Cointegration Analysis - Exports & Economic Performance in Developing Economies

COINTEGRATION ANALYSIS: EXPORTS AND ECONOMIC PERFORMANCE IN DEVELOPING ECONOMIES

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Dedicated to my mother,
Tsehaytu Gurmu Sherpha

ABSTRACT

This thesis tests the theory of export-led growth in developing economies, mainly the case where export expansion is considered to be the primary determinant of growth rate differences among developing economies' growth and the capability to catch-up the higher productivity level of developed economies.

The export-led growth hypothesis predicts that individual developing economies' growth is limited by the growth of their exports, and that this is limited by the trade regime limits on the expansion of their exports. In the light of endogenous growth theory, where growth is largely determined by the acquisition of new technologies and knowledge, exports promote technological progress by facilitating international technological and knowledge spillovers. Accordingly, the particular export-led growth hypothesis predicts that export expansion has a long run causal relationship with economic growth. Thus, exports will be the primary determinant of productivity growth differences among developing economies, and hence, their relative growth rates, while predicting that countries that open their economies, that have developed diversified and competitive export basis and accumulate their human capital will achieve accelerated and sustainable economic growth and catch-up the higher productivity and technology level of developed economies.

There is also an extensive empirical literature on the topic. However, in light of the concurrent development of dynamic growth theory and time series econometrics, the majority of hitherto empirical works have not employed encompassing empirical models that appropriately test the long run causal relationship between exports and economic growth. Among other things, assuming stationarity in the export-led growth series, the studies have been conducted using econometric models that do not describe the stochastic properties of the data such as the presence of unit roots.

Besides, since the studies have been conducted in the conventional econometric models that they have not estimated, tested and interpreted the link among export expansion, economic growth and catching-up process in dynamic and long run settings. Currently, the cointegration econometric method is proposed as a useful tool in the process of investigating the dynamic links that exist among export-led growth variables.

Therefore, after providing a theoretical argument for a link between export expansion, trade regime, economic growth and the catching-up process, the study has reviewed past

empirical studies. Accordingly, the spurious nature of the conventional empirical estimates of the economic impacts of exports on growth is shown. The approach in this study has been based upon 'serious economic theory' hereinafter the 'new' growth theory which captures the dynamics of export-led growth, human capital and catching-up processes; and the study has also formulated and tested its empirical method within the context of cointegration analysis, a recent econometric development. The principal idea is to validate the logic of the hypothesised growth model from the empirical point of view. The study has conducted its empirical test for samples of economies using annual data that based on its availability, variously covers the period from 1950 to 1991.

Cointegration analysis shows the existence of dynamic 'latent' long run causal relationship between economic growth (that has been captured by purchasing power parity based per capita income), human capital, physical capital and labour input variables on the one hand and export expansion variable. The test on disaggregated export variables particularly validates the dynamic role that manufactured export plays in the growth process. The estimate of the impact of export expansion on growth and catching-up processes of developing economies is more significant even than previously supposed.

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ABBREVATIONS AND A GLOSSARY OF TERMS

ADF: Augmented Dickey-Fuller Test

C: Catching-UP Variable

CI: Cointegrating

CRDW: Cointegrating Regression Durbin Watson Statistic

DAC: Development Assistance Committee

DF: Dickey-Fuller Test

DGP: Data Generation Process

DUPSE: Directly Unproductive Profit Seeking Economy

DW: Durbin Watson Statistic

ECM: Error Correction Mechanism(s)

EG: Engle and Granger

ELG: Export-Led Growth

EXP: Export Promotion

GDP: Real Gross Domestic Product

GNP: Real Gross National Product

H.O.: Heckscher-Ohlin

H: Human Capital

HD: Heteroskedasticity

ILO: International Labour Organisation

IMF: International Monetary Fund

INS: Insignificant

IPS/IS: Import Substituting Strategy

K: Physical Capital

L: Labour Input

LM: Lagrange Multiplier

NA: Not Applicable

NICs: Newly Industrialising Countries

NORM: Normality

NS: Non-stationary

OECD: Organisation for Economic Co-operation and Development

OLS: Ordinary Least Squares

PCI: Purchasing Power Parity Based Real Per Capita Income

RESET: Ramsey's RESET Test

S.D.: Standard Deviation

S: Stationary

SI: Significant

TNCs: Transnational Corporations

UNCTAD: United Nations Centre for Trade and Development

U_t: Residual Variable in Model III

U_{t-1}: ECM term in ECM Model III

VAR: Vector Autoregressive

v_t: Residual Variable in Model II

V_{t-1} : ECM Term in ECM Model I

v_{t-1}: ECM in ECM Model II

V_t : Residual variables for Model I

WB: World Bank

X/Y: Exports Share of Gross Domestic Product

X: Real Exports

Xf: Real Fuel Exports

Xm: Real manufacturing Exports

Xp: Real Primary Products (non-fuel) Exports

CHAPTER ONE

THE CHANGING POSITION OF DEVELOPING ECONOMIES IN THE WORLD ECONOMY

1.1. Introduction

The study of export-led growth is among the most controversial parts of economic debate. Analysis of the role of exports in promoting economic growth can be tracked back to classical economics. The greatest minds in classical economics, particularly Adam Smith, John Stuart Mill and David Ricardo thought exports could be a principal impulse of growth. Three main ingredients can be distinguished in their reasoning. First, the 'vent for surplus' principle that implies, without exports, the economy may be functioning inside its production possibilities frontier (Myint, 1958). Second, there is the view that by removing the constraint of domestic market size, exporting provides the scope for subsequent capitalisation on a division of labour, thereby directly improves labour productivity. The third element is the impact of exporting on economic motivations, found mainly in Mill. It has been claimed that apart from the comparative advantage gains from exporting, there are indirect (dynamic) benefits, which are of a higher order (Thoburn, 1977).

