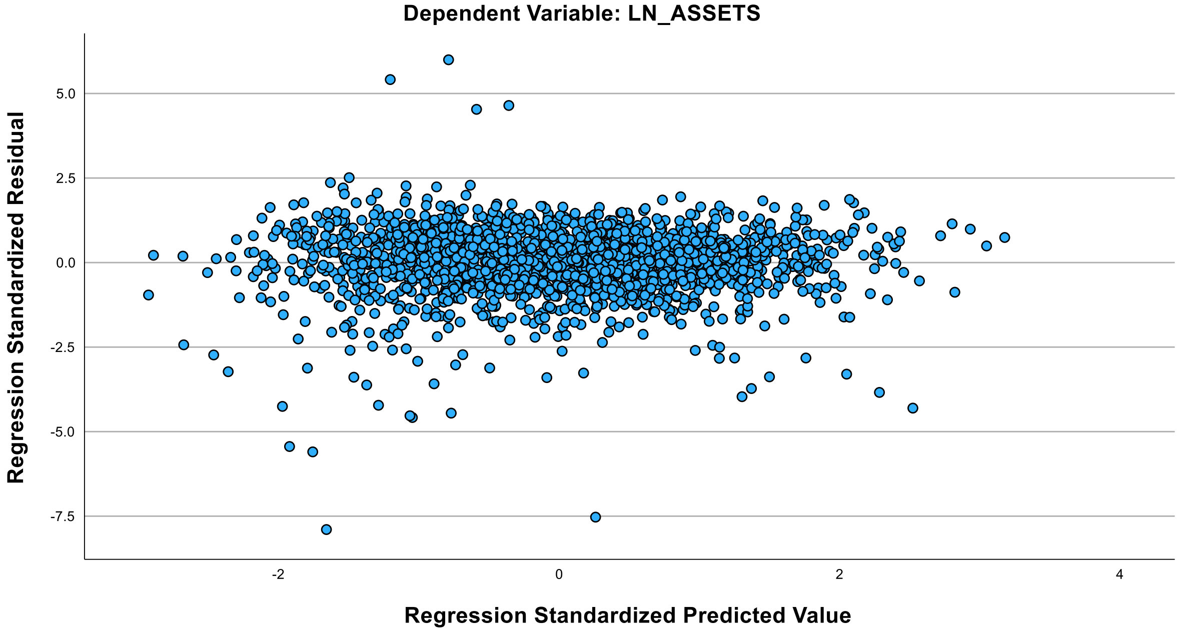
Normal P-P Plot of Regression Standardized Residual

Dependent Variable: LN_ASSETS



Scatterplot

Dependent Variable: LN_ASSETS



Mixed Model Analysis (Fixed Effects)

Notes

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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1860
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_ASSETS BY SECTOR WITH LIQR LN_INVEST ACTIVE YEAR_CAT AGE INOWN /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001

		) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR LN_INVEST ACTIVE YEAR_CAT AGE INOWN | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.03

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	ACTIVE	1		1	
	YEAR_CAT	1		1	
	AGE	1		1	
	INOWN	1		1	
Repeated Effects	YEAR	6	Diagonal	6	COMPID

Total	27		26	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	
	LN_INVEST	
	ACTIVE	
	YEAR_CAT	
	AGE	
	INOWN	
Repeated Effects	YEAR	310
Total		

a. Dependent Variable: LN_ASSETS.

Information Criteria[a]

-2 Log Likelihood	6247.75352859
Akaike's Information Criterion (AIC)	6299.75352859

Hurvich and Tsai's Criterion (AICC)	6300.51948604
Bozdogan's Criterion (CAIC)	6469.49015453
Schwarz's Bayesian Criterion (BIC)	6443.49015453

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_ASSETS.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	1829.643	3965.259	<.001
SECTOR	13	1720.165	3.721	<.001
LIQR	1	1676.295	65.560	<.001
LN_INVEST	1	1740.913	909.318	<.001
ACTIVE	1	1721.411	1.848	.174
YEAR_CAT	1	1542.457	79.564	<.001
AGE	1	1678.496	50.551	<.001
INOWN	1	1799.167	56.611	<.001

a. Dependent Variable: LN_ASSETS.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval
						Lower Bound
Intercept	11.932	.259	1798.136	46.024	<.001	11.424
[SECTOR=1]	-.418	.217	1718.291	-1.921	.055	-.844
[SECTOR=2]	.105	.220	1720.012	.476	.634	-.327
[SECTOR=3]	-.253	.225	1721.015	-1.125	.261	-.693
[SECTOR=4]	-.152	.228	1719.819	-.668	.504	-.599
[SECTOR=5]	.238	.240	1720.312	.989	.323	-.234
[SECTOR=6]	.002	.223	1720.773	.008	.994	-.436
[SECTOR=7]	-.427	.214	1721.055	-1.995	.046	-.846
[SECTOR=8]	-.006	.217	1719.283	-.028	.978	-.431
[SECTOR=9]	-.132	.243	1720.280	-.543	.588	-.610
[SECTOR=10]	-.417	.216	1719.711	-1.930	.054	-.842
[SECTOR=11]	-.205	.217	1718.741	-.944	.345	-.632
[SECTOR=12]	-.364	.229	1717.976	-1.586	.113	-.814
[SECTOR=13]	-.231	.288	1718.375	-.802	.422	-.797
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	.019	.002	1676.295	8.097	<.001	.014
LN_INVEST	.684	.023	1740.913	30.155	<.001	.639
ACTIVE	-.152	.112	1721.411	-1.359	.174	-.371
YEAR_CAT	.206	.023	1542.457	8.920	<.001	.161

AGE	.098	.014	1678.496	7.110	<.001	.071
INOWN	-.009	.001	1799.167	-7.524	<.001	-.012

Estimates of Fixed Effects[a]

	95% Confidence Interval
Parameter	Upper Bound
Intercept	12.440
[SECTOR=1]	.009
[SECTOR=2]	.537
[SECTOR=3]	.188
[SECTOR=4]	.295
[SECTOR=5]	.709
[SECTOR=6]	.440
[SECTOR=7]	-.007
[SECTOR=8]	.419
[SECTOR=9]	.345
[SECTOR=10]	.007
[SECTOR=11]	.221
[SECTOR=12]	.086
[SECTOR=13]	.334
[SECTOR=14]	.

LIQR	.023
LN_INVEST	.728
ACTIVE	.067
YEAR_CAT	.251
AGE	.125
INOWN	-.007

a. Dependent Variable: LN_ASSETS.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound
Repeated Measures	Var: [YEAR=2018]	3.628	.299	12.119	<.001	3.086
	Var: [YEAR=2019]	1.716	.140	12.300	<.001	1.464
	Var: [YEAR=2020]	1.412	.114	12.398	<.001	1.206

	Var: [YEAR=2021]	1.381	.112	12.332	<.001	1.178
	Var: [YEAR=2022]	1.230	.100	12.286	<.001	1.049
	Var: [YEAR=2023]	1.526	.126	12.117	<.001	1.298

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval Upper Bound
Repeated Measures	Var: [YEAR=2018]	4.265
	Var: [YEAR=2019]	2.013
	Var: [YEAR=2020]	1.654
	Var: [YEAR=2021]	1.619
	Var: [YEAR=2022]	1.443
	Var: [YEAR=2023]	1.794

a. Dependent Variable: LN_ASSETS.

Mixed Model Analysis (Random Effects)

Notes

Output Created		02-SEP-2025 14:07:04
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\assets\assets_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1860
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_ASSETS BY SECTOR WITH LIQR LN_INVEST ACTIVE YEAR_CAT AGE INOWN /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR

		LN_INVEST ACTIVE YEAR_CAT AGE INOWN | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /RANDOM=INTERCEPT | SUBJECT(COMPID) COVTYPE(AR1) /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.30
	Elapsed Time	00:00:00.30

Warnings

The covariance structure for random effect with only one level will be changed to Identity.

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	ACTIVE	1		1	
	YEAR_CAT	1		1	
	AGE	1		1	

	INOWN	1		1	
Random Effects	Intercept	1	Identity	1	COMPID
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		28		27	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	
	LN_INVEST	
	ACTIVE	
	YEAR_CAT	
	AGE	
	INOWN	
Random Effects	Intercept	
Repeated Effects	YEAR	310
Total		

a. Dependent Variable: LN_ASSETS.

Information Criteria[a]

-2 Log Likelihood	5228.05115481
Akaike's Information Criterion (AIC)	5282.05115481
Hurvich and Tsai's Criterion (AICC)	5282.87648232
Bozdogan's Criterion (CAIC)	5458.31611251
Schwarz's Bayesian Criterion (BIC)	5431.31611251

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_ASSETS.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	436.579	1714.039	<.001
SECTOR	13	305.924	1.023	.429
LIQR	1	1338.472	289.499	<.001
LN_INVEST	1	320.934	247.043	<.001
ACTIVE	1	305.346	.563	.454
YEAR_CAT	1	473.299	52.033	<.001
AGE	1	320.558	6.463	.011

INOWN	1	1721.965	78.868	<.001

a. Dependent Variable: LN_ASSETS.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound
Intercept	12.313	.469	344.639	26.254	<.001	11.391
[SECTOR=1]	-.536	.434	305.525	-1.234	.218	-1.390
[SECTOR=2]	-.025	.440	305.318	-.058	.954	-.891
[SECTOR=3]	-.409	.449	305.467	-.912	.363	-1.292
[SECTOR=4]	-.143	.455	305.531	-.314	.754	-1.037
[SECTOR=5]	.096	.481	305.233	.200	.841	-.849
[SECTOR=6]	-.136	.447	305.322	-.305	.761	-1.015
[SECTOR=7]	-.596	.427	305.561	-1.396	.164	-1.436
[SECTOR=8]	-.057	.433	305.562	-.131	.896	-.908
[SECTOR=9]	-.194	.486	305.546	-.399	.690	-1.151
[SECTOR=10]	-.485	.433	305.218	-1.122	.263	-1.337
[SECTOR=11]	-.290	.434	305.487	-.668	.505	-1.145
[SECTOR=12]	-.368	.457	306.178	-.806	.421	-1.268
[SECTOR=13]	-.269	.576	305.771	-.467	.641	-1.402
[SECTOR=14]	0[b]	0	.	.	.	.

LIQR	.028	.002	1338.472	17.015	<.001	.025
LN_INVEST	.689	.044	320.934	15.718	<.001	.603
ACTIVE	-.168	.223	305.346	-.750	.454	-.607
YEAR_CAT	.208	.029	473.299	7.213	<.001	.151
AGE	.066	.026	320.558	2.542	.011	.015
INOWN	-.012	.001	1721.965	-8.881	<.001	-.015

Estimates of Fixed Effects[a]

	95% Confidence Interval
Parameter	Upper Bound
Intercept	13.236
[SECTOR=1]	.319
[SECTOR=2]	.840
[SECTOR=3]	.474
[SECTOR=4]	.752
[SECTOR=5]	1.042
[SECTOR=6]	.743
[SECTOR=7]	.244
[SECTOR=8]	.795
[SECTOR=9]	.763
[SECTOR=10]	.366

[SECTOR=11]	.564
[SECTOR=12]	.531
[SECTOR=13]	.864
[SECTOR=14]	.
LIQR	.032
LN_INVEST	.776
ACTIVE	.272
YEAR_CAT	.265
AGE	.118
INOWN	-.010

a. Dependent Variable: LN_ASSETS.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter	Estimate	Std. Error	Wald Z	Sig.

Repeated Measures	Var: [YEAR=2018]	3.033	.258	11.763	<.001
	Var: [YEAR=2019]	1.077	.097	11.126	<.001
	Var: [YEAR=2020]	.543	.054	10.119	<.001
	Var: [YEAR=2021]	.290	.032	9.082	<.001
	Var: [YEAR=2022]	.235	.030	7.816	<.001
	Var: [YEAR=2023]	.518	.053	9.698	<.001
Intercept [subject = COMPID]	Variance	.986	.086	11.411	<.001

Estimates of Covariance Parameters[a]

		95% Confidence Interval	
Parameter		Lower Bound	Upper Bound
Repeated Measures	Var: [YEAR=2018]	2.568	3.583
	Var: [YEAR=2019]	.903	1.285
	Var: [YEAR=2020]	.447	.659
	Var: [YEAR=2021]	.234	.360
	Var: [YEAR=2022]	.183	.303
	Var: [YEAR=2023]	.423	.634
Intercept [subject = COMPID]	Variance	.830	1.171

a. Dependent Variable: LN_ASSETS.

Model 3 – OCI3

Employment

Regression

Notes

Output Created		02-SEP-2025 10:08:40
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\emply\emply_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1800
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE

		/STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT LN_EMPLY /METHOD=ENTER AGE LIQR LN_INVEST YEAR_CAT SECTOR ACTIVE OCI3 /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:00.33
	Elapsed Time	00:00:00.30
	Memory Required	7472 bytes
	Additional Memory Required for Residual Plots	800 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	OCI-3, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE[b]	.	Enter

a. Dependent Variable: LN_EMPLY

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.682[a]	.465	.463	.875114	.554

a. Predictors: (Constant), OCI-3, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE

b. Dependent Variable: LN_EMPLY

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1191.003	7	170.143	222.170	<.001[b]
	Residual	1372.358	1792	.766		
	Total	2563.361	1799			

a. Dependent Variable: LN_EMPLY

b. Predictors: (Constant), OCI-3, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE

Coefficients[a]

		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	.686	.123		5.569	<.001
	AGE	.090	.009	.220	9.817	<.001
	LIQR	-.004	.002	-.042	-2.402	.016
	LN_INVEST	.420	.015	.488	27.508	<.001

	YEAR_CAT	.135	.015	.193	9.019	<.001
	SECTOR	-.019	.006	-.058	-3.317	<.001
	ACTIVE	.154	.078	.034	1.974	.048
	OCI-3	-8.887E-5	.000	-.145	-7.792	<.001

Coefficients[a]

		95.0% Confidence Interval for B		Correlations			Collinearity Statistics
Model		Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance
1	(Constant)	.444	.927				
	AGE	.072	.108	.374	.226	.170	.594
	LIQR	-.007	-.001	-.059	-.057	-.042	.963
	LN_INVEST	.390	.450	.515	.545	.475	.948
	YEAR_CAT	.106	.164	.355	.208	.156	.652
	SECTOR	-.030	-.008	-.138	-.078	-.057	.978
	ACTIVE	.001	.306	.045	.047	.034	.992
	OCI-3	.000	.000	-.345	-.181	-.135	.862

Coefficients[a]

		Collinearity Statistics
Model		VIF
1	(Constant)	

	AGE	1.685
	LIQR	1.038
	LN_INVEST	1.054
	YEAR_CAT	1.534
	SECTOR	1.022
	ACTIVE	1.008
	OCI-3	1.161

a. Dependent Variable: LN_EMPLY

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	AGE	LIQR	LN_INVEST
1	1	6.220	1.000	.00	.00	.01	.00
	2	.662	3.064	.00	.00	.90	.00
	3	.463	3.664	.00	.02	.00	.02
	4	.247	5.020	.00	.01	.02	.55
	5	.214	5.395	.00	.04	.01	.06
	6	.104	7.751	.01	.00	.01	.23
	7	.068	9.557	.00	.67	.02	.00

	8	.022	16.774	.98	.26	.03	.12

Collinearity Diagnostics[a]

		Variance Proportions			
Model	Dimension	YEAR_CAT	SECTOR	ACTIVE	OCI-3
1	1	.00	.00	.00	.01
	2	.00	.00	.00	.00
	3	.03	.01	.00	.56
	4	.04	.20	.00	.01
	5	.11	.60	.00	.14
	6	.16	.09	.46	.11
	7	.66	.00	.10	.01
	8	.00	.10	.44	.15

a. Dependent Variable: LN_EMPLY

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_EMPLY	Predicted Value	Residual
103	-3.256	.000	2.84898	-2.848977
151	-3.765	1.792	5.08649	-3.294732
152	-3.507	1.792	4.86056	-3.068798
153	-3.456	1.609	4.63350	-3.024061

154	-3.423	1.386	4.38163	-2.995340
155	-3.057	1.386	4.06117	-2.674877
156	-3.096	1.099	3.80833	-2.709715
640	-3.230	.000	2.82626	-2.826265
641	-3.052	.000	2.67105	-2.671055
643	3.220	7.241	4.42278	2.817869
644	3.118	6.895	4.16569	2.728984
811	-3.250	.000	2.84376	-2.843762
1087	3.422	5.438	2.44383	2.994249
1089	3.107	4.754	2.03449	2.719102
1090	3.022	4.443	1.79765	2.644998
1517	-3.240	.000	2.83550	-2.835499
1518	-3.069	.000	2.68601	-2.686013
1542	3.281	5.075	2.20385	2.871325

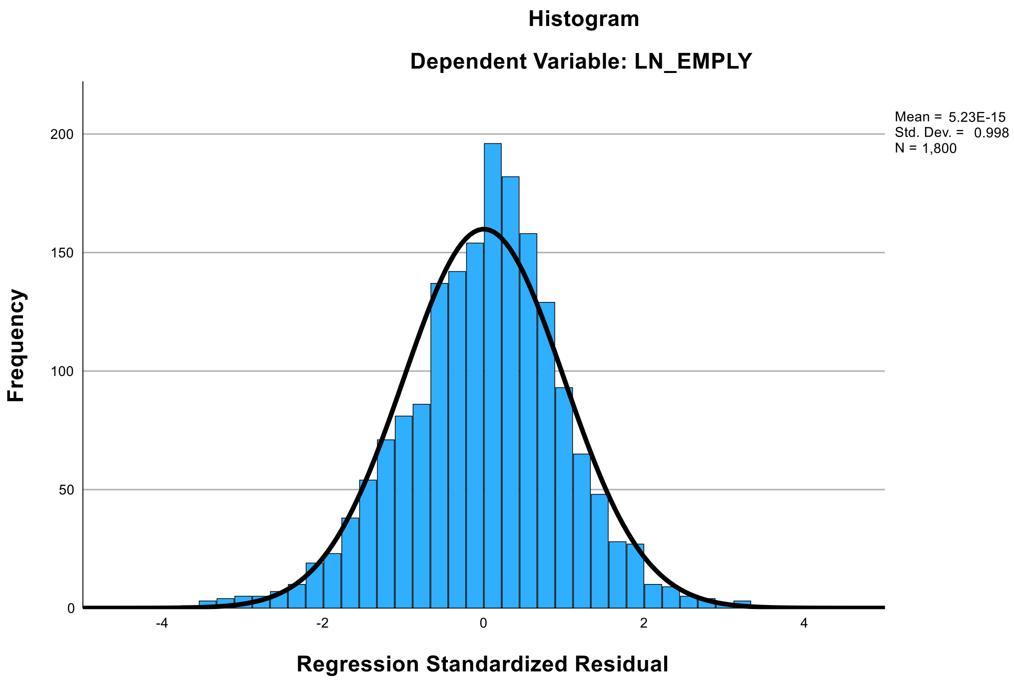
a. Dependent Variable: LN_EMPLY

Residuals Statistics[a]