In this circumstance, exporting appears to boost the rate of profit, which ameliorates to form sufficient amount of capital to accumulate. In this context, Riedel (1987) has held the view that by yielding greater national income exports expand the ability to accumulate and consequently to grow. Richard Baldwin and Elena Seghezza (1996) and Richard Baldwin and Richard Forslid (1996) support this view. Imports also create economic incentives to increase prosperity. The Patterns of consumption and production will be different between open and closed economies. In an exporting economy that specialises in a particular product, importing is an alternative to domestic production. The residents may have a wider range of choices for goods and services, generated by imports. Imports, thus, introduce a new range of choices and relieve the economy from the restraint of closed economy. This increases the ambitions and motivations of the firms and their workforces for the gratification of new choices, and encourages people to work hard to satisfy new needs. In addition, import may motivate people to save and accumulate capital for the future satisfaction of their needs. Access to new objects, ideas, information, skills and technology are also created through the trading process.

Neo-classical economists demonstrate that international differences in relative prices can influence the supply and demand conditions of export products. Beyond technologically related differences in labour productivity, variations among countries in tastes and preferences are also possible sources of gains from exporting. Most important, however, by introducing capital as a separate factor of production, relative endowments of capital and labour become important determinants of the nature and characteristics of exports in neo-classical theory. They pointed out the effect of exports on economic efficiency that in turn are the key determinants of the capacity to save, invest and to grow.

All these add up to an enthusiastic conviction of growth through trade, and one that came under attack in the early 1950s. Long before these times Marxist writers also had been concerned with the problem. They had linked foreign investment by advanced countries in primary product exports of poor countries to their theory of imperialism. To some extent the 1950s writers rekindled Marxist hypotheses (Singer, 1950; Myrdal, 1957 and Prebisch, 1959).

The Singer-Myrdal-Prebisch stance is an extreme one. It comes near to saying that poor countries have been made poorer by trade because of secular deterioration in the terms of trade of primary products relative to manufactures (Thoburn, 1977). They asserted that export-biased growth would worsen the condition of their growth and terms of trade (Kasliwal, 1995, p. 210). This is known to economists as 'immiserising growth' which describes a special kind of welfare loss that comes into effect because of exporting. This happens due to a decline in the terms of trade. In an export biased economy, an increase in output generates welfare gains, but this is more than offset by the loss of welfare created by the fall in the terms of trade, thus; there is a net welfare loss. This prediction is based on the assumption that foreign demand curve for exportables is inelastic. Bhagwati (1958, 1971 and 1988) argues that such perverse effects of growth can in fact emanate within a rigorously specified economic model. However, there is no empirical evidence which demonstrates the actual presence of 'immiserizing growth' in developing economies. The decline in the developing economies' terms of trade, which is itself subject to an intense debate, could not justify the net welfare loss in the presence of output growth through trade.

In the late 1960s, the incredible success of the few economies that followed 'export promoting rather than import-substituting' oscillated the weight of academic conviction behind the export promotion strategy. However, the debt crisis of the 1980s and sluggish product prices have activated export distrust (Bhagwati, 1988; Hughes 1993).

Riedel (1984) argues that the drop in primary product prices is not frustrating because the export composition of developing economies has been more switching to manufactured goods. Nevertheless, there is still the dilemma of the 'fallacy of composition' (Martin, 1992). Hughes (1993) attacks the dilemma by elucidating her views that the gist of export pessimism ignores the dynamics of world trade. Because developing economies have steadily increasing their exports of manufactures to the USA and Japan, more remarkably, to one another in the form of flourishing intra-industry trade.

Concurrently the significance of exports in promoting growth of developing economies should be seen in the light of new growth and trade theories. The seminal theoretical literature of Rivera-Batiz and Romer (1991a and b), Feenstra (1990) and Grossman and Helpman (1991) have advanced the link between exports and endogenous growth. In this regard, export expansion means the ease of access to knowledge, which crosses national boundaries and results in endogenous technological progress. Thus, by promoting their exports sector developing economies can acquire and disseminate a new knowledge across the economic sectors more efficiently and at a higher speed of diffusion and improve their technological capability.

Recently there is a growing literature suggesting that exporting and the accompanying trade policy may increase growth rates of output. Many researchers have provided a variety of frameworks for an export-led economy that is rooted in the endogenous growth models of Romer (1986) and Lucas (1988). One of the key lessons from this branch of literature is that exports are an important determinant of the link between trade and growth. Grossman and Helpman (1991), Rivera-Batiz and Romer (1991a and b), and Quah and Rauch (1990) show that exporting can increase the growth by providing a wider access to foreign market, technology and inputs which in turn facilitates more research and development and or learning by doing activities. Accordingly, this literature seems to provide a theoretical foundation for long held convention among economists that international trade is an important factor of economic growth.

A look at basic trade statistics gives a first view of the increasing importance of international trade for developing economies. Nevertheless, in the views of economists such as Todaro, international trade has often played a crucial though not necessarily a benign role in the historical development of developing economies (Todaro, 1991). All economies are in effect interdependent when engaged in international trade, under which conditions autarkic and self-sufficient economies are irrelevant. No single economy, whether China and India, or the city-state of Singapore, is outside the sphere of international trade and international economic policy.

However, it has been further held that international trade must be understood in a wider perspective than simply in the inter-country flow of commodities and financial resources (Kenen, 1994 and Todaro, 1991). International trade is a complex and interesting arena. It is not only about flows of commodities and financial resources but also about flows of new ideas, information, knowledge, technology and political influence. The interplay of events, the nature of international adjustments and interdependence, the relative merits of export-led or open economy forces vis-à-vis protectionist controls among others are very important issues, amongst others.

1.2. Exports and Macroeconomic Indicators: Stylised Facts

Exporting is a big international business. Every country engages in it. However, there exists a considerable disagreement over whether the developing economies, as whole, have benefited from participation in such an international economic activity. Opposing theoretical outlooks, contending sources of data and variations in the time period covered lead to widely divergent inferences. What seems incontrovertible is that world economic growth has swayed over time and the functioning of the developing economies has not been steady.

The growth rates of the developing economies as a group has been higher than that portrayed by developed economies for the most of the post-war period. Between 1950 and 1975 the developing economies achieved average annual growth rates of 5.6 per cent and the developed economies 4.7 per cent (Krasner, 1985, p 97). In the period 1980-93 these rates reduced to 2.9 per cent respectively (World Bank, 1995, p. 164). Tables 2.1 and 2.2 (appendix to the chapter) provide data on growth in gross domestic product (GDP) and gross national product (GNP) per capita, on the basis of the level of income groupings of the economies.

On regional terms, variations among the different developing regions were even more distinctively evident. East Asia performed best while Sub Saharan Africa had fallen, in real terms, since 1973. As a percentage of the average developed economies' income the region's per capita income was declined from 11 per cent in 1950 to 5 per cent in 1991 (World Bank, 1991, p. 13). If one compares average annual income per capita growth rates in the 1980s, the uneven growth in the developing economies is explicitly revealed. The East Asia region recorded 6.3 per cent growth, South Asia reached 2.9 per cent, and Latin America 0.5 per cent. However, Sub-Saharan Africa and the middle East and North African regions both registered negative growth rates of 1.1 per cent and 1.5 per cent respectively (World Bank, 1992, p. 196). These overall trends are also exhibited in the exporting performance of the developing economies.

World exports have expanded quicker than world output in the post-war period and the developing economies' achievements have been sharply mixed. The developing economies' share of world exports trade fell from 31 per cent in 1950 to 21.4 per cent in 1960, rose to 27.9 per cent in 1980 but declined to 17.8 per cent in 1990. At the same time, the developed economies increased their share of world exports trade from 60.4 per cent in 1950 to 66.8 per cent in 1960, registered a slight decline to 63.1 per cent in 1980 but rose again to 74.6 in 1990 (UNCTAD, 1994; Todaro, 1994, p. 411; World Bank, 1992, p. 245).[1]

The export performance of developing economies has persisted to lag behind that of developed economies. From 1965 to 1990 the volume of exports from developing countries grew at a rate of roughly 4 per cent per annum compared with 7 per cent for developed economies. The rates of growth of exports and imports for different economy groups are given in Table 2.3 (appendix to the chapter) for the years of 1965 to 1990.

World exports trade has grown consistently in the post-war period, with manufacturing providing the most dynamic sector (see, Table 2.4 in appendix to the chapter). Between 1950 and 1985, trade in manufactures increased more than twice as fast as manufactured output. Exports in other products has grown at a much slower rate. Between 1950 and 1983, exports of minerals grew at approximately the same pace as the growth in the world output, but has grown more slowly since. Exports of agricultural products has grown more slowly than world output (Grimwade, 1989, pp. 53-55). The relatively poor export performance of many developing countries emanates from a concentration of exports in primary products, i.e. the products with most sluggish demand in world markets.[2] The share of primary products in the world exports trade has stagnated or declined for a number of reasons. The two most important are their low income elasticity of demand and their vulnerability to substitution from synthetic fibres and other materials as result of technological innovation in the developed economies.

The poor performance of primary products in world exports has led to a debate on the terms of trade (Kasliwal, 1995, p. 232). No agreement exists on whether there is a persistent tendency for the terms of trade of the developing economies as a whole to worsen relative to those of the developed economies. Contending theoretical and methodological approaches make it difficult to compare the various findings (Yang, 1988; Bleaney and Greenaway, 1993). Spraos has carried out a survey of a number of studies and come to the conclusion that, while the declining tendency cannot be decisively disproved, it is open to scepticism when the record up to the 1970s is taken into account (Spraos, 1980).

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1 The figures do not include the ex-centrally-planned economies.

2 This analysis does not pertain to oil, which faces exceptional market conditions.

Notwithstanding an incessant tendency for the terms of trade of primary products to deteriorate vis-à-vis manufactured products cannot be ascertained, nevertheless, the price of primary products are more erratic. And since 1974, with the exception of 1979-80, prices of primary products have fallen consistently. In the 1980s, prices of primary products dropped, recording the lowest levels since the end of World War II. At the close of the decade, average primary product prices were 33 per cent lower than at the beginning the 1980s (Williams, 1994, p. 16). These declines in prices affected the poorest countries, which had not diversified their structures of exports. The two regions with the largest terms of trade losses were Sub Saharan Africa and Latin America. Declining terms of trade cost Sub Saharan Africa and Latin America, 13 and 15 per cent respectively of their purchasing power in real terms relative to the 1970s (Williams, 1994, P. 16). It is arguable that for developing economy exporters with a heavy dependence on the export of specific primary products the international trading system has been unfavourable, not only in the 1980s but for most of the post-war period.

Though the exports trade of developing economies is dominated by primary products, the conception must be eliminated is that the world is immaculately categorised into two distinctive groups: the developing economies producing and exporting solely primary products in exchange for manufactures from developed economies, and the developed world producing and exporting solely manufactures in exchange for primary products from developing economies. In reality, a good deal of exporting in both manufacture and primary products proceeds on among the developed and developed economies alike, with the developed economies exporting significant quantities of primary products (particularly, temperate zone foodstuffs) and the developing economies exporting a few manufactured goods. Developed countries, in fact, account for about 50 per cent of the world's supply of primary products (Thirlwall, 1992).