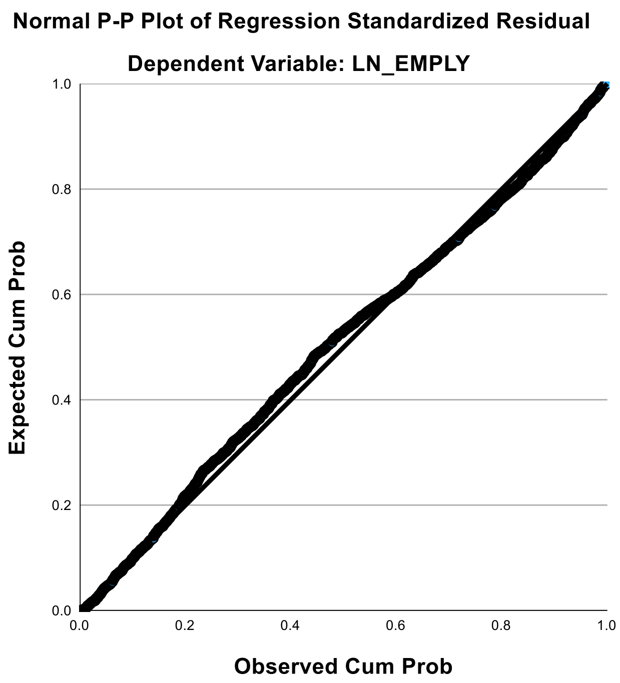
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.00652	5.23722	2.64779	.813656	1800
Residual	-3.294732	2.994249	.000000	.873410	1800
Std. Predicted Value	-3.246	3.182	.000	1.000	1800
Std. Residual	-3.765	3.422	.000	.998	1800

a. Dependent Variable: LN_EMPLY

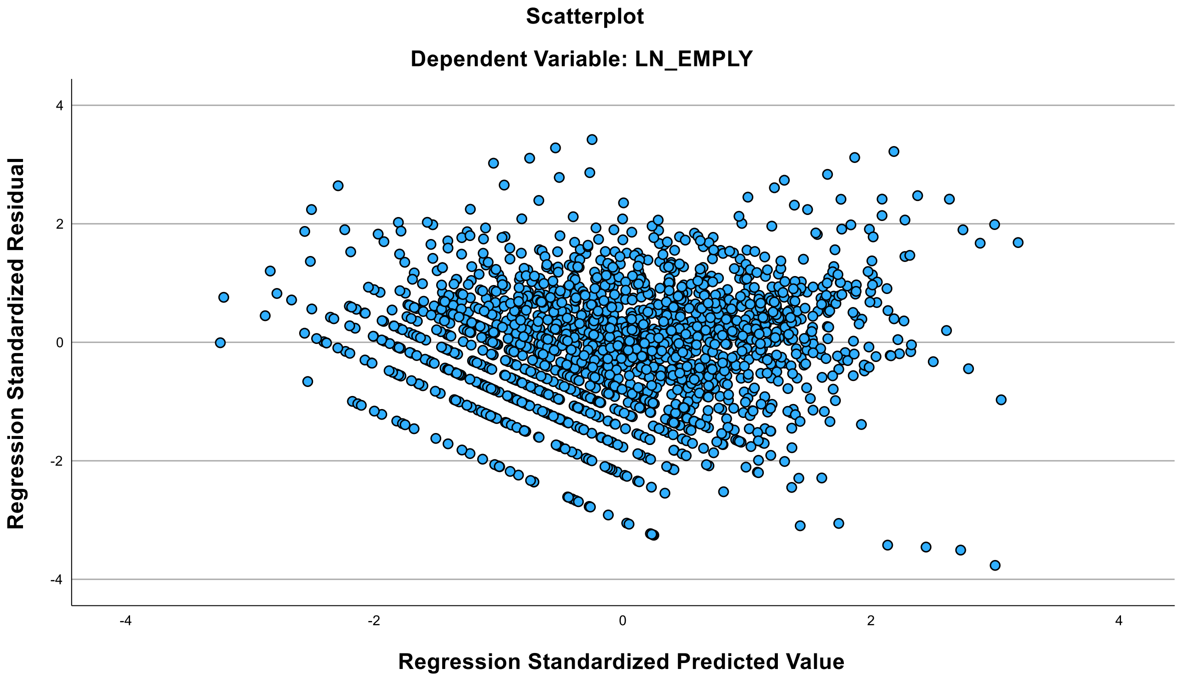
Charts



Histogram
Dependent Variable: LN_EMPLY
Mean = 5.23E-15
Std. Dev. = 0.998
N = 1,800
200
150
100
50
0
Frequency
-4
-2
0
2
4
Regression Standardized Residual



Normal P-P Plot of Regression Standardized Residual
Dependent Variable: LN_EMPLY
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob



Mixed Model Analysis (Fixed Effects)

Notes

Output Created		02-SEP-2025 13:38:33
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\emply\emply_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	1800
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_EMPLY BY SECTOR WITH LIQR ACTIVE LN_INVEST AGE YEAR_CAT OCI3 /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR ACTIVE LN_INVEST AGE YEAR_CAT OCI3 | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	ACTIVE	1		1	
	LN_INVEST	1		1	
	AGE	1		1	
	YEAR_CAT	1		1	
	OCI3	1		1	
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		27		26	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	
	ACTIVE	
	LN_INVEST	
	AGE	

	YEAR_CAT	
	OCI3	
Repeated Effects	YEAR	300
Total		

a. Dependent Variable: LN_EMPLY.

Information Criteria[a]

-2 Log Likelihood	4521.54999903
Akaike's Information Criterion (AIC)	4573.54999903
Hurvich and Tsai's Criterion (AICC)	4574.34187720
Bozdogan's Criterion (CAIC)	4742.43408957
Schwarz's Bayesian Criterion (BIC)	4716.43408957

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_EMPLY.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	1776.999	22.184	<.001
SECTOR	13	1789.166	8.335	<.001
LIQR	1	1707.687	3.721	.054
ACTIVE	1	1788.998	5.127	.024
LN_INVEST	1	1792.181	836.506	<.001
AGE	1	1776.010	88.161	<.001
YEAR_CAT	1	1427.002	89.363	<.001
OCI3	1	1741.211	55.748	<.001

a. Dependent Variable: LN_EMPLY.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound
Intercept	.596	.168	1797.612	3.559	<.001	.268
[SECTOR=1]	.011	.146	1789.065	.078	.938	-.275
[SECTOR=2]	-.134	.148	1789.147	-.904	.366	-.424
[SECTOR=3]	-.010	.152	1789.424	-.067	.946	-.308
[SECTOR=4]	.031	.155	1789.460	.198	.843	-.273
[SECTOR=5]	.141	.164	1788.950	.860	.390	-.180
[SECTOR=6]	.334	.152	1789.012	2.201	.028	.036

[SECTOR=7]	-.436	.145	1789.128	-3.018	.003	-.720
[SECTOR=8]	-.087	.145	1789.459	-.596	.551	-.372
[SECTOR=9]	.050	.163	1789.300	.304	.761	-.271
[SECTOR=10]	-.029	.145	1788.990	-.200	.842	-.314
[SECTOR=11]	-.414	.146	1789.093	-2.842	.005	-.700
[SECTOR=12]	-.213	.153	1789.039	-1.391	.164	-.514
[SECTOR=13]	-.066	.193	1789.530	-.342	.733	-.445
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	-.003	.002	1707.687	-1.929	.054	-.006
ACTIVE	.173	.077	1788.998	2.264	.024	.023
LN_INVEST	.434	.015	1792.181	28.922	<.001	.405
AGE	.085	.009	1776.010	9.389	<.001	.067
YEAR_CAT	.141	.015	1427.002	9.453	<.001	.112
OCI3	-8.389E-5	1.124E-5	1741.211	-7.466	<.001	.000

Estimates of Fixed Effects[a]

	95% Confidence Interval
Parameter	Upper Bound
Intercept	.925
[SECTOR=1]	.298
[SECTOR=2]	.156

[SECTOR=3]	.287
[SECTOR=4]	.335
[SECTOR=5]	.461
[SECTOR=6]	.632
[SECTOR=7]	-.153
[SECTOR=8]	.198
[SECTOR=9]	.370
[SECTOR=10]	.256
[SECTOR=11]	-.128
[SECTOR=12]	.087
[SECTOR=13]	.313
[SECTOR=14]	.
LIQR	5.107E-5
ACTIVE	.323
LN_INVEST	.463
AGE	.103
YEAR_CAT	.170
OCI3	-6.185E-5

a. Dependent Variable:
LN_EMPLY.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval Lower Bound
Repeated Measures	Var: [YEAR=2018]	.824	.069	11.944	<.001	.700
	Var: [YEAR=2019]	.722	.060	12.096	<.001	.614
	Var: [YEAR=2020]	.677	.055	12.214	<.001	.577
	Var: [YEAR=2021]	.657	.054	12.202	<.001	.560
	Var: [YEAR=2022]	.689	.057	12.084	<.001	.586
	Var: [YEAR=2023]	.775	.065	11.965	<.001	.658

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval Upper Bound
Repeated Measures	Var: [YEAR=2018]	.971
	Var: [YEAR=2019]	.849

	Var: [YEAR=2020]	.795
	Var: [YEAR=2021]	.772
	Var: [YEAR=2022]	.811
	Var: [YEAR=2023]	.913

a. Dependent Variable: LN_EMPLY.

Mixed Model Analysis (Random Effects)

Notes

Output Created		02-SEP-2025 13:57:29
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\emply\emply_dataset.sav
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	N of Rows in Working Data File	1800
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_EMPLY BY SECTOR WITH LIQR LN_INVEST AGE YEAR_CAT ACTIVE OCI3 /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR LN_INVEST AGE YEAR_CAT ACTIVE OCI3 | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /RANDOM=INTERCEPT | SUBJECT(COMPID) COVTYPE(AR1) /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.34
	Elapsed Time	00:00:00.34

Warnings

The covariance structure for random effect with only one level will be changed to Identity.

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	AGE	1		1	
	YEAR_CAT	1		1	
	ACTIVE	1		1	
	OCI3	1		1	
Random Effects	Intercept	1	Identity	1	COMPID
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		28		27	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	

	LN_INVEST	
	AGE	
	YEAR_CAT	
	ACTIVE	
	OCI3	
Random Effects	Intercept	
Repeated Effects	YEAR	300
Total		

a. Dependent Variable: LN_EMPLY.

Information Criteria[a]

-2 Log Likelihood	3136.93888245
Akaike's Information Criterion (AIC)	3190.93888245
Hurvich and Tsai's Criterion (AICC)	3191.79215559
Bozdogan's Criterion (CAIC)	3366.31851494
Schwarz's Bayesian Criterion (BIC)	3339.31851494

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_EMPLY.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	343.463	8.134	.005
SECTOR	13	296.440	2.028	.019
LIQR	1	1133.460	.965	.326
LN_INVEST	1	300.412	201.557	<.001
AGE	1	301.671	11.299	<.001
YEAR_CAT	1	402.300	62.304	<.001
ACTIVE	1	296.255	.663	.416
OCI3	1	1635.723	56.509	<.001

a. Dependent Variable: LN_EMPLY.

Estimates of Fixed Effects[a]

						95% Confidence Interval
Parameter	Estimate	Std. Error	df	t	Sig.	Lower Bound
Intercept	.656	.337	311.751	1.948	.052	-.007
[SECTOR=1]	-.035	.318	296.319	-.110	.913	-.661
[SECTOR=2]	-.161	.322	296.342	-.501	.617	-.794
[SECTOR=3]	-.045	.330	296.402	-.136	.892	-.694

[SECTOR=4]	.025	.337	296.380	.073	.942	-.639
[SECTOR=5]	.193	.356	296.297	.541	.589	-.508
[SECTOR=6]	.341	.330	296.427	1.033	.302	-.309
[SECTOR=7]	-.470	.314	296.416	-1.495	.136	-1.089
[SECTOR=8]	-.102	.316	296.441	-.322	.748	-.724
[SECTOR=9]	.089	.356	296.347	.251	.802	-.610
[SECTOR=10]	-.053	.316	296.281	-.166	.868	-.675
[SECTOR=11]	-.463	.317	296.311	-1.459	.146	-1.088
[SECTOR=12]	-.179	.334	296.263	-.536	.593	-.836
[SECTOR=13]	-.212	.421	296.503	-.505	.614	-1.040
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	-.001	.001	1133.460	-.983	.326	-.003
LN_INVEST	.458	.032	300.412	14.197	<.001	.394
AGE	.064	.019	301.671	3.361	<.001	.026
YEAR_CAT	.162	.020	402.300	7.893	<.001	.121
ACTIVE	.136	.167	296.255	.814	.416	-.192
OCI3	-7.795E-5	1.037E-5	1635.723	-7.517	<.001	-9.829E-5

Estimates of Fixed Effects[a]

	95% Confidence Interval
Parameter	Upper Bound

Intercept	1.318
[SECTOR=1]	.592
[SECTOR=2]	.472
[SECTOR=3]	.605
[SECTOR=4]	.689
[SECTOR=5]	.894
[SECTOR=6]	.991
[SECTOR=7]	.149
[SECTOR=8]	.521
[SECTOR=9]	.789
[SECTOR=10]	.570
[SECTOR=11]	.162
[SECTOR=12]	.478
[SECTOR=13]	.615
[SECTOR=14]	.
LIQR	.001
LN_INVEST	.521
AGE	.101
YEAR_CAT	.202
ACTIVE	.464
OCI3	-5.761E-5

a. Dependent Variable:
LN_EMPLY.

b. This parameter is set to zero
because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.
Repeated Measures	Var: [YEAR=2018]	.654	.058	11.375	<.001
	Var: [YEAR=2019]	.382	.035	10.802	<.001
	Var: [YEAR=2020]	.144	.015	9.563	<.001
	Var: [YEAR=2021]	.046	.008	6.130	<.001
	Var: [YEAR=2022]	.121	.013	9.061	<.001
	Var: [YEAR=2023]	.274	.026	10.531	<.001
Intercept [subject = COMPID]	Variance	.546	.047	11.637	<.001

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval	
		Lower Bound	Upper Bound
Repeated Measures	Var: [YEAR=2018]	.551	.777

	Var: [YEAR=2019]	.319	.458
	Var: [YEAR=2020]	.118	.177
	Var: [YEAR=2021]	.034	.064
	Var: [YEAR=2022]	.097	.150
	Var: [YEAR=2023]	.227	.329
Intercept [subject = COMPID]	Variance	.462	.647

a. Dependent Variable: LN_EMPLY.

Assets

Regression

Notes

Output Created		02-SEP-2025 10:48:34
Comments		
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		2023\assets\assets_dataset.sav
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	Split File	<none>
	N of Rows in Working Data File	1860
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT LN_ASSETS /METHOD=ENTER AGE LN_INVEST LIQR YEAR_CAT SECTOR ACTIVE OCI3 /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:00.34

	Elapsed Time	00:00:00.34
	Memory Required	7424 bytes
	Additional Memory Required for Residual Plots	800 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	OCI-3, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE[b]	.	Enter

a. Dependent Variable: LN_ASSETS

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.686[a]	.471	.469	1.370041	.827

a. Predictors: (Constant), OCI-3, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE

b. Dependent Variable: LN_ASSETS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3091.868	7	441.695	235.318	<.001[b]

	Residual	3476.227	1852	1.877		
	Total	6568.096	1859			

a. Dependent Variable: LN_ASSETS

b. Predictors: (Constant), OCI-3, ACTIVE, LIQR, SECTOR, LN_INVEST, YEAR_CAT, AGE

Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	11.341	.188		60.395	<.001
	AGE	.145	.014	.223	10.129	<.001
	LN_INVEST	.687	.023	.506	29.272	<.001
	LIQR	.019	.002	.130	7.554	<.001
	YEAR_CAT	.198	.023	.180	8.566	<.001
	SECTOR	-.013	.009	-.026	-1.511	.131
	ACTIVE	-.060	.119	-.008	-.499	.618
	OCI-3	.000	.000	-.140	-7.670	<.001

Coefficients[a]

Model		95.0% Confidence Interval for B		Correlations			Collinearity Statistics
		Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance
1	(Constant)	10.973	11.710				

	AGE	.117	.173	.343	.229	.171	.590
	LN_INVEST	.641	.733	.533	.562	.495	.955
	LIQR	.014	.023	.111	.173	.128	.963
	YEAR_CAT	.153	.243	.335	.195	.145	.647
	SECTOR	-.030	.004	-.101	-.035	-.026	.983
	ACTIVE	-.294	.174	.009	-.012	-.008	.993
	OCI-3	.000	.000	-.338	-.175	-.130	.864

Coefficients[a]

Model		Collinearity Statistics VIF
1	(Constant)	
	AGE	1.694
	LN_INVEST	1.047
	LIQR	1.039
	YEAR_CAT	1.545
	SECTOR	1.018
	ACTIVE	1.007
	OCI-3	1.158

a. Dependent Variable: LN_ASSETS

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	AGE	LN_INVEST	LIQR
1	1	6.221	1.000	.00	.00	.00	.01
	2	.663	3.064	.00	.00	.00	.90
	3	.460	3.677	.00	.02	.02	.00
	4	.247	5.021	.00	.02	.60	.02
	5	.215	5.377	.00	.03	.04	.00
	6	.105	7.696	.02	.00	.22	.01
	7	.067	9.639	.01	.67	.00	.02
	8	.023	16.617	.98	.26	.12	.04

Collinearity Diagnostics[a]

		Variance Proportions			
Model	Dimension	YEAR_CAT	SECTOR	ACTIVE	OCI-3
1	1	.00	.00	.00	.01
	2	.00	.00	.00	.00
	3	.03	.01	.00	.56
	4	.05	.15	.00	.01
	5	.09	.66	.00	.15

	6	.16	.09	.46	.11
	7	.66	.00	.10	.01
	8	.00	.09	.44	.16

a. Dependent Variable: LN_ASSETS

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_ASSETS	Predicted Value	Residual
61	-4.555	7.447	13.68756	-6.240388
62	-3.011	9.223	13.34803	-4.125370
78	-3.277	9.763	14.25358	-4.490162
157	-4.516	11.932	18.11894	-6.186489
158	-4.034	12.253	17.78053	-5.527074
159	-3.477	12.684	17.44751	-4.763149
160	-3.015	12.955	17.08629	-4.131110
161	-3.459	11.859	16.59870	-4.739359
425	-4.599	6.912	13.21313	-6.301379
426	-8.167	1.609	12.79795	-11.188513
516	-4.735	6.960	13.44784	-6.487491
552	-3.509	7.989	12.79632	-4.807777
882	-5.385	4.605	11.98252	-7.377348
1062	-3.276	8.468	12.95591	-4.487903