In short, the difference between developing and developed economies is not exclusively synonymous with the difference between primary producers and producers of manufactured goods. This must be conveyed in discussing the terms of trade, the ratio of export to import prices. There is a distinction to be made between the terms of trade for developing and developed economies and the terms of trade for primary and manufactured goods. The fact prevails, however, the primary products do dominate the balance of payments of most developing economies, and the developing economies' share of world exports trade in manufactures is very small. Exports of primary products account for approximately 85 per cent of the export earnings of the developing economies taken together, and manufactured goods from developing economies account for not more than 17 per cent of world trade in manufactures. Moreover, the range of these traded goods is narrow, about 80 per cent comprise of textiles and light manufactures in which world competition is ardent (Page, 1994; Thirlwall, 1992).

For developing economies as a whole, the repercussions of falling primary commodity prices has been compensated by an expansion have manufactured exports. The developing economies as a group increased their share of market in world exports of manufactures from 4.3 per cent in 1963 to 7 per cent in 1970 and then to 17 per cent in 1990. The shift in the product composition of the developing economies' exports was more articulated in East Asia and South Asia than in Africa. According to the World Bank calculations, the share of primary products in Africa's merchandise exports declined by only 1 per cent between 1965 and 1990, from 93 to 92 per cent. For the Middle East and North Africa region the share of primary products in total exports declined from 98 per cent to 87 per cent (World Bank, 1992, p. 249).

The consequential increase in manufacture exports although not circumscribed to a handful of economies, mainly benefited the NICs, particularly the four 'Asian Tigers' of Hong Kong, Singapore, South Korea and Taiwan. In 1990, the NICs dominated Asian developing economy region shared 83 per cent of the developing economies' manufactured exports while Latin America and African economies achieved only 12 and 3 per cent respectively (Page, 1994, pp. 8-9). Consequently, the more developed of the developing economies were thus not entangled in the snare of reliance on a limited number of primary products. The thriving trade strategies of these countries capacitated them to broaden their production basis and to boost, significantly, their exports of manufactured goods. The increase in the developing economies manufactured exports has, to a considerable extent, been attained against the defensive protectionist policies of developed economies (see Page, 1994; Dicken, 1992, p. 33).

1.3. The Research Hypothesis and Methodology

As it is introduced in the above discussion, the links between exports and economic growth have concerned economists for a long time. Can export-led growth increase the growth rate of developing economies income? Should developing economies follow their comparative advantages in order to catching up and become as rich as developed economies or should they protect their key industries to grow faster?

Many empirical studies have examined the significance of exports to catch up the illuminated economic performance of advanced economies (Bahmani-Oskooee and Alse, 1993; Balassa, 1978 and 1985; Feder 1983; Jung and Marshall, 1985). In the studies export growth has been considered as a main determinant of production and employment growth of developing economies.

According to Kugler (1991) the theoretical reasoning as a rule, substantiates the hypothesis of export-led growth that predicts the causal relationship between exports and economic growth. Given the theoretical arguments, the observed robust correlation of exports and production growth is interpreted as empirical substantiation in favour of the export-led growth hypothesis. Jung and Marshall (1985) however, found little support for an exports promotion strategy. Darrat (1987) and Hsiao (1987) have used time series data and repudiated the export-led growth hypothesis for most developing economies in their sample. Thus, the investigations have failed to provide uniform support for the hypothesis.

Accordingly, the purpose of this research work is to provide a fresh empirical evidence by testing whether there is a 'latent' causal or steady long run relationship between export expansion and economic growth.

For this research work, except the recent attempts by a very few economists such as Bahmani-Oskooee and J. Alse (1993), Ghatak et al (1994 , 1995 and 1997) the massive empirical works that provide strong correlation of export growth and economic growth in developing economies has nothing to say about a relationship between the exports and the growth trend development, as it may arise from a pure short run relationship. Furthermore, in recent econometric works it has been claimed that time series data that have been analysed based on ordinary least square (OLS) method are not convincing. Because they have implied economic variables are stationary though they are non-stationary (Dickey and Fuller, 1981;

Dolado et al., 1990). Non-stationarity causes several econometric troubles. One of the most troublesome results from a common prediction of macro-economic relationship among the levels of particular economic variables. That is, the presumption often suggests some set of variables cannot wander too far away from each other. Accordingly, in order to justify the presence of causal relationship, this necessitates the presence of cointegration.

So as to test for the existence of a long-run or trended relationship between economic growth and exports for developing economies, the theory of cointegration developed by Engle and Granger (1987), Johansen (1988b and 1995), and Stock and Watson (1988) among others are considered.

Accordingly, the thesis examines the importance of foreign trade and one particular aspect of this, exports for better economic performance. The investigation is conducted in relation to developing economies for period from 1950-1994.

The explanation for developing countries and their categorisation is based on the OECD and the World Bank approach (see chapter six). The specific data periods for particular sample countries is given in the appendix to chapter six. To overcome the problems related to OLS regression method, the relationships are further analysed based on unit roots tests, error correction mechanism (ECM) and cointegration approach. The cointegration approach advanced by Engle and Granger (1987) and Johansen (1988b and 1995) are applied. The production function approach is used within the framework of endogenous growth theory. The export sector is presumed as a dynamic one .The increasing returns generated by the expansion of this dynamic sector arises in the context of the creation and implementation of knowledge and ideas. In this context, we assume that aggregate production possibilities are characterised by increasing returns to scale, the long-run rate of growth can be determined by factors that are endogenous to the economic environment. Thus, export expansion and human capital variables capture the endogenous technological progress.

Moreover, it is argued that the expansion of the export sector and policies towards promoting exports have a positive impact on efficiency directly (through increased competition and increased efficiency) and indirectly, which can be expressed through factor inputs (increased capacity utilisation, increased investment embodying new technology, increased acquisition of skills). The supply side real economic variables: - per capita GDP, physical capital, human capital, labour and exports are considered to form the equation. Of course, for the purpose of investigating the significance of different export structures, exports are further disaggregated into three main categories (non-fuel primary, fuel and manufactures products).

In the absence of technical progress, the one sector neo-classical growth model (Solow, 1956 and 1970 postulates that economic growth is the function of the increase in capital employed per worker. This model assumes constant returns to labour and capital, with marginal productivity diminishing for each factor of production. The saving rates and growth in the labour force are taken as exogenous and the economy is assumed to be perfectly competitive. It predicts that in moving towards the steady state, higher growth of output per capita could arise with higher capital investment rates. This process increases the ratio of capital to labour. In this context, where capital per unit of labour is low, the marginal productivity of capital is high, and with a given rate of capital investment this drives capital scarce, poor (developing) economies to a higher growth in per capita output relative to capital abundant, rich (developed) economies. The neo-classical model predicts that the rate of return to capital is very large (small) where the stock of capital is small (large). Provided that the only difference among particular economies is their initial levels of capital, the hypothesis of the neo-classical model is that poor economies with limited capital will advance more rapidly than affluent economies with greater capital stock, so there will be a situation of unconditional convergence. The prediction of unconditional convergence will also tend to imply a reduction in a cross-economy scattering of income over time (Sala-i-Martin, 1996).

The neo-classical characterisation of capital scarce, poor (developing) economies with low capital per labour and high marginal productivity of capital has also the implication that in the open economy context such an economic condition is conducive to attract foreign investment towards such economies.

However, in the presence of technical progress and in the long run, the neo-classical growth model predicts that it is not the capital investment and saving ratios that are the driving forces of economic growth. Rather, they are the labour force growth and technical progress will determine its rates of long run growth. Thus, in the long run positive rates of productivity and per capita income depend particularly upon a positive unexplained rate of technical progress. In this argument, technical progress also sustains the contribution of capital to a high level. Thus, the steady state or 'golden age' growth can take place with exogenous technical progress, which should be capital augmenting (Ghatak, 1995, p. 57).

In the neo-classical model, the change in technology or technical progress is usually taken as a proxy for an autonomous change in productivity. It is also known as a 'residual' element to portray the growth rate of output, that part of output growth which is not exclaimed by the growth rate of such factors as labour and capital inputs (Ghatak, 1995, pp. 71-78). It should also be noted that in the neo-classical model exogenous technology is regarded as a pure public good. The public good assumption implies that technology is non-excludable, and this indicates that there is a free and symmetric access to it (Romer, 1995). Thus, in the long run, both developing and advanced economies can attain the same level of exogenous technology in their corresponding production function. Given the common technology, therefore, the neo-classical growth model here also postulates unconditional convergence of poor economies to the high income and productivity level of rich economies. On the other hand, endogenous growth models (Romer, 1986; Lucas, 1988) do not support decreasing aggregate returns to capital accumulation and the assumptions of exogenous technology.

While neo-classical growth models presuppose a 'natural' tendency for economies to converge in the level of per capita output, endogenous growth models have no such implication, since variations in growth rates across countries can persist indefinitely. Thus, can neo-classical convergence explain the growth nature of developing economies in the post-war period? Should the growth patterns of developing economies simply be viewed as a 'natural' convergence towards the income and productivity levels of developed economies, in which case no change in trade policies need to be evoked to sustain the normal tendency? Or is endogenous growth more apposite, in which case a sustained and clear change in trade and accompanying policies might generate a corresponding change in growth rates. Since endogenous growth is consistent with perpetual growth, unit root in output level in previous years which implies that output levels are not correlated with growth. Thus if the output and productivity trends of developing economies follow a random walk (a unit root), it rejects the hypothesis of smooth convergence but justifies the conditional convergence or catch up in the context of an endogenous growth model. This thesis tests for the presence of catching up trend in developing economies' growth as well as the role of exports in this dynamic process.

Accordingly, apart from the introduction and conclusion part, the thesis is presented as follows. The second chapter discusses export-led growth theoretical issues within the developing economies' context. In the third chapter, trade policy issues are considered. The fourth chapter undertakes surveys of empirical works regarding export expansion and economic growth relationships. The fifth chapter investigates issues of non-stationary time series and cointegration econometric methodology. Besides, the sixth chapter specifies the econometric methodology and data set. Then, it conducts econometric tests based on the theoretical formulation, methodology and data specification. finally it, then, gives an economic interpretation to empirical findings.

Chapter One: Appendix I

Table 2.1. :- Average Annual Growth of GDP, 1965-1993.

Economy Group	1965-73	1973-1980	1980-93
Low- and middle-income	6.5	4.7	2.9
Low-income	5.3	4.5	5.7
Middle-income	7.0	4.7	2.1
High-income	4.8	3.1	2.9
World	5.0	3.3	2.9

Source: World Bank, World Development Report (1987, p. 186 and 1995, pp. 164-165).

Chapter One: Appendix II

Table 2.2. :- Average Annual Growth of GNP Per Capita, 1965-1993

Economy Group	1965-73	1973-80	1980-93
Low-and middle-income	4.3	2.6	0.9
Low-income	2.4	2.6	3.7
Middle-income	5.3	2.7	0.2
High-income	3.7	2.4	2.2
World	2.8	2.1	1.2

Source: World Bank, World Development Report (1992, p. 186 and 1995, pp. 162-163).