1073	-4.540	6.153	12.37309	-6.220361
1074	-3.600	7.046	11.97860	-4.932819
1134	-3.858	7.090	12.37570	-5.285627
1147	4.667	20.353	13.95962	6.393763
1148	4.569	19.899	13.63940	6.259770
1149	6.037	21.632	13.36165	8.270771
1150	5.270	20.295	13.07540	7.220040
1321	-3.228	10.289	14.71100	-4.422255
1363	-3.412	10.808	15.48270	-4.675057
1392	-3.784	7.796	12.98043	-5.184786
1393	-3.005	9.620	13.73704	-4.116981
1476	-5.315	4.605	11.88709	-7.281921
1674	-7.187	4.605	14.45130	-9.846126

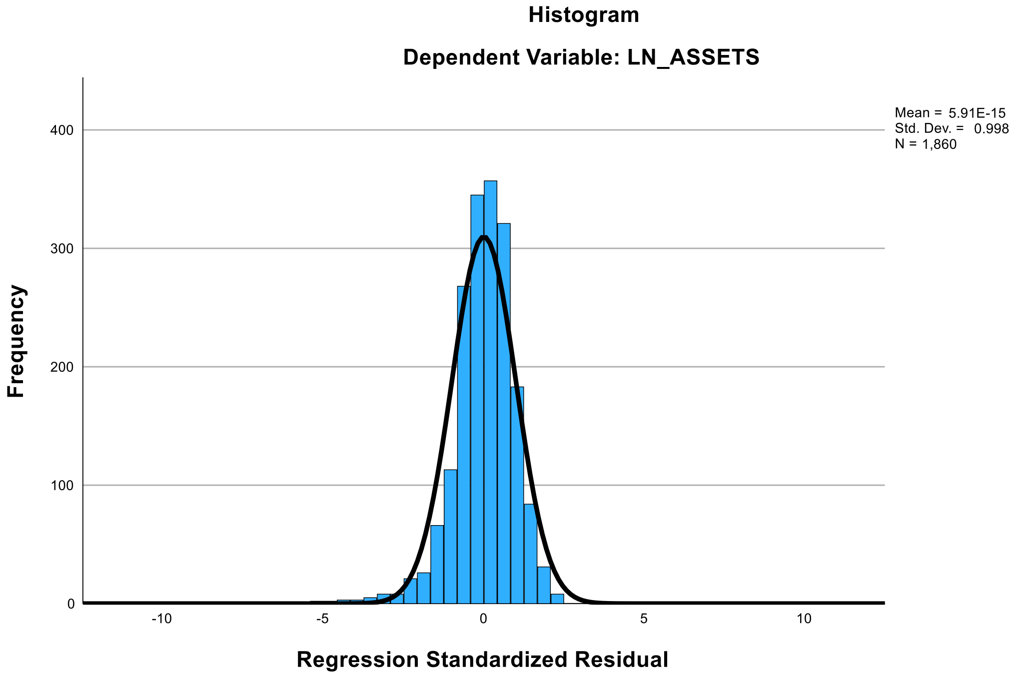
a. Dependent Variable: LN_ASSETS

Residuals Statistics[a]

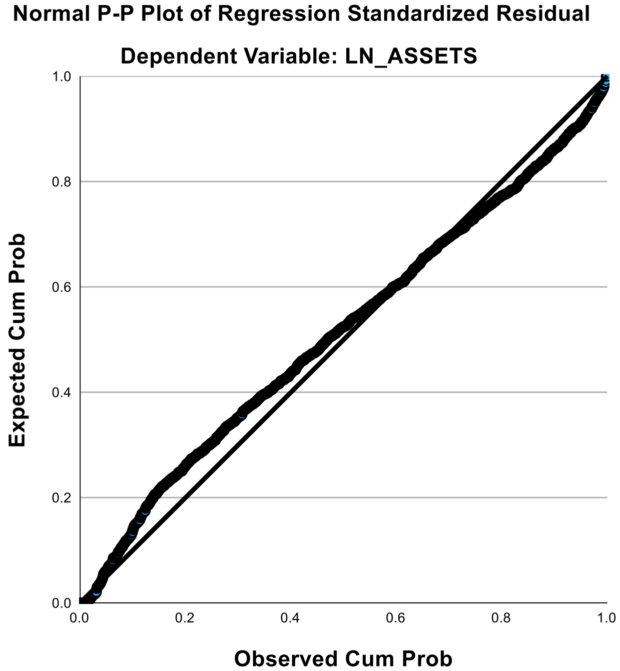
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	10.15551	18.54350	14.50781	1.289647	1860
Residual	-11.188513	8.270771	.000000	1.367459	1860
Std. Predicted Value	-3.375	3.129	.000	1.000	1860
Std. Residual	-8.167	6.037	.000	.998	1860

a. Dependent Variable: LN_ASSETS

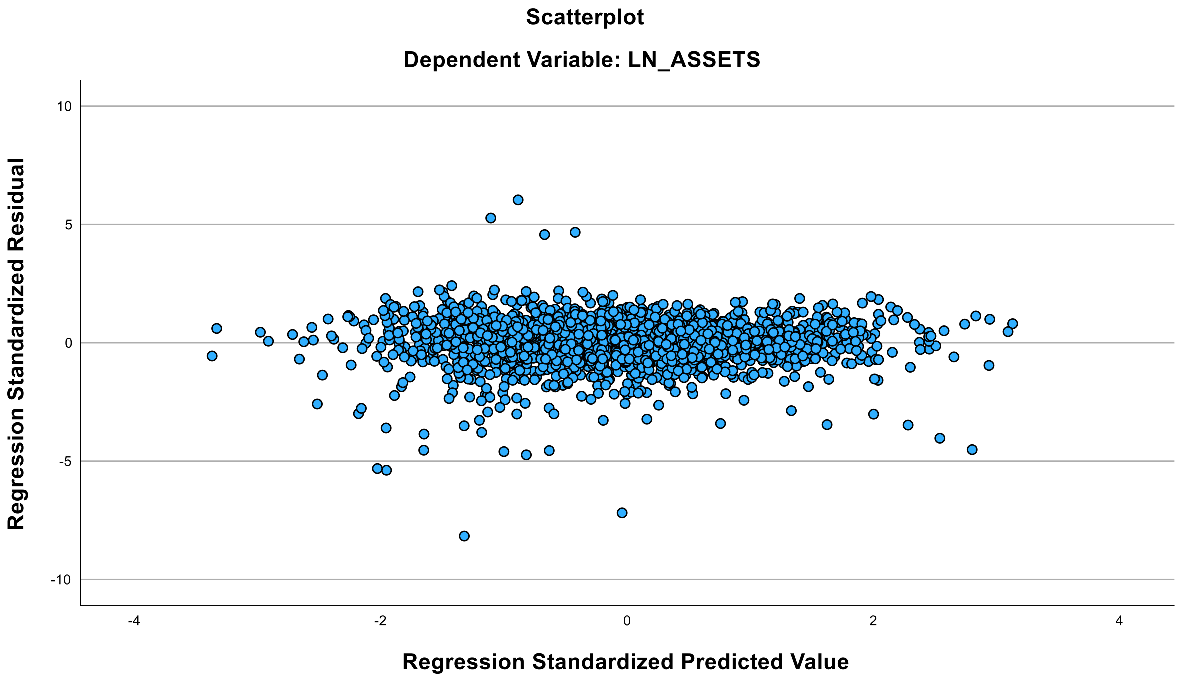
Charts



Histogram
Dependent Variable: LN_ASSETS
Mean = 5.91E-15
Std. Dev. = 0.998
N = 1,860
Frequency
400
300
200
100
0
-10
-5
0
5
10
Regression Standardized Residual



Normal P-P Plot of Regression Standardized Residual
Dependent Variable: LN_ASSETS
Expected Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob



Mixed Model Analysis (Fixed Effects)

Notes

Output Created		02-SEP-2025 14:04:58
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\assets\assets_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	1860
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_ASSETS BY SECTOR WITH LIQR LN_INVEST ACTIVE YEAR_CAT AGE OCI3 /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR LN_INVEST ACTIVE YEAR_CAT AGE OCI3 | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.02

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	ACTIVE	1		1	
	YEAR_CAT	1		1	
	AGE	1		1	
	OCI3	1		1	
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		27		26	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	
	LIQR	
	LN_INVEST	
	ACTIVE	
	YEAR_CAT	
	AGE	

	OCI3	
Repeated Effects	YEAR	310
Total		

a. Dependent Variable: LN_ASSETS.

Information Criteria[a]

-2 Log Likelihood	6262.41288169
Akaike's Information Criterion (AIC)	6314.41288169
Hurvich and Tsai's Criterion (AICC)	6315.17883914
Bozdogan's Criterion (CAIC)	6484.14950763
Schwarz's Bayesian Criterion (BIC)	6458.14950763

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_ASSETS.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.

Intercept	1	1819.437	4500.640	<.001
SECTOR	13	1716.065	4.213	<.001
LIQR	1	1675.261	60.817	<.001
LN_INVEST	1	1725.832	1037.592	<.001
ACTIVE	1	1716.346	1.458	.227
YEAR_CAT	1	1544.157	86.206	<.001
AGE	1	1683.988	69.446	<.001
OCI3	1	1817.427	41.133	<.001

a. Dependent Variable: LN_ASSETS.

Estimates of Fixed Effects[a]

						95% Confidence Interval
Parameter	Estimate	Std. Error	df	t	Sig.	Lower Bound
Intercept	11.657	.251	1778.658	46.470	<.001	11.165
[SECTOR=1]	-.531	.218	1716.013	-2.438	.015	-.957
[SECTOR=2]	.118	.221	1715.962	.536	.592	-.315
[SECTOR=3]	-.308	.225	1717.852	-1.368	.172	-.750
[SECTOR=4]	-.237	.228	1717.478	-1.038	.299	-.684
[SECTOR=5]	.225	.241	1715.887	.933	.351	-.248
[SECTOR=6]	-.042	.224	1716.208	-.187	.852	-.481
[SECTOR=7]	-.387	.214	1716.632	-1.806	.071	-.807

[SECTOR=8]	-.047	.217	1717.264	-.218	.828	-.473
[SECTOR=9]	-.207	.244	1716.235	-.850	.395	-.686
[SECTOR=10]	-.407	.217	1716.129	-1.874	.061	-.832
[SECTOR=11]	-.297	.218	1716.077	-1.362	.173	-.724
[SECTOR=12]	-.520	.229	1716.054	-2.269	.023	-.969
[SECTOR=13]	-.306	.289	1716.764	-1.061	.289	-.873
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	.018	.002	1675.261	7.799	<.001	.014
LN_INVEST	.710	.022	1725.832	32.212	<.001	.666
ACTIVE	-.135	.112	1716.346	-1.207	.227	-.355
YEAR_CAT	.215	.023	1544.157	9.285	<.001	.170
AGE	.112	.013	1683.988	8.333	<.001	.085
OCI3	.000	1.714E-5	1817.427	-6.413	<.001	.000

Estimates of Fixed Effects[a]

	95% Confidence Interval
Parameter	Upper Bound
Intercept	12.149
[SECTOR=1]	-.104
[SECTOR=2]	.551
[SECTOR=3]	.134

[SECTOR=4]	.211
[SECTOR=5]	.697
[SECTOR=6]	.398
[SECTOR=7]	.033
[SECTOR=8]	.379
[SECTOR=9]	.271
[SECTOR=10]	.019
[SECTOR=11]	.131
[SECTOR=12]	-.070
[SECTOR=13]	.260
[SECTOR=14]	.
LIQR	.023
LN_INVEST	.753
ACTIVE	.084
YEAR_CAT	.261
AGE	.138
OCI3	-7.631E-5

a. Dependent Variable:
LN_ASSETS.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.	95% Confidence Interval
						Lower Bound
Repeated Measures	Var: [YEAR=2018]	3.699	.304	12.155	<.001	3.149
	Var: [YEAR=2019]	1.766	.143	12.312	<.001	1.506
	Var: [YEAR=2020]	1.403	.113	12.402	<.001	1.198
	Var: [YEAR=2021]	1.357	.110	12.352	<.001	1.158
	Var: [YEAR=2022]	1.245	.102	12.267	<.001	1.061
	Var: [YEAR=2023]	1.543	.128	12.104	<.001	1.313

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval
		Upper Bound
Repeated Measures	Var: [YEAR=2018]	4.347
	Var: [YEAR=2019]	2.070

	Var: [YEAR=2020]	1.643
	Var: [YEAR=2021]	1.591
	Var: [YEAR=2022]	1.461
	Var: [YEAR=2023]	1.815

a. Dependent Variable: LN_ASSETS.

Mixed Model Analysis (Random Effects)

Notes

Output Created		02-SEP-2025 14:08:51
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\2018-2023\assets\assets_dataset.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>

	N of Rows in Working Data File	1860
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data for all variables in the model.
Syntax		MIXED LN_ASSETS BY SECTOR WITH LIQR LN_INVEST ACTIVE YEAR_CAT AGE OCI3 /CRITERIA=DFMETHOD(SATTERTHWAITE) CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0.00000001, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0, ABSOLUTE) /FIXED=SECTOR LIQR LN_INVEST ACTIVE YEAR_CAT AGE OCI3 | SSTYPE(3) /METHOD=ML /PRINT=SOLUTION TESTCOV /RANDOM=INTERCEPT | SUBJECT(COMPID) COVTYPE(AR1) /REPEATED=YEAR | SUBJECT(COMPID) COVTYPE(DIAG).
Resources	Processor Time	00:00:00.27
	Elapsed Time	00:00:00.26

Warnings

The covariance structure for random effect with only one level will be changed to Identity.

Model Dimension[a]

		Number of Levels	Covariance Structure	Number of Parameters	Subject Variables
Fixed Effects	Intercept	1		1	
	SECTOR	14		13	
	LIQR	1		1	
	LN_INVEST	1		1	
	ACTIVE	1		1	
	YEAR_CAT	1		1	
	AGE	1		1	
	OCI3	1		1	
Random Effects	Intercept	1	Identity	1	COMPID
Repeated Effects	YEAR	6	Diagonal	6	COMPID
Total		28		27	

Model Dimension[a]

		Number of Subjects
Fixed Effects	Intercept	
	SECTOR	

	LIQR	
	LN_INVEST	
	ACTIVE	
	YEAR_CAT	
	AGE	
	OCI3	
Random Effects	Intercept	
Repeated Effects	YEAR	310
Total		

a. Dependent Variable: LN_ASSETS.

Information Criteria[a]

-2 Log Likelihood	5231.13582702
Akaike's Information Criterion (AIC)	5285.13582702
Hurvich and Tsai's Criterion (AICC)	5285.96115453
Bozdogan's Criterion (CAIC)	5461.40078472
Schwarz's Bayesian Criterion (BIC)	5434.40078472

The information criteria are displayed in smaller-is-better form.[a]

a. Dependent Variable: LN_ASSETS.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	377.475	1775.316	<.001
SECTOR	13	306.178	1.123	.339
LIQR	1	1357.592	276.110	<.001
LN_INVEST	1	311.325	270.019	<.001
ACTIVE	1	305.947	.386	.535
YEAR_CAT	1	471.724	58.052	<.001
AGE	1	312.728	10.981	.001
OCI3	1	1633.723	77.059	<.001

a. Dependent Variable: LN_ASSETS.

Estimates of Fixed Effects[a]

						95% Confidence Interval
Parameter	Estimate	Std. Error	df	t	Sig.	Lower Bound
Intercept	11.951	.462	328.391	25.864	<.001	11.042
[SECTOR=1]	-.650	.435	306.005	-1.494	.136	-1.506

[SECTOR=2]	.012	.441	306.051	.028	.977	-.856
[SECTOR=3]	-.442	.450	306.207	-.983	.326	-1.327
[SECTOR=4]	-.234	.456	306.100	-.512	.609	-1.131
[SECTOR=5]	.112	.482	305.966	.233	.816	-.836
[SECTOR=6]	-.153	.448	306.198	-.342	.733	-1.034
[SECTOR=7]	-.522	.428	306.186	-1.220	.224	-1.365
[SECTOR=8]	-.074	.434	306.202	-.171	.864	-.928
[SECTOR=9]	-.268	.488	305.998	-.550	.583	-1.228
[SECTOR=10]	-.453	.434	305.988	-1.045	.297	-1.307
[SECTOR=11]	-.384	.435	305.995	-.882	.378	-1.241
[SECTOR=12]	-.549	.458	305.940	-1.199	.231	-1.451
[SECTOR=13]	-.332	.577	306.246	-.575	.565	-1.468
[SECTOR=14]	0[b]	0	.	.	.	.
LIQR	.028	.002	1357.592	16.617	<.001	.024
LN_INVEST	.715	.043	311.325	16.432	<.001	.629
ACTIVE	-.139	.224	305.947	-.621	.535	-.580
YEAR_CAT	.220	.029	471.724	7.619	<.001	.163
AGE	.086	.026	312.728	3.314	.001	.035
OCI3	.000	1.730E-5	1633.723	-8.778	<.001	.000

Estimates of Fixed Effects[a]

Parameter	95% Confidence Interval Upper Bound
Intercept	12.860
[SECTOR=1]	.206
[SECTOR=2]	.880
[SECTOR=3]	.443
[SECTOR=4]	.663
[SECTOR=5]	1.060
[SECTOR=6]	.728
[SECTOR=7]	.320
[SECTOR=8]	.780
[SECTOR=9]	.691
[SECTOR=10]	.400
[SECTOR=11]	.473
[SECTOR=12]	.352
[SECTOR=13]	.804
[SECTOR=14]	.
LIQR	.031
LN_INVEST	.800
ACTIVE	.302
YEAR_CAT	.276

AGE	.137
OCI3	.000

a. Dependent Variable: LN_ASSETS.

b. This parameter is set to zero because it is redundant.

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error	Wald Z	Sig.
Repeated Measures	Var: [YEAR=2018]	2.994	.255	11.751	<.001
	Var: [YEAR=2019]	1.057	.095	11.107	<.001
	Var: [YEAR=2020]	.493	.050	9.900	<.001
	Var: [YEAR=2021]	.273	.031	8.860	<.001
	Var: [YEAR=2022]	.273	.033	8.249	<.001
	Var: [YEAR=2023]	.555	.056	9.848	<.001
Intercept [subject = COMPID]	Variance	.990	.087	11.416	<.001

Estimates of Covariance Parameters[a]

Parameter		95% Confidence Interval Lower Bound	Upper Bound
Repeated Measures	Var: [YEAR=2018]	2.534	3.537
	Var: [YEAR=2019]	.886	1.261
	Var: [YEAR=2020]	.404	.601
	Var: [YEAR=2021]	.219	.341
	Var: [YEAR=2022]	.215	.346
	Var: [YEAR=2023]	.455	.677
Intercept [subject = COMPID]	Variance	.834	1.175

a. Dependent Variable: LN_ASSETS.