Chapter One: Appendix III

Table 2.3:- Export and Import Growth and Terms of Trade, 1965-90

Economy Group	Average Annual Growth Rate (per cent)				Terms of Trade (1987=100)	
	Exports		Imports			
By Income	1965-80	1980-90	1965-80	1980-90	1985	1990
Low-income	5.1	5.4	4.8	2.8	107	100
China & India	4.1	9.8	4.4	8.0	103	103
Other Low-income	5.8	1.5	5.0	-1.9	106	93
Middle-income	3.9	3.8	6.1	0.9	110	102
High-income	7.3	4.3	4.4	5.3	97	100
OECD members	7.2	4.1	4.1	5.2	94	100
Others*	8.8	8.3	9.8	6.7	100	100
By Regional Category**	1965-80	1980-90	1965-80	1980-90	1985	1990
Sub Saharan Africa	6.1	0.2	5.6	-4.3	110	100
East Asia & Pacific	8.5	9.8	7.1	8.0	106	103
South Asia	1.8	6.8	0.6	4.1	101	95
Middle East & N. Africa	5.7	-1.1	12.8	-4.7	130	96
Latin America & Caribbean	-1.0	3.0	4.1	-2.1	111	110
World	6.6	4.3	4.6	4.5	106	100

* Comprises of Israel, Singapore, Hong Kong, Kuwait and United Arab Emirates.

** Regional classification is only for low and middle income economies.
Source: World Bank (1992). World Development Report.

Chapter One: Appendix IV

Table 2.4: - Percentage Share of Sectors in Merchandise Exports, 1965 and 1990

Economy Group	Share of Merchandise Exports									
	Fuels, minerals, and metals		other primary products		Machinery and transport equipment		Other manufactures		Textiles and clothing****	
	1965	1990	1965	1990	1965	1990	1965	1990	1965	1990
By Income Category										
Low - income	17	27	52	20	3	9	28	45	17	21
China & India	13	10	29	17	6	15	52	58	31	26
Other*	21	48	69	24	1	1	10	26	6	15
Middle-income	38	32	39	20	11	17	14	33	3	9
High-income	10	8	21	11	31	42	38	40	7	5
OECD	9	7	21	12	31	42	38	39	7	4
Other**	39	11	24	7	5	36	36	48	16	15

**** Textiles and clothing are a sub -group of other manufactures.

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Table 2.4: - Percentage Share of Sectors in Merchandise Exports in GDP, 1965 and 1990

Economy Group	Share of Merchandise Exports									
	Fuels, minerals, and metals		other primary products		Machinery and transport equipment		Other manufactures		Textiles and clothing****	
	1965	1990	1965	1990	1965	1990	1965	1990	1965	1990
By Region***										
Sub Saharan Africa	23	63	70	29	0	1	7	7	0	1
East Asia & Pacific	21	13	48	18	5	22	27	47	13	19
South Asia	6	6	57	24	1	5	36	65	29	33
Europe	10	9	21	16	33	27	32	47	8	16
Middle East & N. Africa	74	75	24	12	0	1	4	15	3	4
L. America and Caribbean	45	38	48	29	1	11	6	21	1	3
World	16	12	27	13	25	36	33	39	7	6

* Other low income

** High income developing economies (Israel, Singapore, Hong Kong, United Arab Emirates and Kuwait).
*** Low income and middle income only.
**** Textiles and clothing are a sub -group of other manufactures.
Source: World Bank. World Development Report (1992, pp. 248-294).

CHAPTER TWO

II. EXPORT-LED GROWTH IN DEVELOPING ECONOMIES

2.1. Introduction

In the era of global economic interaction and competition the bearing of trade on economic growth of developing economies is not in doubt. A close association between their modern economic growth and a considerable expansion of their exports marked the historical experience of the developed economies. In antiquity, the Egyptians, Greeks, and Phoenicians considerably enhanced their wealth from flourishing Mediterranean trade. In the Middle Ages, Arab traders exchanged European precious metals for the spices and silk of China. During the industrial revolution, Britain built its overseas empire on exporting its manufactured goods. Following the Meiji restoration in 1868 Japan commenced international trade to obtain natural resources and foreign technology (Schaefer, 1995, p. 1). The historical experiences have led to the proposition that exports a primary source of growth (Sundrum, 1994, p. 105).

Furthermore, it has been claimed that an open economy force has also contributed to an economic convergence and catching up process of the relatively less developed economies. At the same time, there was also an acceleration of economic growth in many developing economies, which enhanced their exports, particularly, of manufacturing products. In the case of primary products, exports as an 'engine' of growth seems to have been hardly strong (Lewis, 1980; Riedel, 1987). However, the post 1960 successes of the newly industrialising countries (NICs) have mainly been credited to the miracle of export-led growth that enables them to foster their exports in which they have a comparative and competitive advantage (Hughes, 1985 and 1993; Ghatak, 1995, p.349).

As it is extensively acknowledged in traditional trade theory, by breaking the close relationship between production and consumption, and by extending some options, and by cessation of others, the possibility of exporting influences in important ways the possibility of economic growth (Chaudhuri, 1989, p.11). It enables an economy to disengage its pattern of production from the pattern of consumption.

An 'autarkic economy', per se, has no alternative but to produce and consume the same goods and services. An export-led economy, on the other hand, can specialise in the production of goods and services it is best able to produce, independently of its pattern of wants, if pertinent trading opportunities do exist. Specialisation in production may rely on natural resources, as well as capital stock and technology. Variations in patterns of want are associated systematically to levels of income and demand factors, which have a role to play in the explanation of the relationship between, export expansion and growth.