Model 4- IHI

Patent

Regression

Notes

Output Created	14-OCT-2025 07:33:10

Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\Innovation\2022\basedata2022.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	396
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT LN_PATENT /METHOD=ENTER ACTIVE AGE LIQR_AVG SECTOR_1 SECTOR_2 SECTOR_3 SECTOR_4 SECTOR_5 SECTOR_6 SECTOR_7 SECTOR_8 SECTOR_9 SECTOR_10 SECTOR_11 SECTOR_12 SECTOR_13 LN_IHI_MIN

		/SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:00.39
	Elapsed Time	00:00:00.27
	Memory Required	20224 bytes
	Additional Memory Required for Residual Plots	640 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	LN_IHI_MIN, SECTOR_13, SECTOR_6, LIQR_AVG, ACTIVE, SECTOR_1, SECTOR_9, SECTOR_5, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_10, AGE, SECTOR_8, SECTOR_7, SECTOR_2[b]	.	Enter

a. Dependent Variable: LN_PATENT

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.431[a]	.186	.148	.817566	2.171

a. Predictors: (Constant), LN_IHI_MIN, SECTOR_13, SECTOR_6, LIQR_AVG, ACTIVE, SECTOR_1, SECTOR_9, SECTOR_5, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_10, AGE, SECTOR_8, SECTOR_7, SECTOR_2

b. Dependent Variable: LN_PATENT

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	56.318	17	3.313	4.956	<.001[b]
	Residual	246.645	369	.668		
	Total	302.962	386			

a. Dependent Variable: LN_PATENT

b. Predictors: (Constant), LN_IHI_MIN, SECTOR_13, SECTOR_6, LIQR_AVG, ACTIVE, SECTOR_1, SECTOR_9, SECTOR_5, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_10, AGE, SECTOR_8, SECTOR_7, SECTOR_2

Coefficients[a]

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		

1	(Constant)	3.099	.561		5.526	<.001
	ACTIVE	.286	.142	.096	2.012	.045
	AGE	.068	.017	.212	4.093	<.001
	LIQR_AVG	.015	.006	.133	2.623	.009
	SECTOR_1	-.284	.318	-.097	-.892	.373
	SECTOR_2	-.060	.318	-.021	-.188	.851
	SECTOR_3	-.335	.332	-.096	-1.009	.314
	SECTOR_4	-.081	.338	-.022	-.240	.810
	SECTOR_5	-.755	.346	-.184	-2.180	.030
	SECTOR_6	.200	.331	.058	.606	.545
	SECTOR_7	-.142	.318	-.049	-.445	.656
	SECTOR_8	-.177	.317	-.062	-.558	.577
	SECTOR_9	-.596	.359	-.130	-1.660	.098
	SECTOR_10	-.104	.322	-.033	-.322	.748
	SECTOR_11	.104	.319	.035	.327	.744
	SECTOR_12	-.040	.331	-.011	-.119	.905
	SECTOR_13	-.005	.442	-.001	-.012	.991
	LN_IHI_MIN	-.242	.050	-.240	-4.866	<.001

Coefficients[a]

		95.0% Confidence Interval for B		Correlations		
Model		Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	1.996	4.201			

	ACTIVE	.006	.566	.057	.104	.094
	AGE	.035	.101	.196	.208	.192
	LIQR_AVG	.004	.025	.097	.135	.123
	SECTOR_1	-.909	.342	-.070	-.046	-.042
	SECTOR_2	-.685	.566	.050	-.010	-.009
	SECTOR_3	-.987	.317	-.045	-.052	-.047
	SECTOR_4	-.745	.583	.045	-.012	-.011
	SECTOR_5	-1.436	-.074	-.138	-.113	-.102
	SECTOR_6	-.450	.850	.119	.032	.028
	SECTOR_7	-.768	.484	.025	-.023	-.021
	SECTOR_8	-.801	.447	-.026	-.029	-.026
	SECTOR_9	-1.302	.110	-.113	-.086	-.078
	SECTOR_10	-.737	.530	.013	-.017	-.015
	SECTOR_11	-.523	.731	.089	.017	.015
	SECTOR_12	-.691	.612	-.016	-.006	-.006
	SECTOR_13	-.875	.864	.018	-.001	-.001
	LN_IHI_MIN	-.340	-.144	-.278	-.246	-.229

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	ACTIVE	.962	1.039

	AGE	.820	1.219
	LIQR_AVG	.864	1.157
	SECTOR_1	.188	5.310
	SECTOR_2	.176	5.669
	SECTOR_3	.242	4.131
	SECTOR_4	.271	3.691
	SECTOR_5	.309	3.240
	SECTOR_6	.244	4.106
	SECTOR_7	.180	5.559
	SECTOR_8	.181	5.523
	SECTOR_9	.360	2.781
	SECTOR_10	.208	4.811
	SECTOR_11	.188	5.328
	SECTOR_12	.251	3.980
	SECTOR_13	.579	1.727
	LN_IHI_MIN	.909	1.100

a. Dependent Variable: LN_PATENT

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	ACTIVE	AGE	LIQR_AVG
1	1	5.432	1.000	.00	.00	.00	.01
	2	1.026	2.301	.00	.00	.00	.01
	3	1.006	2.323	.00	.00	.00	.00
	4	1.001	2.329	.00	.00	.00	.00
	5	1.000	2.330	.00	.00	.00	.00
	6	1.000	2.331	.00	.00	.00	.00
	7	1.000	2.331	.00	.00	.00	.00
	8	1.000	2.331	.00	.00	.00	.00
	9	1.000	2.331	.00	.00	.00	.00
	10	1.000	2.331	.00	.00	.00	.00
	11	1.000	2.331	.00	.00	.00	.00
	12	1.000	2.331	.00	.00	.00	.00
	13	1.000	2.331	.00	.00	.00	.00
	14	.356	3.908	.00	.00	.03	.78
	15	.102	7.296	.00	.48	.40	.06
	16	.056	9.861	.01	.48	.44	.11
	17	.017	17.883	.01	.02	.00	.00
	18	.004	37.718	.98	.01	.13	.03

Collinearity Diagnostics[a]

Model	Dimension	Variance Proportions

		SECTOR_1	SECTOR_2	SECTOR_3	SECTOR_4	SECTOR_5	SECTOR_6
1	1	.00	.00	.00	.00	.00	.00
	2	.00	.03	.02	.01	.03	.01
	3	.01	.01	.05	.02	.01	.02
	4	.00	.02	.03	.00	.06	.00
	5	.00	.01	.01	.09	.02	.00
	6	.00	.03	.00	.00	.00	.00
	7	.04	.00	.02	.02	.03	.01
	8	.03	.00	.00	.03	.01	.00
	9	.02	.00	.00	.00	.04	.01
	10	.00	.01	.03	.00	.02	.01
	11	.00	.00	.03	.03	.01	.02
	12	.01	.02	.02	.00	.04	.07
	13	.04	.01	.00	.03	.00	.06
	14	.00	.01	.01	.00	.00	.00
	15	.00	.00	.00	.00	.00	.00
	16	.05	.06	.05	.05	.05	.05
	17	.62	.59	.57	.52	.49	.57
	18	.18	.21	.16	.19	.18	.16

Collinearity Diagnostics[a]

		Variance Proportions				
Model	Dimension	SECTOR_7	SECTOR_8	SECTOR_9	SECTOR_10	SECTOR_11

1	1	.00	.00	.00	.00	.00
	2	.01	.01	.06	.04	.00
	3	.01	.00	.00	.00	.01
	4	.02	.01	.00	.00	.00
	5	.01	.02	.06	.00	.00
	6	.00	.01	.04	.00	.09
	7	.00	.00	.00	.00	.00
	8	.00	.00	.00	.01	.00
	9	.04	.01	.02	.04	.00
	10	.01	.05	.05	.00	.03
	11	.01	.01	.03	.06	.01
	12	.02	.00	.00	.01	.00
	13	.00	.02	.05	.00	.00
	14	.00	.00	.00	.00	.00
	15	.00	.00	.00	.00	.00
	16	.07	.05	.04	.05	.05
	17	.62	.64	.52	.61	.61
	18	.16	.16	.11	.17	.18

Collinearity Diagnostics[a]

		Variance Proportions		
Model	Dimension	SECTOR_12	SECTOR_13	LN_IHI_MIN
1	1	.00	.00	.00

	2	.00	.03	.00
	3	.06	.00	.00
	4	.09	.00	.00
	5	.00	.00	.00
	6	.01	.01	.00
	7	.02	.18	.00
	8	.00	.31	.00
	9	.02	.01	.00
	10	.01	.01	.00
	11	.01	.00	.00
	12	.00	.00	.00
	13	.00	.00	.00
	14	.00	.00	.00
	15	.00	.00	.00
	16	.02	.02	.03
	17	.58	.32	.22
	18	.17	.09	.75

a. Dependent Variable: LN_PATENT

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_PATENT	Predicted Value	Residual
165	3.532	5.808	2.92086	2.887278

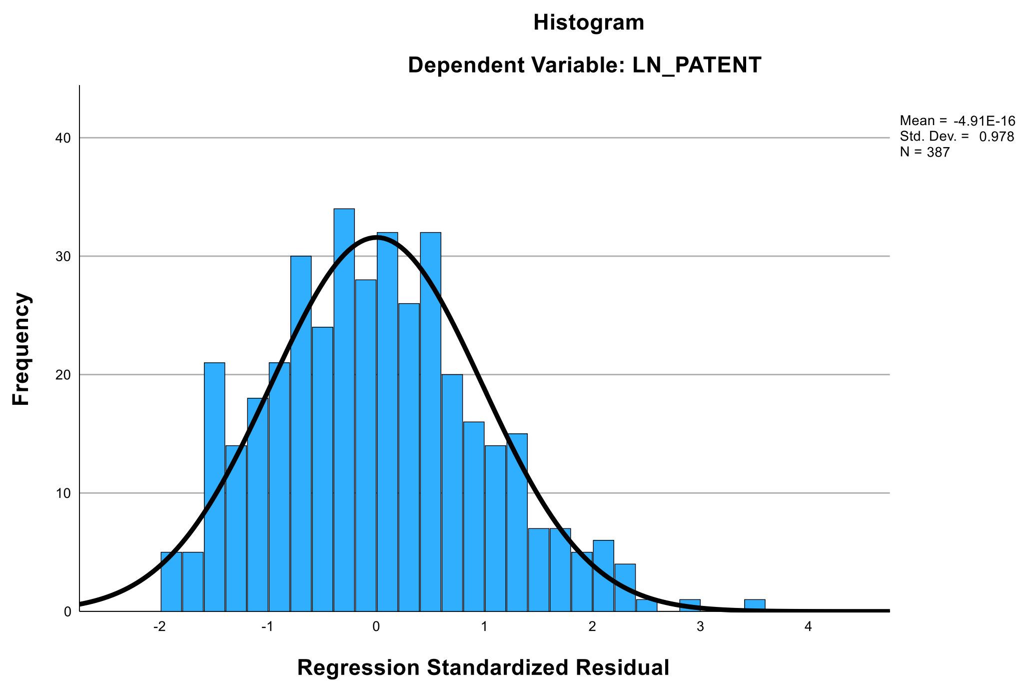
a. Dependent Variable: LN_PATENT

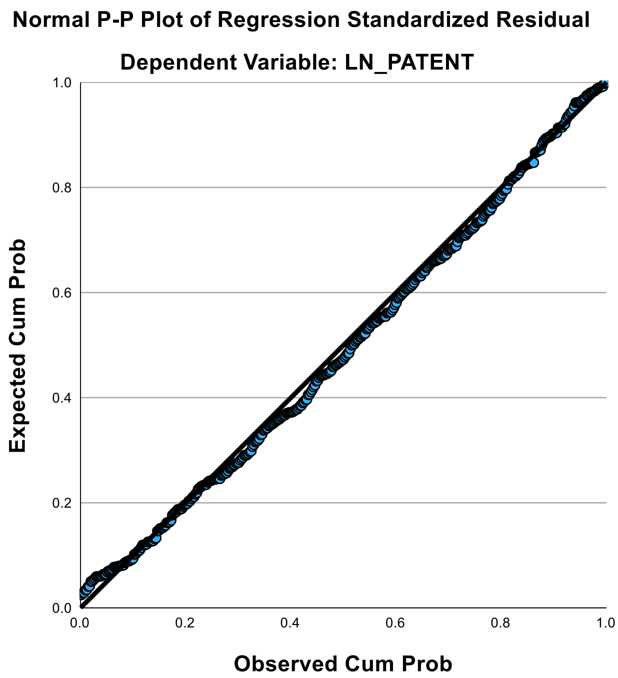
Residuals Statistics[a]

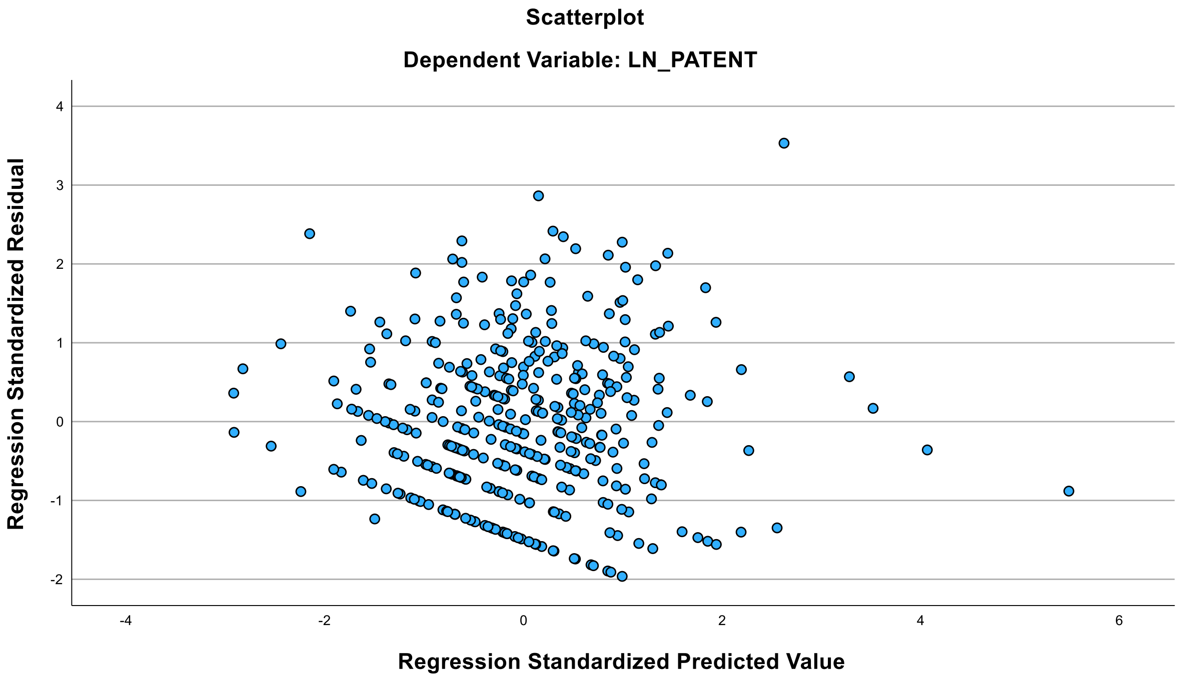
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.80351	4.01679	1.92036	.381969	387
Residual	-1.605084	2.887278	.000000	.799360	387
Std. Predicted Value	-2.924	5.488	.000	1.000	387
Std. Residual	-1.963	3.532	.000	.978	387

a. Dependent Variable: LN_PATENT

Charts


Histogram
Dependent Variable: LN_PATENT
Mean = -4.91E-16
Std. Dev. = 0.978
N = 387
Frequency
40
30
20
10
0
-2
-1
0
1
2
3
4
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: LN_PATENT
Expected Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob



IPScore

Regression

Notes

Output Created		14-OCT-2025 07:58:23
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\Innovation\2022\basedata2022.sav
	Active Dataset	DataSet1
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	396
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT IPSCORE /METHOD=ENTER ACTIVE AGE LIQR_AVG SECTOR_1 SECTOR_2 SECTOR_3 SECTOR_4 SECTOR_5 SECTOR_6 SECTOR_7 SECTOR_8 SECTOR_9 SECTOR_10 SECTOR_11 SECTOR_12 SECTOR_13 LN_IHI_MIN /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:02.67

	Elapsed Time	00:00:00.61
	Memory Required	20224 bytes
	Additional Memory Required for Residual Plots	640 bytes

[DataSet1] D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\Innovation\2022\basedata2022.sav

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	LN_IHI_MIN, SECTOR_13, SECTOR_6, LIQR_AVG, ACTIVE, SECTOR_1, SECTOR_9, SECTOR_5, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_10, AGE, SECTOR_8, SECTOR_7, SECTOR_2[b]	.	Enter

a. Dependent Variable: IPSCORE

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.369[a]	.136	.096	.43301	2.150

a. Predictors: (Constant), LN_IHI_MIN, SECTOR_13, SECTOR_6, LIQR_AVG, ACTIVE, SECTOR_1, SECTOR_9, SECTOR_5, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_10, AGE, SECTOR_8, SECTOR_7, SECTOR_2

b. Dependent Variable: IPSCORE

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.890	17	.641	3.417	<.001[b]
	Residual	69.187	369	.187		
	Total	80.077	386			

a. Dependent Variable: IPSCORE

b. Predictors: (Constant), LN_IHI_MIN, SECTOR_13, SECTOR_6, LIQR_AVG, ACTIVE, SECTOR_1, SECTOR_9, SECTOR_5, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_10, AGE, SECTOR_8, SECTOR_7, SECTOR_2

Coefficients[a]

		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.197	.297		7.396	<.001
	ACTIVE	.226	.075	.148	2.996	.003
	AGE	-.008	.009	-.051	-.962	.337

	LIQR_AVG	.003	.003	.052	1.007	.315
	SECTOR_1	.160	.168	.106	.952	.342
	SECTOR_2	.217	.168	.149	1.289	.198
	SECTOR_3	.094	.176	.053	.536	.592
	SECTOR_4	.077	.179	.040	.433	.665
	SECTOR_5	-.176	.183	-.083	-.959	.338
	SECTOR_6	.145	.175	.081	.831	.406
	SECTOR_7	.074	.169	.050	.441	.659
	SECTOR_8	.210	.168	.142	1.248	.213
	SECTOR_9	-.115	.190	-.049	-.606	.545
	SECTOR_10	.093	.171	.058	.543	.588
	SECTOR_11	.168	.169	.111	.993	.321
	SECTOR_12	.111	.175	.061	.634	.527
	SECTOR_13	.237	.234	.064	1.013	.312
	LN_IHI_MIN	-.130	.026	-.250	-4.936	<.001

Coefficients[a]

Model		95.0% Confidence Interval for B		Correlations		
		Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	1.612	2.781			
	ACTIVE	.078	.374	.139	.154	.145
	AGE	-.026	.009	-.059	-.050	-.047
	LIQR_AVG	-.003	.009	.109	.052	.049

	SECTOR_1	-.171	.492	.033	.049	.046
	SECTOR_2	-.114	.549	.122	.067	.062
	SECTOR_3	-.251	.439	-.016	.028	.026
	SECTOR_4	-.274	.429	-.009	.023	.021
	SECTOR_5	-.536	.185	-.126	-.050	-.046
	SECTOR_6	-.199	.490	.010	.043	.040
	SECTOR_7	-.257	.406	-.026	.023	.021
	SECTOR_8	-.121	.540	.057	.065	.060
	SECTOR_9	-.489	.259	-.132	-.032	-.029
	SECTOR_10	-.243	.428	-.030	.028	.026
	SECTOR_11	-.164	.499	.050	.052	.048
	SECTOR_12	-.234	.456	-.012	.033	.031
	SECTOR_13	-.223	.698	.027	.053	.049
	LN_IHI_MIN	-.182	-.078	-.228	-.249	-.239

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	ACTIVE	.962	1.039
	AGE	.820	1.219
	LIQR_AVG	.864	1.157
	SECTOR_1	.188	5.310

	SECTOR_2	.176	5.669
	SECTOR_3	.242	4.131
	SECTOR_4	.271	3.691
	SECTOR_5	.309	3.240
	SECTOR_6	.244	4.106
	SECTOR_7	.180	5.559
	SECTOR_8	.181	5.523
	SECTOR_9	.360	2.781
	SECTOR_10	.208	4.811
	SECTOR_11	.188	5.328
	SECTOR_12	.251	3.980
	SECTOR_13	.579	1.727
	LN_IHI_MIN	.909	1.100

a. Dependent Variable: IPSCORE

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	ACTIVE	AGE	LIQR_AVG
1	1	5.432	1.000	.00	.00	.00	.01

	2	1.026	2.301	.00	.00	.00	.01
	3	1.006	2.323	.00	.00	.00	.00
	4	1.001	2.329	.00	.00	.00	.00
	5	1.000	2.330	.00	.00	.00	.00
	6	1.000	2.331	.00	.00	.00	.00
	7	1.000	2.331	.00	.00	.00	.00
	8	1.000	2.331	.00	.00	.00	.00
	9	1.000	2.331	.00	.00	.00	.00
	10	1.000	2.331	.00	.00	.00	.00
	11	1.000	2.331	.00	.00	.00	.00
	12	1.000	2.331	.00	.00	.00	.00
	13	1.000	2.331	.00	.00	.00	.00
	14	.356	3.908	.00	.00	.03	.78
	15	.102	7.296	.00	.48	.40	.06
	16	.056	9.861	.01	.48	.44	.11
	17	.017	17.883	.01	.02	.00	.00
	18	.004	37.718	.98	.01	.13	.03

Collinearity Diagnostics[a]

		Variance Proportions					
Model	Dimension	SECTOR_1	SECTOR_2	SECTOR_3	SECTOR_4	SECTOR_5	SECTOR_6
1	1	.00	.00	.00	.00	.00	.00
	2	.00	.03	.02	.01	.03	.01

	3	.01	.01	.05	.02	.01	.02
	4	.00	.02	.03	.00	.06	.00
	5	.00	.01	.01	.09	.02	.00
	6	.00	.03	.00	.00	.00	.00
	7	.04	.00	.02	.02	.03	.01
	8	.03	.00	.00	.03	.01	.00
	9	.02	.00	.00	.00	.04	.01
	10	.00	.01	.03	.00	.02	.01
	11	.00	.00	.03	.03	.01	.02
	12	.01	.02	.02	.00	.04	.07
	13	.04	.01	.00	.03	.00	.06
	14	.00	.01	.01	.00	.00	.00
	15	.00	.00	.00	.00	.00	.00
	16	.05	.06	.05	.05	.05	.05
	17	.62	.59	.57	.52	.49	.57
	18	.18	.21	.16	.19	.18	.16

Collinearity Diagnostics[a]

		Variance Proportions				
Model	Dimension	SECTOR_7	SECTOR_8	SECTOR_9	SECTOR_10	SECTOR_11
1	1	.00	.00	.00	.00	.00
	2	.01	.01	.06	.04	.00
	3	.01	.00	.00	.00	.01

	4	.02	.01	.00	.00	.00
	5	.01	.02	.06	.00	.00
	6	.00	.01	.04	.00	.09
	7	.00	.00	.00	.00	.00
	8	.00	.00	.00	.01	.00
	9	.04	.01	.02	.04	.00
	10	.01	.05	.05	.00	.03
	11	.01	.01	.03	.06	.01
	12	.02	.00	.00	.01	.00
	13	.00	.02	.05	.00	.00
	14	.00	.00	.00	.00	.00
	15	.00	.00	.00	.00	.00
	16	.07	.05	.04	.05	.05
	17	.62	.64	.52	.61	.61
	18	.16	.16	.11	.17	.18

Collinearity Diagnostics[a]

		Variance Proportions		
Model	Dimension	SECTOR_12	SECTOR_13	LN_IHI_MIN
1	1	.00	.00	.00
	2	.00	.03	.00
	3	.06	.00	.00
	4	.09	.00	.00

	5	.00	.00	.00
	6	.01	.01	.00
	7	.02	.18	.00
	8	.00	.31	.00
	9	.02	.01	.00
	10	.01	.01	.00
	11	.01	.00	.00
	12	.00	.00	.00
	13	.00	.00	.00
	14	.00	.00	.00
	15	.00	.00	.00
	16	.02	.02	.03
	17	.58	.32	.22
	18	.17	.09	.75

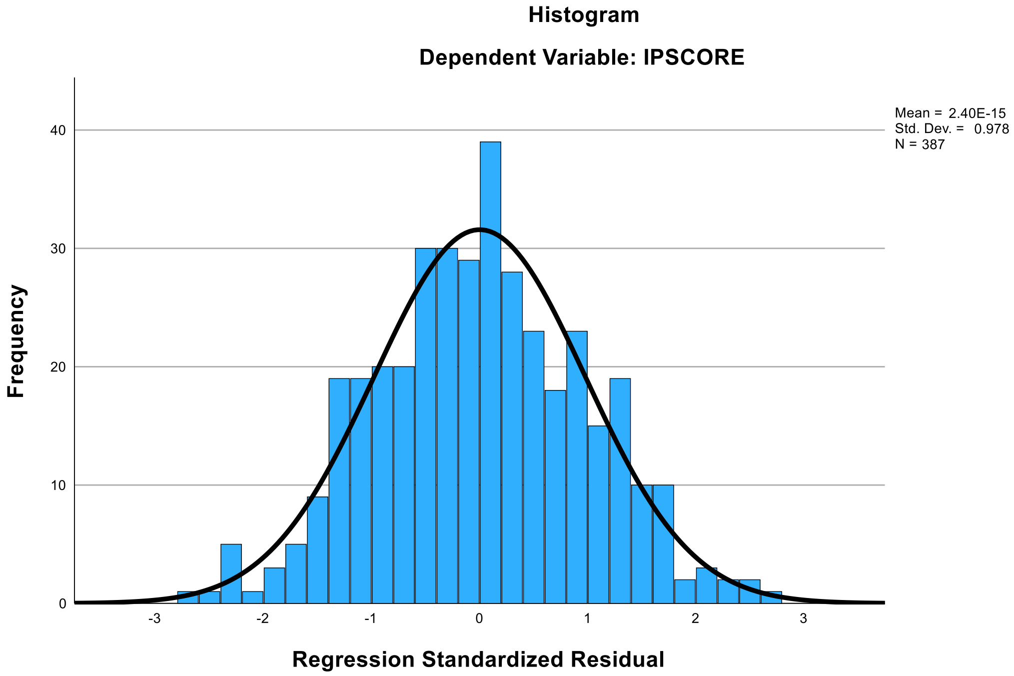
a. Dependent Variable: IPSCORE

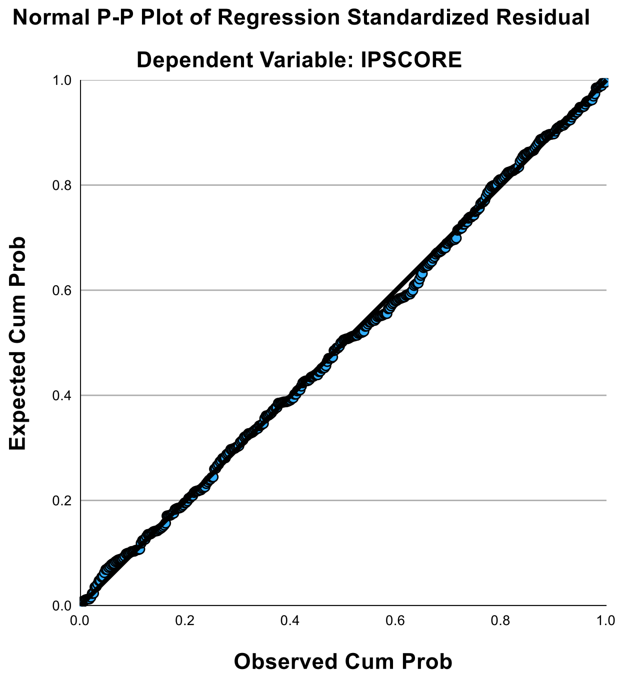
Residuals Statistics[a]

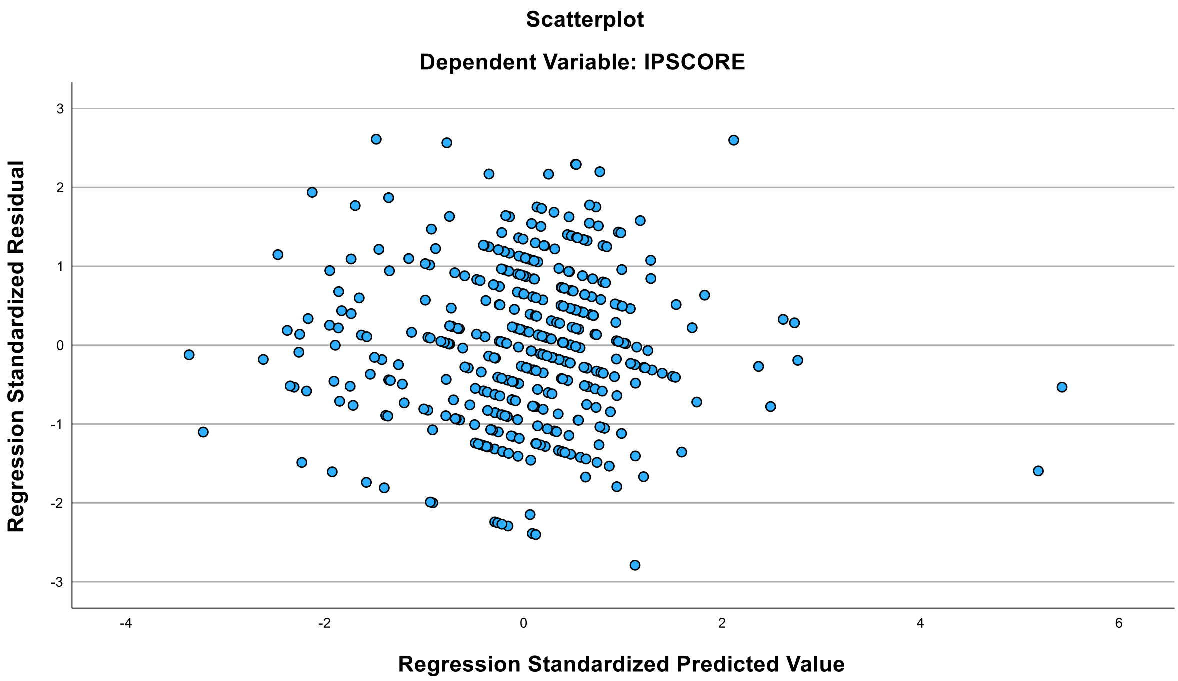
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.8530	2.3305	1.4199	.16797	387
Residual	-1.20776	1.13026	.00000	.42337	387
Std. Predicted Value	-3.375	5.422	.000	1.000	387
Std. Residual	-2.789	2.610	.000	.978	387

a. Dependent Variable: IPSCORE

Charts







Model 5- INOWN

Patent

Regression

Notes

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Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	INOWN_MIN, SECTOR_10, ACTIVE, SECTOR_5, SECTOR_13, SECTOR_9, SECTOR_6, LIQR_AVG, SECTOR_12,	.	Enter

	SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_1, AGE, SECTOR_7, SECTOR_8, SECTOR_2[b]		

a. Dependent Variable: LN_PATENT

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.406[a]	.165	.126	.828053	2.196

a. Predictors: (Constant), INOWN_MIN, SECTOR_10, ACTIVE, SECTOR_5, SECTOR_13, SECTOR_9, SECTOR_6, LIQR_AVG, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_1, AGE, SECTOR_7, SECTOR_8, SECTOR_2

b. Dependent Variable: LN_PATENT

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	49.950	17	2.938	4.285	<.001[b]
	Residual	253.013	369	.686		
	Total	302.962	386			

a. Dependent Variable: LN_PATENT

b. Predictors: (Constant), INOWN_MIN, SECTOR_10, ACTIVE, SECTOR_5, SECTOR_13, SECTOR_9, SECTOR_6, LIQR_AVG, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_1, AGE, SECTOR_7, SECTOR_8, SECTOR_2

Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.158	.355		3.261	.001
	ACTIVE	.266	.144	.089	1.844	.066
	AGE	.068	.017	.214	4.017	<.001
	LIQR_AVG	.015	.006	.141	2.750	.006
	SECTOR_1	-.127	.323	-.043	-.394	.694
	SECTOR_2	.072	.321	.025	.225	.822
	SECTOR_3	-.213	.336	-.061	-.633	.527
	SECTOR_4	.194	.343	.052	.565	.572
	SECTOR_5	-.532	.350	-.130	-1.518	.130
	SECTOR_6	.315	.335	.091	.939	.348
	SECTOR_7	-.063	.322	-.022	-.196	.845
	SECTOR_8	-.059	.323	-.021	-.184	.854
	SECTOR_9	-.493	.365	-.108	-1.349	.178
	SECTOR_10	.025	.327	.008	.078	.938
	SECTOR_11	.254	.323	.087	.787	.432
	SECTOR_12	.107	.336	.030	.319	.750
	SECTOR_13	.227	.450	.032	.503	.615
	INOWN_MIN	-.008	.002	-.189	-3.714	<.001

Coefficients[a]

Model		95.0% Confidence Interval for B		Correlations		
		Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	.460	1.856			
	ACTIVE	-.018	.549	.057	.096	.088
	AGE	.035	.102	.196	.205	.191
	LIQR_AVG	.004	.027	.097	.142	.131
	SECTOR_1	-.763	.508	-.070	-.020	-.019
	SECTOR_2	-.559	.704	.050	.012	.011
	SECTOR_3	-.873	.448	-.045	-.033	-.030
	SECTOR_4	-.480	.868	.045	.029	.027
	SECTOR_5	-1.220	.157	-.138	-.079	-.072
	SECTOR_6	-.344	.973	.119	.049	.045
	SECTOR_7	-.697	.571	.025	-.010	-.009
	SECTOR_8	-.694	.575	-.026	-.010	-.009
	SECTOR_9	-1.212	.226	-.113	-.070	-.064
	SECTOR_10	-.617	.668	.013	.004	.004
	SECTOR_11	-.381	.890	.089	.041	.037
	SECTOR_12	-.554	.769	-.016	.017	.015
	SECTOR_13	-.658	1.111	.018	.026	.024
	INOWN_MIN	-.011	-.004	-.244	-.190	-.177

Coefficients[a]

Model		Collinearity Statistics Tolerance	VIF
1	(Constant)		
	ACTIVE	.964	1.037
	AGE	.799	1.251
	LIQR_AVG	.866	1.155
	SECTOR_1	.187	5.344
	SECTOR_2	.177	5.634
	SECTOR_3	.242	4.136
	SECTOR_4	.270	3.709
	SECTOR_5	.309	3.233
	SECTOR_6	.243	4.110
	SECTOR_7	.180	5.558
	SECTOR_8	.180	5.565
	SECTOR_9	.356	2.808
	SECTOR_10	.207	4.829
	SECTOR_11	.187	5.345
	SECTOR_12	.250	4.000
	SECTOR_13	.573	1.744
	INOWN_MIN	.873	1.145

a. Dependent Variable: LN_PATENT

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	ACTIVE	AGE	LIQR_AVG
1	1	4.971	1.000	.00	.00	.00	.01
	2	1.064	2.161	.00	.00	.00	.01
	3	1.016	2.212	.00	.00	.00	.00
	4	1.005	2.224	.00	.00	.00	.00
	5	1.000	2.229	.00	.00	.00	.00
	6	1.000	2.230	.00	.00	.00	.00
	7	1.000	2.230	.00	.00	.00	.00
	8	1.000	2.230	.00	.00	.00	.00
	9	1.000	2.230	.00	.00	.00	.00
	10	1.000	2.230	.00	.00	.00	.00
	11	1.000	2.230	.00	.00	.00	.00
	12	1.000	2.230	.00	.00	.00	.00
	13	1.000	2.230	.00	.00	.00	.00
	14	.447	3.335	.00	.00	.01	.05
	15	.349	3.776	.00	.01	.04	.72
	16	.096	7.204	.00	.64	.30	.04
	17	.043	10.717	.05	.28	.57	.15

	18	.009	23.226	.95	.07	.08	.01

Collinearity Diagnostics[a]

		Variance Proportions					
Model	Dimension	SECTOR_1	SECTOR_2	SECTOR_3	SECTOR_4	SECTOR_5	SECTOR_6
1	1	.00	.00	.00	.00	.00	.00
	2	.01	.03	.01	.02	.01	.00
	3	.01	.00	.00	.00	.02	.03
	4	.00	.03	.07	.03	.03	.00
	5	.00	.00	.03	.00	.01	.02
	6	.05	.02	.00	.05	.00	.01
	7	.00	.00	.02	.02	.08	.03
	8	.00	.01	.00	.02	.00	.04
	9	.00	.01	.05	.00	.02	.05
	10	.00	.00	.01	.00	.01	.01
	11	.00	.01	.00	.02	.05	.00
	12	.00	.01	.00	.00	.04	.01
	13	.07	.02	.00	.07	.02	.01
	14	.00	.00	.00	.01	.00	.00
	15	.00	.01	.01	.00	.00	.00
	16	.00	.01	.00	.00	.00	.00
	17	.16	.15	.15	.16	.15	.16
	18	.68	.69	.63	.60	.57	.63