However, by opening their economies and expanding their exports, developing economies can extend their technological possibilities and the capacity to extract and reinvest a 'surplus'. By drawing on the link between technology transfer and international integration, economists such as Sachs and Warns (1995) have sought to explain differences in growth between countries. This link is established through export-led growth that an economy which formerly was closed to the world economy, and the adoption and investment in new ideas on the part of its firms is a function of their possibility and the degree to which technology can spill over from advanced economies to developing economies. Lewis argues that new ideas will be accepted most rapidly in those countries where people are accustomed to variety of opinion, or to change, therefore, pragmatic in their outlook. A society, which is isolated, homogenous, proud, and authoritarian, is by contrast unlikely to absorb new ideas quickly when it meets them (Lewis, 1955, p. 178).

Export-led growth regime can help to minimise the exposure to sclerotic (Olson, 1982 and Abramovitz, 1986) and rent seeking (Krueger, 1974) behaviours which are encumbrance to growth. Due to international orientation, exposure and competition, the country can develop encompassing organisations which able to avert sectional inclinations. This provides the way in which authorities can pre-commit not to exercise discretion in favour of domestic interest groups that do arrest growth. In an export-led economy, price structures are not heavily distorted and principally reflect opportunities and production costs. Hence, resources are efficiently allocated. Private property and entrepreneurship are part of the system that there is considerable economic liberty. The quality of the government is acceptable in such an economy because it holds the capitalist rules of the game. These are good grounds for relating catch up and convergence to particular trade regime and trade policy, which is in turn characterised by particular political economy. These arguments give reasons for believing that catch up and convergence are strongly conditioned by the trade regime in place that able to obviate the threats of rent-seeking and x-inefficiency in production system through designing and enforcing suitable industrial and export promotion policies (Crafts, 1992).

As it is argued in the 1995 World Bank's World Development Report, convergence is not a natural process in which each and every poorer country can attain irrespective of their economic policies. Rather, it is conditional and particularly based on their educational attainment, infrustractural foundation and export-led growth strategy. The notion behind expecting economic convergence for those economies that pursue export-led growth is that such poorer economies can import capital and modern technologies from richer economies and thereby reap the 'advantages of backwardness.' Furthermore, For export-led economies, there will be a wider scope for mutually beneficial trade and factor movements as the world economy enlarges. There will be bigger markets and better sources of supplies. Opportunities for international investments will increase, flow and transfers of technology will expand, and new economic policies and industrial methods will be employed. The new impetus from competitive forces will cause not only a useful reallocation of resources but also an intensified research for improvements and innovation. Sachs and Warner (1995) argue that open developing economies tend to converge, but closed developing economies do not. They suggest that export expansion and the accompanying spread of trade liberalisation programmes in developing economies are remarkably strengthening the presumable tendencies towards convergence.

The goal of this chapter is to provide analytical explanation of the role of export expansion in promoting economic growth in developing economies from divergent theoretical perspectives.

The question may arise, whether and in what way, export expansion in a given developing economy, i.e. the opportunities for trading with other economies, can influence the process of economic growth in comparison to a 'closed economy'. In this regard, it is are going to be questioned whether the problems of economic growth are different in an 'export-led economy' that captured by export expansion.

It follows from what has been said above that effects of export expansion on growth in particular cases can be conveyed through various sources. Exports can work through the factor market, so as to say, by influencing the rate of capital accumulation or technical change. It can also spread its influence through the goods market, through specialisation, in certain kinds of activities. It is this aspect of trade that has been mostly addressed, through the articulation and development of the theory of comparative advantage.

All economies engage in export activities. David Greenaway and Chris Milner (1987, p. 1) have pointed out that; the significance of exports to a given economy can be measured relative to GDP. For example one can measure 'openness' by the share of exports in GDP. The degree of openness varies from one economy to another. India, for instance, is a relatively closed economy, with exports accounting for less than 10 per cent of GDP in 1990. By contrast, Singapore is a classical small open economy with exports accounting for in excess of 200 per cent of GDP in 1990 (IMF, 1994). [1]

The export sector provides a link between the domestic economy and the outside world. This link acts as a channel through which the impetus of economic activity can be carried from one economy to another. This channel therefore makes a conduit of interdependence between economies. However, the more open the economy (as defined above), the more sensitive is its welfare to economic activity elsewhere. Thus, it may be questioned that whether this openness of the developing countries' economies has stimulated their economic growth without any reservation. The answer to this question plays an important role in the discussions on the direction of the economic policies of developing economies follow.

Researchers in export-led growth analysis have answered the question about the growth effect of export expansion in particular and international trade in general in widely divergent ways. In this framework, economists, when they discuss the role of export

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[1] However, Greenaway and Milner (1987) and Summer and Huston (1991) measured the degree of openness using the percentage share of exports plus imports in the GNP and GDP respectively. Liberalisation episodes and exchange rate and other trade distortion measures have been considered in the works of Agarwala (1983), Dollar (1992), Krueger (1987), Bhagwati (1978) and Ghatak et al. (1994).
Sachs and Warner (1995) classified a given developing economy as having closed trade policies if it has at least one of the following characteristics:-
(1) Non-tariff barriers (NTBs) covering 40 per cent or more of trade.
(2) Average tariff rates of 40 per cent or more.
(3) A black-market exchange rate that is depreciated by 20 per cent or more relative to the official exchange rate, on average, during the 1970s and 1980s.
(4) A socialist economic system as defined by Kornai (1992).
(5) A state monopoly on major exports. Thus, they have shown that only a handful of developing economies (Barbados, Cyprus, Hong Kong, Malaysia, Mauritius, Singapore, Thailand, and the Yemen Arab Republic) have been continuously open since the start of the post-war period, or from the start of their independence.

expansion in the process of economic growth of developing economies, tend to identify four general perspectives. The first is a wholly optimistic view of orthodox classical and neo-classical free trade model (Greenaway and Milner, 1987, p. 12). It establishes that the welfare of all countries that engage in exports is increased, even when such trade is between developed and low-income countries. The second perspective is competitive or dynamic comparative advantage based on new trade theory model, which is also optimistic about export-led growth, recommends integration to the world economy. The third perspective is the dirigiste or structuralist model, which is pessimistic about export-led growth. The fourth perspective is a pessimistic but a very dismal view of radical model. It postulates that exports and economic specialisation have actually caused the polarisation of the world into a developed core and underdeveloped periphery (Greenaway and Milner, 1987, p.12).