Collinearity Diagnostics[a]

		Variance Proportions				
Model	Dimension	SECTOR_7	SECTOR_8	SECTOR_9	SECTOR_10	SECTOR_11
1	1	.00	.00	.00	.00	.00
	2	.03	.00	.02	.00	.00
	3	.01	.02	.04	.05	.01
	4	.00	.01	.00	.01	.00
	5	.01	.01	.01	.00	.01
	6	.00	.02	.00	.00	.02
	7	.04	.00	.00	.01	.00
	8	.00	.01	.10	.00	.04
	9	.00	.00	.00	.02	.01
	10	.00	.04	.01	.02	.01
	11	.02	.00	.00	.05	.01
	12	.01	.01	.13	.01	.02
	13	.01	.00	.00	.00	.00
	14	.01	.00	.01	.00	.00
	15	.00	.00	.00	.00	.00
	16	.00	.00	.00	.00	.00
	17	.19	.17	.15	.17	.17
	18	.67	.68	.52	.66	.68

Collinearity Diagnostics[a]

Model	Dimension	Variance Proportions SECTOR_12	SECTOR_13	INOWN_MIN
1	1	.00	.00	.01
	2	.02	.04	.03
	3	.02	.00	.00
	4	.02	.01	.00
	5	.10	.00	.00
	6	.02	.00	.00
	7	.01	.00	.00
	8	.01	.00	.00
	9	.00	.10	.00
	10	.00	.20	.00
	11	.02	.11	.00
	12	.00	.09	.00
	13	.00	.00	.00
	14	.01	.01	.78
	15	.00	.00	.02
	16	.00	.00	.06
	17	.11	.09	.08
	18	.66	.35	.01

a. Dependent Variable: LN_PATENT

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_PATENT	Predicted Value	Residual
165	4.051	5.808	2.45389	3.354256

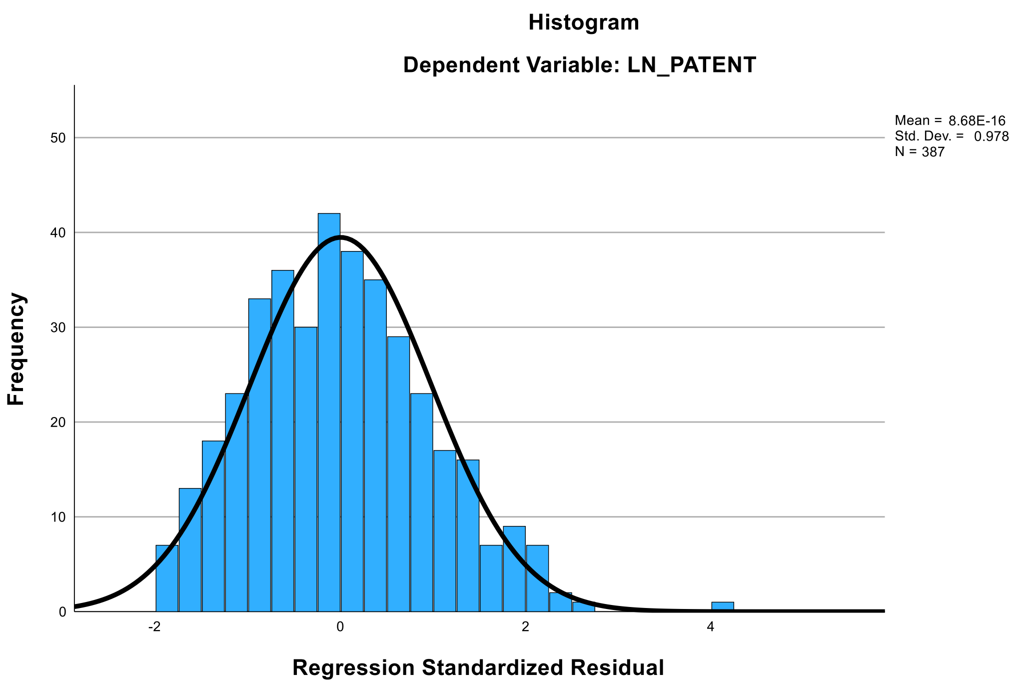
a. Dependent Variable: LN_PATENT

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.58578	2.71345	1.92036	.359726	387
Residual	-1.588991	3.354256	.000000	.809613	387
Std. Predicted Value	-3.710	2.205	.000	1.000	387
Std. Residual	-1.919	4.051	.000	.978	387

a. Dependent Variable: LN_PATENT

Charts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4
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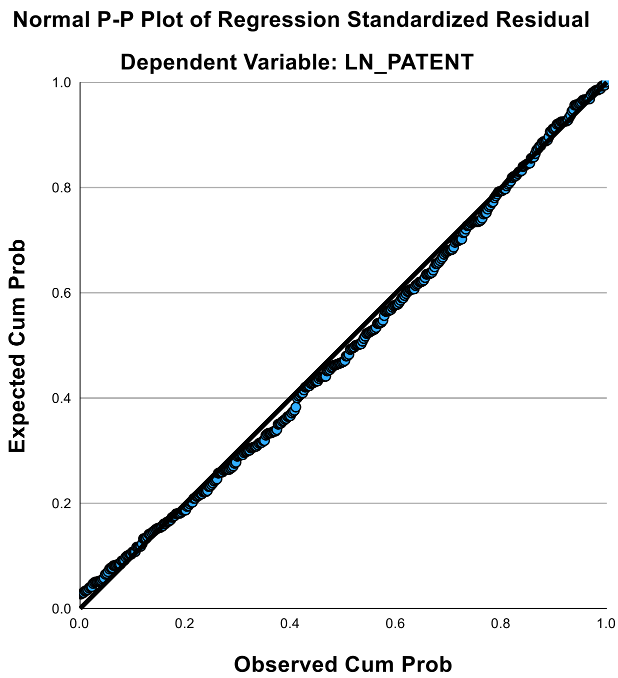
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Dependent Variable: LN_PATENT
Expected Cum Prob
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0.2
0.4
0.6
0.8
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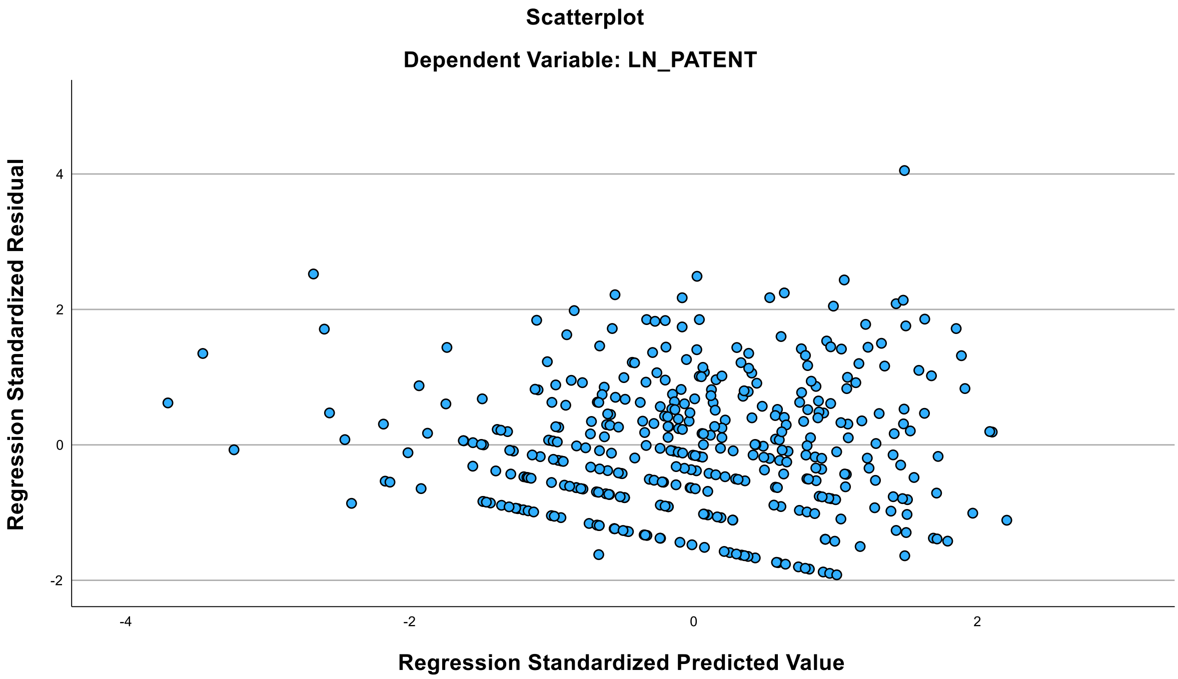
Observed Cum Prob



IPScore

Regression

Notes

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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT IPSCORE /METHOD=ENTER ACTIVE AGE LIQR_AVG SECTOR_1 SECTOR_2 SECTOR_3 SECTOR_4 SECTOR_5 SECTOR_6 SECTOR_7 SECTOR_8 SECTOR_9 SECTOR_10 SECTOR_11 SECTOR_12 SECTOR_13 INOWN_MIN /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:00.30

	Elapsed Time	00:00:00.25
	Memory Required	20224 bytes
	Additional Memory Required for Residual Plots	640 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	INOWN_MIN, SECTOR_10, ACTIVE, SECTOR_5, SECTOR_13, SECTOR_9, SECTOR_6, LIQR_AVG, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_1, AGE, SECTOR_7, SECTOR_8, SECTOR_2[b]	.	Enter

a. Dependent Variable: IPSCORE

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.340[a]	.115	.075	.43815	2.182

a. Predictors: (Constant), INOWN_MIN, SECTOR_10, ACTIVE, SECTOR_5, SECTOR_13, SECTOR_9, SECTOR_6, LIQR_AVG, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_1, AGE, SECTOR_7, SECTOR_8, SECTOR_2

b. Dependent Variable: IPSCORE

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.239	17	.543	2.831	<.001[b]
	Residual	70.838	369	.192		
	Total	80.077	386			

a. Dependent Variable: IPSCORE

b. Predictors: (Constant), INOWN_MIN, SECTOR_10, ACTIVE, SECTOR_5, SECTOR_13, SECTOR_9, SECTOR_6, LIQR_AVG, SECTOR_12, SECTOR_4, SECTOR_3, SECTOR_11, SECTOR_1, AGE, SECTOR_7, SECTOR_8, SECTOR_2

Coefficients[a]

Model		Unstandardised Coefficients		Standardised Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.158	.188		6.160	<.001
	ACTIVE	.215	.076	.141	2.825	.005
	AGE	-.009	.009	-.052	-.944	.346
	LIQR_AVG	.003	.003	.060	1.143	.254
	SECTOR_1	.246	.171	.163	1.441	.150
	SECTOR_2	.288	.170	.197	1.697	.091

	SECTOR_3	.161	.178	.090	.904	.366
	SECTOR_4	.228	.181	.118	1.255	.210
	SECTOR_5	-.054	.185	-.026	-.293	.770
	SECTOR_6	.208	.177	.116	1.173	.242
	SECTOR_7	.117	.171	.079	.687	.492
	SECTOR_8	.275	.171	.186	1.610	.108
	SECTOR_9	-.057	.193	-.024	-.297	.767
	SECTOR_10	.163	.173	.102	.945	.345
	SECTOR_11	.250	.171	.165	1.461	.145
	SECTOR_12	.192	.178	.106	1.078	.282
	SECTOR_13	.365	.238	.099	1.532	.126
	INOWN_MIN	-.004	.001	-.204	-3.898	<.001

Coefficients[a]

		95.0% Confidence Interval for B		Correlations		
Model		Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	.788	1.527			
	ACTIVE	.065	.365	.139	.146	.138
	AGE	-.026	.009	-.059	-.049	-.046
	LIQR_AVG	-.002	.009	.109	.059	.056
	SECTOR_1	-.090	.583	.033	.075	.071
	SECTOR_2	-.046	.623	.122	.088	.083
	SECTOR_3	-.189	.510	-.016	.047	.044

	SECTOR_4	-.129	.584	-.009	.065	.061
	SECTOR_5	-.419	.310	-.126	-.015	-.014
	SECTOR_6	-.141	.556	.010	.061	.057
	SECTOR_7	-.218	.453	-.026	.036	.034
	SECTOR_8	-.061	.611	.057	.084	.079
	SECTOR_9	-.438	.323	-.132	-.015	-.015
	SECTOR_10	-.177	.503	-.030	.049	.046
	SECTOR_11	-.086	.586	.050	.076	.072
	SECTOR_12	-.158	.542	-.012	.056	.053
	SECTOR_13	-.103	.833	.027	.079	.075
	INOWN_MIN	-.006	-.002	-.179	-.199	-.191

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	ACTIVE	.964	1.037
	AGE	.799	1.251
	LIQR_AVG	.866	1.155
	SECTOR_1	.187	5.344
	SECTOR_2	.177	5.634
	SECTOR_3	.242	4.136
	SECTOR_4	.270	3.709

	SECTOR_5	.309	3.233
	SECTOR_6	.243	4.110
	SECTOR_7	.180	5.558
	SECTOR_8	.180	5.565
	SECTOR_9	.356	2.808
	SECTOR_10	.207	4.829
	SECTOR_11	.187	5.345
	SECTOR_12	.250	4.000
	SECTOR_13	.573	1.744
	INOWN_MIN	.873	1.145

a. Dependent Variable: IPSCORE

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	ACTIVE	AGE	LIQR_AVG
1	1	4.971	1.000	.00	.00	.00	.01
	2	1.064	2.161	.00	.00	.00	.01
	3	1.016	2.212	.00	.00	.00	.00
	4	1.005	2.224	.00	.00	.00	.00

	5	1.000	2.229	.00	.00	.00	.00
	6	1.000	2.230	.00	.00	.00	.00
	7	1.000	2.230	.00	.00	.00	.00
	8	1.000	2.230	.00	.00	.00	.00
	9	1.000	2.230	.00	.00	.00	.00
	10	1.000	2.230	.00	.00	.00	.00
	11	1.000	2.230	.00	.00	.00	.00
	12	1.000	2.230	.00	.00	.00	.00
	13	1.000	2.230	.00	.00	.00	.00
	14	.447	3.335	.00	.00	.01	.05
	15	.349	3.776	.00	.01	.04	.72
	16	.096	7.204	.00	.64	.30	.04
	17	.043	10.717	.05	.28	.57	.15
	18	.009	23.226	.95	.07	.08	.01

Collinearity Diagnostics[a]

		Variance Proportions					
Model	Dimension	SECTOR_1	SECTOR_2	SECTOR_3	SECTOR_4	SECTOR_5	SECTOR_6
1	1	.00	.00	.00	.00	.00	.00
	2	.01	.03	.01	.02	.01	.00
	3	.01	.00	.00	.00	.02	.03
	4	.00	.03	.07	.03	.03	.00
	5	.00	.00	.03	.00	.01	.02

	6	.05	.02	.00	.05	.00	.01
	7	.00	.00	.02	.02	.08	.03
	8	.00	.01	.00	.02	.00	.04
	9	.00	.01	.05	.00	.02	.05
	10	.00	.00	.01	.00	.01	.01
	11	.00	.01	.00	.02	.05	.00
	12	.00	.01	.00	.00	.04	.01
	13	.07	.02	.00	.07	.02	.01
	14	.00	.00	.00	.01	.00	.00
	15	.00	.01	.01	.00	.00	.00
	16	.00	.01	.00	.00	.00	.00
	17	.16	.15	.15	.16	.15	.16
	18	.68	.69	.63	.60	.57	.63

Collinearity Diagnostics[a]

		Variance Proportions				
Model	Dimension	SECTOR_7	SECTOR_8	SECTOR_9	SECTOR_10	SECTOR_11
1	1	.00	.00	.00	.00	.00
	2	.03	.00	.02	.00	.00
	3	.01	.02	.04	.05	.01
	4	.00	.01	.00	.01	.00
	5	.01	.01	.01	.00	.01
	6	.00	.02	.00	.00	.02

	7	.04	.00	.00	.01	.00
	8	.00	.01	.10	.00	.04
	9	.00	.00	.00	.02	.01
	10	.00	.04	.01	.02	.01
	11	.02	.00	.00	.05	.01
	12	.01	.01	.13	.01	.02
	13	.01	.00	.00	.00	.00
	14	.01	.00	.01	.00	.00
	15	.00	.00	.00	.00	.00
	16	.00	.00	.00	.00	.00
	17	.19	.17	.15	.17	.17
	18	.67	.68	.52	.66	.68

Collinearity Diagnostics[a]

		Variance Proportions		
Model	Dimension	SECTOR_12	SECTOR_13	INOWN_MIN
1	1	.00	.00	.01
	2	.02	.04	.03
	3	.02	.00	.00
	4	.02	.01	.00
	5	.10	.00	.00
	6	.02	.00	.00
	7	.01	.00	.00

	8	.01	.00	.00
	9	.00	.10	.00
	10	.00	.20	.00
	11	.02	.11	.00
	12	.00	.09	.00
	13	.00	.00	.00
	14	.01	.01	.78
	15	.00	.00	.02
	16	.00	.00	.06
	17	.11	.09	.08
	18	.66	.35	.01

a. Dependent Variable: IPSCORE

Casewise Diagnostics[a]

Case Number	Std. Residual	IPSCORE	Predicted Value	Residual
165	3.135	2.90	1.5264	1.37362

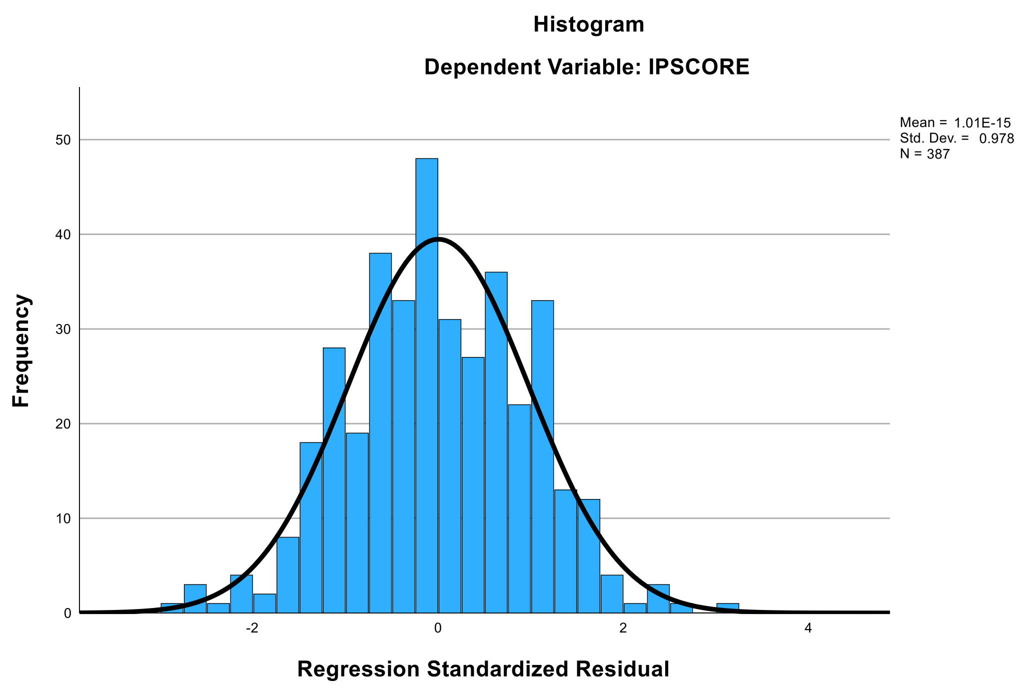
a. Dependent Variable: IPSCORE

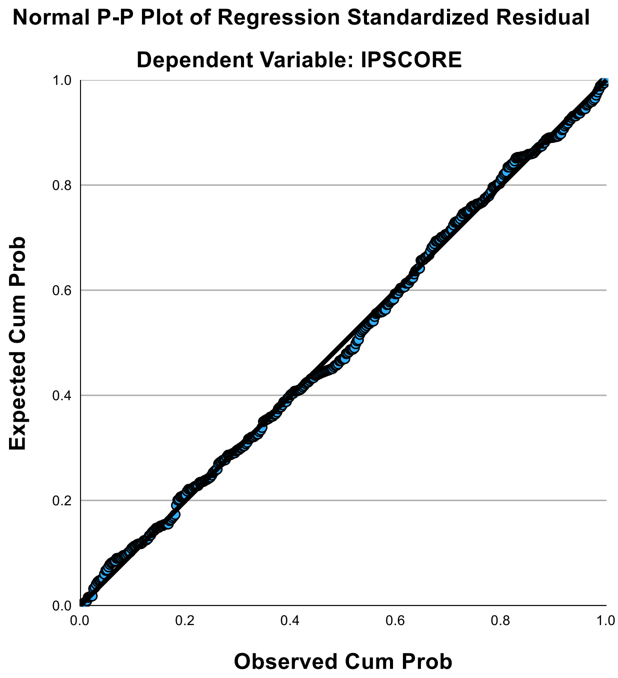
Residuals Statistics[a]

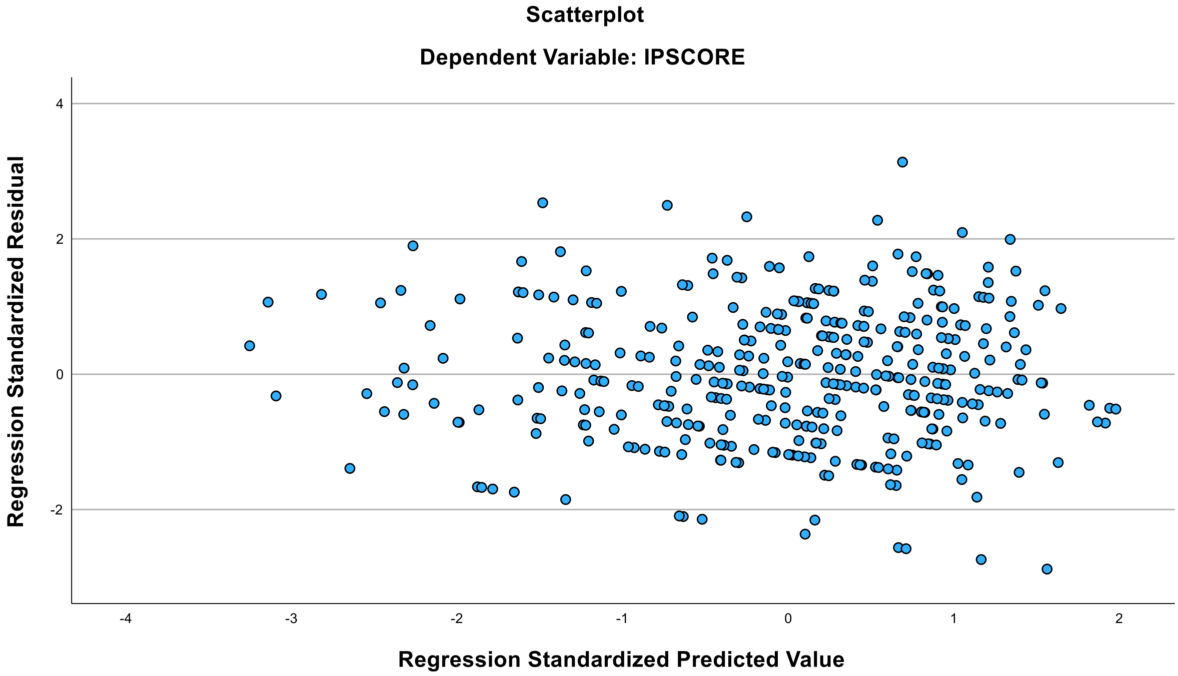
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.9159	1.7258	1.4199	.15471	387
Residual	-1.26151	1.37362	.00000	.42839	387
Std. Predicted Value	-3.258	1.977	.000	1.000	387
Std. Residual	-2.879	3.135	.000	.978	387

a. Dependent Variable: IPSCORE

Charts







Model 6 – OCI3

Patent

Regression

Notes

Output Created		14-OCT-2025 08:05:19
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\Innovation\2022\basedata2022.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	396
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT LN_PATENT

		/METHOD=ENTER ACTIVE AGE LIQR_AVG SECTOR_1 SECTOR_2 SECTOR_3 SECTOR_4 SECTOR_5 SECTOR_6 SECTOR_7 SECTOR_8 SECTOR_9 SECTOR_10 SECTOR_11 SECTOR_12 SECTOR_13 LN_OCI3_MIN /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:00.34
	Elapsed Time	00:00:00.26
	Memory Required	20224 bytes
	Additional Memory Required for Residual Plots	640 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	LN_OCI3_MIN, SECTOR_1, LIQR_AVG, ACTIVE, SECTOR_13, SECTOR_4, SECTOR_12, SECTOR_9, SECTOR_5, SECTOR_6,	.	Enter

	SECTOR_3, SECTOR_7, SECTOR_10, AGE, SECTOR_11, SECTOR_8, SECTOR_2[b]		

a. Dependent Variable: LN_PATENT

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.404[a]	.164	.122	.830981	2.250

a. Predictors: (Constant), LN_OCI3_MIN, SECTOR_1, LIQR_AVG, ACTIVE, SECTOR_13, SECTOR_4, SECTOR_12, SECTOR_9, SECTOR_5, SECTOR_6, SECTOR_3, SECTOR_7, SECTOR_10, AGE, SECTOR_11, SECTOR_8, SECTOR_2

b. Dependent Variable: LN_PATENT

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	46.443	17	2.732	3.956	<.001[b]
	Residual	237.542	344	.691		
	Total	283.985	361			

a. Dependent Variable: LN_PATENT

b. Predictors: (Constant), LN_OCI3_MIN, SECTOR_1, LIQR_AVG, ACTIVE, SECTOR_13, SECTOR_4, SECTOR_12, SECTOR_9, SECTOR_5, SECTOR_6, SECTOR_3, SECTOR_7, SECTOR_10, AGE, SECTOR_11, SECTOR_8, SECTOR_2

Coefficients[a]

Model		Unstandardised Coefficients B	Std. Error	Standardised Coefficients Beta	t	Sig.
1	(Constant)	2.370	.620		3.823	<.001
	ACTIVE	.286	.155	.093	1.838	.067
	AGE	.070	.018	.217	3.899	<.001
	LIQR_AVG	.016	.006	.144	2.708	.007
	SECTOR_1	-.202	.346	-.067	-.583	.560
	SECTOR_2	.025	.344	.009	.072	.943
	SECTOR_3	-.230	.361	-.065	-.637	.525
	SECTOR_4	.204	.372	.050	.547	.585
	SECTOR_5	-.703	.372	-.173	-1.890	.060
	SECTOR_6	.257	.356	.076	.721	.472
	SECTOR_7	-.123	.346	-.043	-.357	.721
	SECTOR_8	-.050	.343	-.017	-.144	.885
	SECTOR_9	-.570	.383	-.128	-1.489	.138
	SECTOR_10	-.014	.347	-.004	-.039	.969
	SECTOR_11	.171	.344	.059	.496	.620
	SECTOR_12	.026	.357	.008	.073	.941
	SECTOR_13	-.257	.488	-.034	-.526	.599
	LN_OCI3_MIN	-.192	.061	-.164	-3.140	.002

Coefficients[a]

Model		95.0% Confidence Interval for B		Correlations		
		Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	1.151	3.589			
	ACTIVE	-.020	.591	.061	.099	.091
	AGE	.035	.105	.187	.206	.192
	LIQR_AVG	.004	.027	.098	.144	.134
	SECTOR_1	-.883	.479	-.056	-.031	-.029
	SECTOR_2	-.652	.701	.030	.004	.004
	SECTOR_3	-.941	.481	-.039	-.034	-.031
	SECTOR_4	-.529	.936	.064	.029	.027
	SECTOR_5	-1.435	.029	-.155	-.101	-.093
	SECTOR_6	-.444	.957	.124	.039	.036
	SECTOR_7	-.804	.557	.013	-.019	-.018
	SECTOR_8	-.725	.626	-.003	-.008	-.007
	SECTOR_9	-1.323	.183	-.116	-.080	-.073
	SECTOR_10	-.696	.669	.014	-.002	-.002
	SECTOR_11	-.507	.848	.097	.027	.024
	SECTOR_12	-.675	.728	-.010	.004	.004
	SECTOR_13	-1.216	.703	-.040	-.028	-.026
	LN_OCI3_MIN	-.312	-.072	-.220	-.167	-.155

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	ACTIVE	.953	1.049
	AGE	.786	1.271
	LIQR_AVG	.862	1.160
	SECTOR_1	.182	5.490
	SECTOR_2	.168	5.959
	SECTOR_3	.236	4.241
	SECTOR_4	.291	3.437
	SECTOR_5	.291	3.431
	SECTOR_6	.218	4.589
	SECTOR_7	.170	5.889
	SECTOR_8	.168	5.939
	SECTOR_9	.328	3.051
	SECTOR_10	.186	5.364
	SECTOR_11	.171	5.843
	SECTOR_12	.233	4.290
	SECTOR_13	.588	1.700
	LN_OCI3_MIN	.892	1.121

a. Dependent Variable: LN_PATENT

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	ACTIVE	AGE	LIQR_AVG
1	1	5.442	1.000	.00	.00	.00	.01
	2	1.027	2.301	.00	.00	.00	.01
	3	1.007	2.324	.00	.00	.00	.00
	4	1.001	2.331	.00	.00	.00	.00
	5	1.000	2.333	.00	.00	.00	.00
	6	1.000	2.333	.00	.00	.00	.00
	7	1.000	2.333	.00	.00	.00	.00
	8	1.000	2.333	.00	.00	.00	.00
	9	1.000	2.333	.00	.00	.00	.00
	10	1.000	2.333	.00	.00	.00	.00
	11	1.000	2.333	.00	.00	.00	.00
	12	1.000	2.333	.00	.00	.00	.00
	13	1.000	2.333	.00	.00	.00	.00
	14	.350	3.943	.00	.00	.03	.77
	15	.097	7.481	.00	.43	.43	.08
	16	.055	9.947	.01	.51	.37	.10
	17	.016	18.200	.01	.03	.01	.01

	18	.004	39.395	.98	.03	.16	.03

Collinearity Diagnostics[a]

		Variance Proportions					
Model	Dimension	SECTOR_1	SECTOR_2	SECTOR_3	SECTOR_4	SECTOR_5	SECTOR_6
1	1	.00	.00	.00	.00	.00	.00
	2	.00	.03	.01	.00	.02	.01
	3	.00	.01	.05	.01	.02	.02
	4	.00	.00	.02	.02	.05	.00
	5	.00	.00	.03	.00	.00	.03
	6	.09	.02	.00	.01	.02	.01
	7	.00	.04	.00	.06	.03	.00
	8	.00	.00	.00	.02	.08	.02
	9	.00	.00	.01	.00	.00	.00
	10	.00	.02	.00	.00	.00	.01
	11	.00	.00	.00	.01	.00	.02
	12	.00	.00	.08	.06	.01	.03
	13	.05	.01	.01	.07	.02	.03
	14	.00	.01	.00	.00	.00	.00
	15	.00	.00	.00	.00	.00	.00
	16	.05	.05	.04	.04	.06	.05
	17	.58	.58	.55	.53	.49	.55
	18	.22	.23	.20	.18	.19	.21

Collinearity Diagnostics[a]

		Variance Proportions				
Model	Dimension	SECTOR_7	SECTOR_8	SECTOR_9	SECTOR_10	SECTOR_11
1	1	.00	.00	.00	.00	.00
	2	.01	.01	.06	.04	.00
	3	.01	.00	.00	.00	.02
	4	.03	.00	.00	.00	.01
	5	.00	.07	.01	.00	.01
	6	.00	.00	.00	.01	.00
	7	.00	.01	.00	.00	.05
	8	.00	.02	.01	.02	.01
	9	.01	.00	.12	.06	.00
	10	.04	.00	.04	.01	.02
	11	.01	.01	.00	.00	.00
	12	.00	.00	.04	.00	.00
	13	.00	.00	.01	.00	.02
	14	.00	.00	.00	.00	.00
	15	.00	.00	.00	.00	.00
	16	.07	.05	.04	.05	.06
	17	.58	.63	.51	.60	.56
	18	.21	.18	.15	.19	.24

Collinearity Diagnostics[a]

Model	Dimension	Variance Proportions SECTOR_12	SECTOR_13	LN_OCI3_MIN
1	1	.00	.00	.00
	2	.00	.01	.00
	3	.05	.00	.00
	4	.05	.06	.00
	5	.01	.00	.00
	6	.02	.00	.00
	7	.00	.01	.00
	8	.01	.02	.00
	9	.03	.00	.00
	10	.04	.02	.00
	11	.00	.40	.00
	12	.00	.05	.00
	13	.00	.00	.00
	14	.00	.00	.00
	15	.00	.00	.00
	16	.03	.01	.03
	17	.55	.32	.23
	18	.22	.10	.74

a. Dependent Variable: LN_PATENT

Casewise Diagnostics[a]

Case Number	Std. Residual	LN_PATENT	Predicted Value	Residual
165	3.688	5.808	2.74339	3.064757

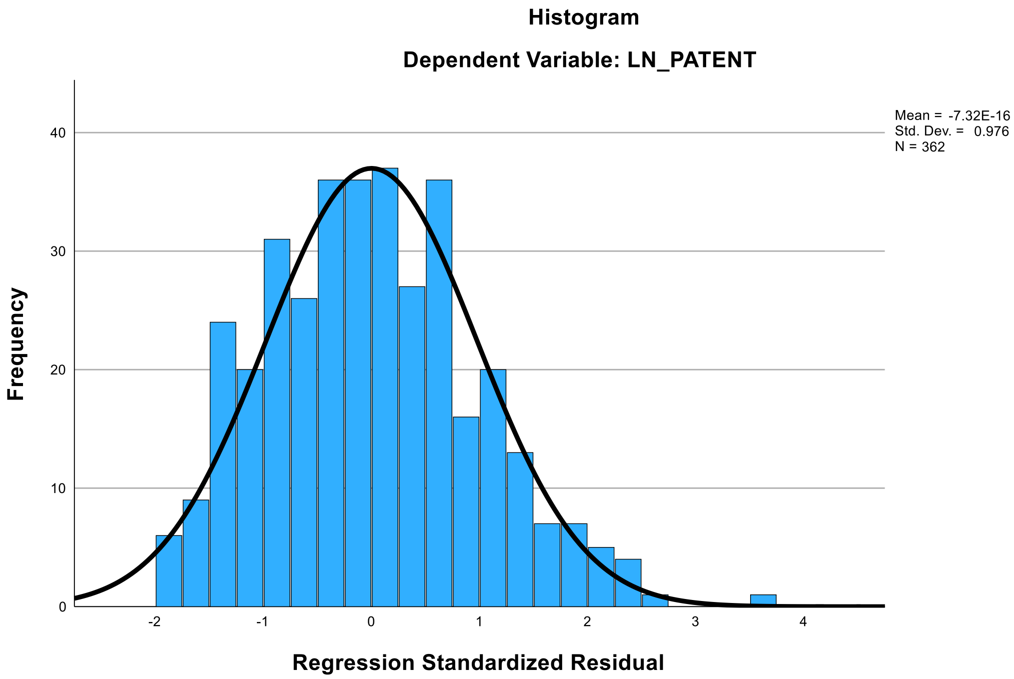
a. Dependent Variable: LN_PATENT

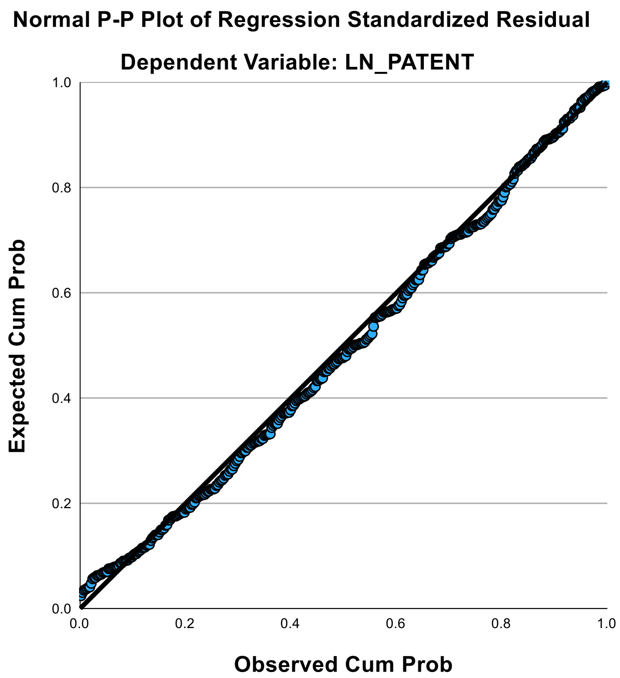
Residuals Statistics[a]

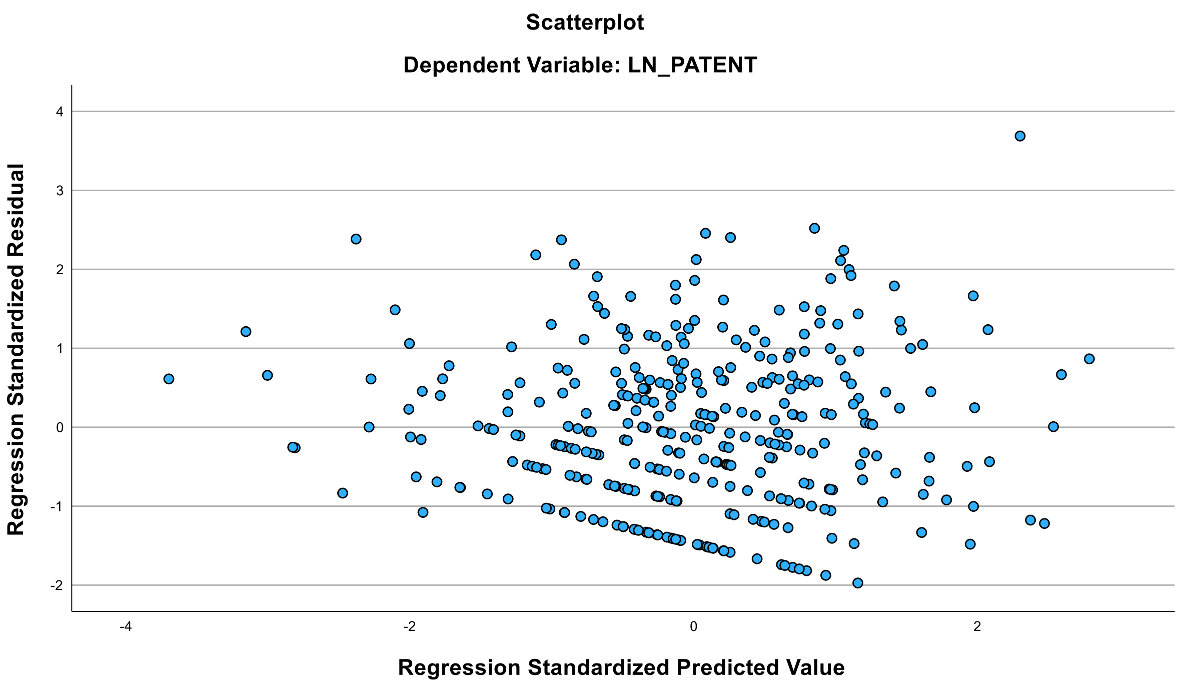
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.59041	2.91843	1.91899	.358678	362
Residual	-1.639846	3.064757	.000000	.811179	362
Std. Predicted Value	-3.704	2.786	.000	1.000	362
Std. Residual	-1.973	3.688	.000	.976	362

a. Dependent Variable: LN_PATENT

Charts


Histogram
Dependent Variable: LN_PATENT
Mean = -7.32E-16
Std. Dev. = 0.976
N = 362
Frequency
40
30
20
10
0
-2
-1
0
1
2
3
4
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: LN_PATENT
Expected Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob



IPScore

Regression

Notes

Output Created		14-OCT-2025 08:08:42
Comments		
Input	Data	D:\Shiraz Dropbox\Farshad Eshraghi\Users\Farshad\UWL\PhD\Thesis\Data\Innovation\2022\basedata2022.sav
	Active Dataset	DataSet1
	Filter	<none>

	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	396
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP /CRITERIA=PIN(.05) POUT(.10) TOLERANCE(.0001) /NOORIGIN /DEPENDENT IPSCORE /METHOD=ENTER ACTIVE AGE LIQR_AVG SECTOR_1 SECTOR_2 SECTOR_3 SECTOR_4 SECTOR_5 SECTOR_6 SECTOR_7 SECTOR_8 SECTOR_9 SECTOR_10 SECTOR_11 SECTOR_12 SECTOR_13 LN_OCI3_MIN /SCATTERPLOT=(*ZRESID ,*ZPRED) /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID) /CASEWISE PLOT(ZRESID) OUTLIERS(3).
Resources	Processor Time	00:00:00.33

	Elapsed Time	00:00:00.25
	Memory Required	20224 bytes
	Additional Memory Required for Residual Plots	640 bytes

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	LN_OCI3_MIN, SECTOR_1, LIQR_AVG, ACTIVE, SECTOR_13, SECTOR_4, SECTOR_12, SECTOR_9, SECTOR_5, SECTOR_6, SECTOR_3, SECTOR_7, SECTOR_10, AGE, SECTOR_11, SECTOR_8, SECTOR_2[b]	.	Enter

a. Dependent Variable: IPSCORE

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.344[a]	.118	.075	.44245	2.249

a. Predictors: (Constant), LN_OCI3_MIN, SECTOR_1, LIQR_AVG, ACTIVE, SECTOR_13, SECTOR_4, SECTOR_12, SECTOR_9, SECTOR_5, SECTOR_6, SECTOR_3, SECTOR_7, SECTOR_10, AGE, SECTOR_11, SECTOR_8, SECTOR_2

b. Dependent Variable: IPSCORE

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.043	17	.532	2.717	<.001[b]
	Residual	67.341	344	.196		
	Total	76.383	361			

a. Dependent Variable: IPSCORE

b. Predictors: (Constant), LN_OCI3_MIN, SECTOR_1, LIQR_AVG, ACTIVE, SECTOR_13, SECTOR_4, SECTOR_12, SECTOR_9, SECTOR_5, SECTOR_6, SECTOR_3, SECTOR_7, SECTOR_10, AGE, SECTOR_11, SECTOR_8, SECTOR_2

Coefficients[a]

		Unstandardised Coefficients		Standardised Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.909	.330		5.783	<.001
	ACTIVE	.224	.083	.140	2.707	.007
	AGE	-.008	.010	-.050	-.874	.382
	LIQR_AVG	.004	.003	.063	1.151	.251
	SECTOR_1	.213	.184	.137	1.155	.249
	SECTOR_2	.272	.183	.183	1.483	.139

	SECTOR_3	.150	.192	.081	.780	.436
	SECTOR_4	.260	.198	.123	1.312	.190
	SECTOR_5	-.131	.198	-.062	-.663	.508
	SECTOR_6	.182	.190	.104	.962	.337
	SECTOR_7	.097	.184	.065	.525	.600
	SECTOR_8	.275	.183	.186	1.506	.133
	SECTOR_9	-.090	.204	-.039	-.440	.660
	SECTOR_10	.151	.185	.096	.820	.413
	SECTOR_11	.205	.183	.137	1.120	.263
	SECTOR_12	.151	.190	.084	.797	.426
	SECTOR_13	.165	.260	.042	.634	.526
	LN_OCI3_MIN	-.118	.033	-.194	-3.616	<.001

Coefficients[a]

		95.0% Confidence Interval for B		Correlations		
Model		Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	1.260	2.558			
	ACTIVE	.061	.387	.130	.144	.137
	AGE	-.027	.010	-.062	-.047	-.044
	LIQR_AVG	-.003	.010	.113	.062	.058
	SECTOR_1	-.150	.576	.041	.062	.058
	SECTOR_2	-.089	.632	.107	.080	.075
	SECTOR_3	-.228	.529	-.015	.042	.040

	SECTOR_4	-.130	.650	.033	.071	.066
	SECTOR_5	-.521	.258	-.136	-.036	-.034
	SECTOR_6	-.191	.555	.009	.052	.049
	SECTOR_7	-.265	.459	-.036	.028	.027
	SECTOR_8	-.084	.635	.067	.081	.076
	SECTOR_9	-.490	.311	-.137	-.024	-.022
	SECTOR_10	-.212	.514	-.032	.044	.041
	SECTOR_11	-.155	.566	.058	.060	.057
	SECTOR_12	-.222	.525	-.008	.043	.040
	SECTOR_13	-.346	.676	-.016	.034	.032
	LN_OCI3_MIN	-.181	-.054	-.173	-.191	-.183

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	ACTIVE	.953	1.049
	AGE	.786	1.271
	LIQR_AVG	.862	1.160
	SECTOR_1	.182	5.490
	SECTOR_2	.168	5.959
	SECTOR_3	.236	4.241
	SECTOR_4	.291	3.437

	SECTOR_5	.291	3.431
	SECTOR_6	.218	4.589
	SECTOR_7	.170	5.889
	SECTOR_8	.168	5.939
	SECTOR_9	.328	3.051
	SECTOR_10	.186	5.364
	SECTOR_11	.171	5.843
	SECTOR_12	.233	4.290
	SECTOR_13	.588	1.700
	LN_OCI3_MIN	.892	1.121

a. Dependent Variable: IPSCORE

Collinearity Diagnostics[a]

				Variance Proportions			
Model	Dimension	Eigenvalue	Condition Index	(Constant)	ACTIVE	AGE	LIQR_AVG
1	1	5.442	1.000	.00	.00	.00	.01
	2	1.027	2.301	.00	.00	.00	.01
	3	1.007	2.324	.00	.00	.00	.00
	4	1.001	2.331	.00	.00	.00	.00

	5	1.000	2.333	.00	.00	.00	.00
	6	1.000	2.333	.00	.00	.00	.00
	7	1.000	2.333	.00	.00	.00	.00
	8	1.000	2.333	.00	.00	.00	.00
	9	1.000	2.333	.00	.00	.00	.00
	10	1.000	2.333	.00	.00	.00	.00
	11	1.000	2.333	.00	.00	.00	.00
	12	1.000	2.333	.00	.00	.00	.00
	13	1.000	2.333	.00	.00	.00	.00
	14	.350	3.943	.00	.00	.03	.77
	15	.097	7.481	.00	.43	.43	.08
	16	.055	9.947	.01	.51	.37	.10
	17	.016	18.200	.01	.03	.01	.01
	18	.004	39.395	.98	.03	.16	.03

Collinearity Diagnostics[a]

		Variance Proportions					
Model	Dimension	SECTOR_1	SECTOR_2	SECTOR_3	SECTOR_4	SECTOR_5	SECTOR_6
1	1	.00	.00	.00	.00	.00	.00
	2	.00	.03	.01	.00	.02	.01
	3	.00	.01	.05	.01	.02	.02
	4	.00	.00	.02	.02	.05	.00
	5	.00	.00	.03	.00	.00	.03

	6	.09	.02	.00	.01	.02	.01
	7	.00	.04	.00	.06	.03	.00
	8	.00	.00	.00	.02	.08	.02
	9	.00	.00	.01	.00	.00	.00
	10	.00	.02	.00	.00	.00	.01
	11	.00	.00	.00	.01	.00	.02
	12	.00	.00	.08	.06	.01	.03
	13	.05	.01	.01	.07	.02	.03
	14	.00	.01	.00	.00	.00	.00
	15	.00	.00	.00	.00	.00	.00
	16	.05	.05	.04	.04	.06	.05
	17	.58	.58	.55	.53	.49	.55
	18	.22	.23	.20	.18	.19	.21

Collinearity Diagnostics[a]

		Variance Proportions				
Model	Dimension	SECTOR_7	SECTOR_8	SECTOR_9	SECTOR_10	SECTOR_11
1	1	.00	.00	.00	.00	.00
	2	.01	.01	.06	.04	.00
	3	.01	.00	.00	.00	.02
	4	.03	.00	.00	.00	.01
	5	.00	.07	.01	.00	.01
	6	.00	.00	.00	.01	.00

	7	.00	.01	.00	.00	.05
	8	.00	.02	.01	.02	.01
	9	.01	.00	.12	.06	.00
	10	.04	.00	.04	.01	.02
	11	.01	.01	.00	.00	.00
	12	.00	.00	.04	.00	.00
	13	.00	.00	.01	.00	.02
	14	.00	.00	.00	.00	.00
	15	.00	.00	.00	.00	.00
	16	.07	.05	.04	.05	.06
	17	.58	.63	.51	.60	.56
	18	.21	.18	.15	.19	.24

Collinearity Diagnostics[a]

		Variance Proportions		
Model	Dimension	SECTOR_12	SECTOR_13	LN_OCI3_MIN
1	1	.00	.00	.00
	2	.00	.01	.00
	3	.05	.00	.00
	4	.05	.06	.00
	5	.01	.00	.00
	6	.02	.00	.00
	7	.00	.01	.00

8	.01	.02	.00
9	.03	.00	.00
10	.04	.02	.00
11	.00	.40	.00
12	.00	.05	.00
13	.00	.00	.00
14	.00	.00	.00
15	.00	.00	.00
16	.03	.01	.03
17	.55	.32	.23
18	.22	.10	.74

a. Dependent Variable: IPSCORE

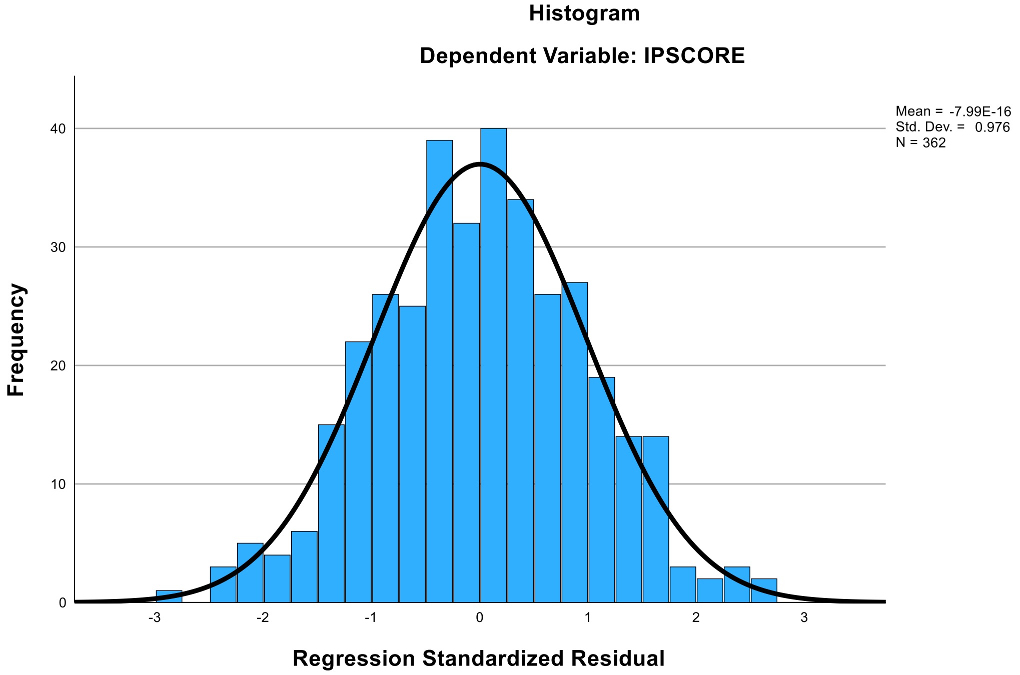
Residuals Statistics[a]

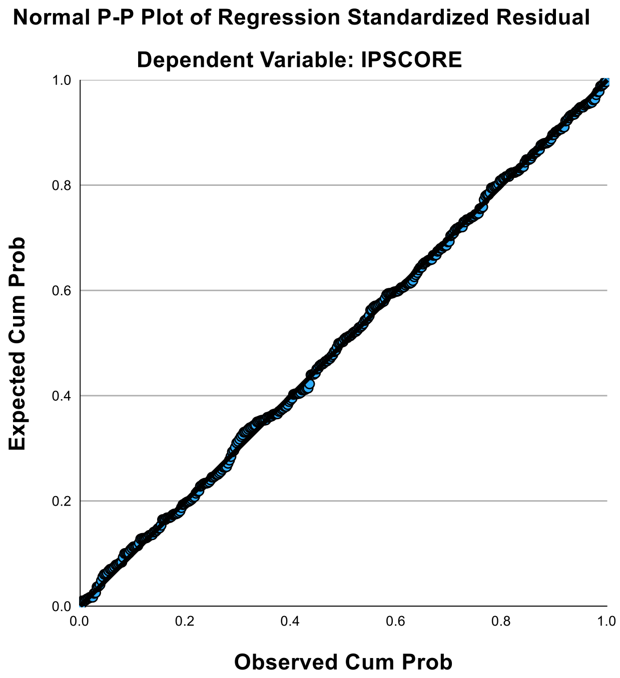
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.9009	1.8299	1.4221	.15827	362
Residual	-1.28429	1.18963	.00000	.43190	362

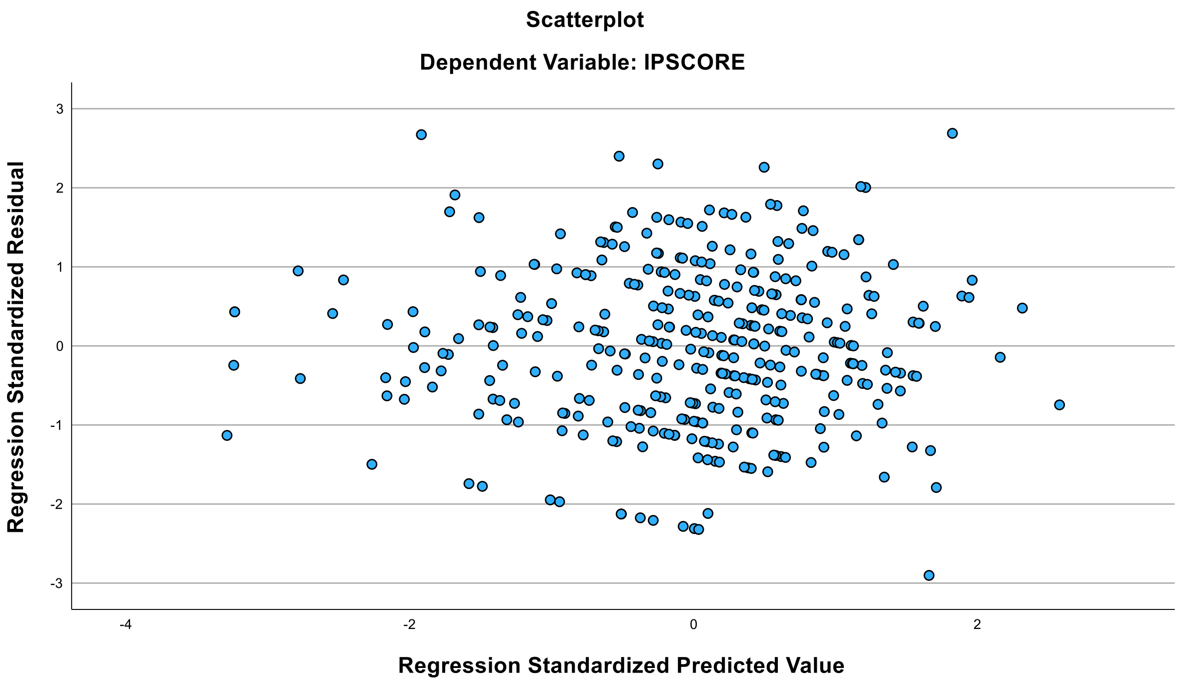
Std. Predicted Value	-3.293	2.577	.000	1.000	362
Std. Residual	-2.903	2.689	.000	.976	362

a. Dependent Variable: IPSCORE

Charts




Normal P-P Plot of Regression Standardized Residual
Dependent Variable: IPSCORE
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Scatterplot
Dependent Variable: IPSCORE
Regression Standardized Residual
Regression Standardized Predicted Value
3
2
1
0
-1
-2
-3
-4
-2
0
2