Nevertheless, over the post-war period, the world exports trade has grown faster than world output. In other words, countries have tended to become more open and more interdependent. This is no less true of the developing economies than developed market economies (Greenaway and Milner, 1987, p.11).[2] This being so, it is clearly important to understand the forces which stimulate export expansion, and the effects of that trade on the economies concerned under different theoretical perspectives as follows. However, most of these theories have been so extensively discussed (see Haberler, 1959; Lewis, 1969; Meier, 1989; Myint, 1958; Nurkse, 1953; Singer, 1950; Balassa, 1978; Krueger, 1981; Riedel, 1987) that only a brief overview is considered here.

Therefore, this chapter is classified into three main sections. In the first section brief theoretical discussion on economic growth is conducted. The second section is dealing with the more positive views of export-led growth, and the third section presents the pessimistic views of export-based growth. The fifth section concludes the chapter.

2 World merchandise export as a percentage of GDP was 7.1, 11.7, 14.5 and 17.1 for the years 1950, 1973, 1985 and 1993 respectively (World Bank, 1995). However, Krugman (1995) argues that although the volume of world trade has been a steady upward trend since about 1950, a long-term perspective reveals that such growing integration is merely represents a recovery to the period between the 1913 and the early post-World War years.

2.2. Theories of Economic Growth

In the view of many economists, economic growth can be proximated by sustained increase in real terms of aggregate income and output of goods and services produced in an economy (Terleckyi, 1982, p. 276; Boltho and Holtham, 1992; David, 1986, p. 611). Likewise, this sustained growth is regarded as a necessary condition for, sustained economic development, modernisation, and progress (David, 1986, p. 61)). This definition may give rise to some problems, both of conceptualisation and measurement.

The first points to note is that economic growth is essentially a dynamic concept and allude to a continuous or almost uninterrupted increase in income and output over time. Variables that lead to a discrete change from a lower to a higher level of income and output may be cordial but that is not growth.

The second point is that the terms income and output are ambiguous, in that they can mean either total income or output or income and output per capita. A rise in total income and output is called 'extensive' growth, a cumulative rise in income and output per capita is 'intensive' growth (Chaudhuri, 1989, p.2; Kasliwal, 1995, p. 39; Reynolds, 1983). When one thinks of growth in the context of an increase in standard of living or of the welfare of population, one naturally thinks of income and output per capita (Kuznets, 1965 and 1971). However, a rise in total income and output over time may also be an extremely significant phenomenon, where, for example, economies of scale are important.

Thirdly, there should be a distinction between output and output capacity. Most theories of economic growth, in so far as they deal with increases in labour force or the accumulation of capital, implicitly deal with changes in output capacity, whereas actual changes in output over time are also influenced by the ability of an economy to utilise accumulated capacity. For a particular economy, growth of output over a given period of time, or a difference in the level of output at two points in time, may be significantly influenced by different degrees of utilisation of capacity for the relevant periods. Thus, in a study of the long run, one cannot successfully exclude the influence of short-run phenomenon completely (Chaudhuri, 1989, p.2; Denison, 1967).

While growth can be measured in terms of changes in output, it would also be important to notice the qualitative changes that are an indispensable part of the process.

These changes take place in both factor and output markets. For the output market, economic growth does not merely induce more output; it leads to newer, and sometimes better, forms of output. In the factor market, economic growth leads to improvements in labour skills or to more efficient or safer forms of equipment. It also leads to changes in the form of activity, e.g. away from rural/agricultural to urban/industrial then to services. The most fundamental change that economic growth creates is in broadening the scope of option that is accessible to a society. In this regard, Kasliwal (1995, pp. 39-40) argues as: 'extensive growth continues quantitatively without much change in the qualitative nature of the economy. Eventually some qualitative changes in productive methods become necessary. That marks the transition to modern intensive growth.' Historically at least, the ability to generate a vigorous or a well educated population, or improving life expectations, improving the quality of life in other ways, has been underpinning in economic growth (Terleckyi, 1982, pp. 277-279; Hirsch, 1977; Chaudhuri, 1989, p.3).

Economic growth, by either raising the whole availability of goods and services, or by increasing the ability to acquire, makes it conceivable for a given society to achieve a higher level of material welfare. In fact, with population growth, it is essential to sustain a given average level of material welfare. Nonetheless, not everyone will acknowledge that economic growth raises welfare, even if they acknowledge that such a raise is an appropriate goal to regard. It might be that economic growth has its own limitation in the sense that while it increases the volume of total output, may make some resources scarcer. Hirsch argued that while growth increases collective consumption, it indeed makes some forms of private 'wants' more difficult to satisfy (Hirsch, 1977).

A better known critique is that 'rapid growth' is based on the exploitation of exhaustible resources, which would make it more difficult to maintain the present level of welfare (Chaudhuri, 1989, p.4). Therefore, environmentalists argue for ecologically friendly or sustainable development, which is 'slow' and 'organic' growth (Kasliwal, 1995, p. 10). Another important disagreement is that for the majority of the population, welfare depends much on the distribution of total output as on its absolute level. While it is true that economic growth has made the distribution of income worse for some countries for at least some of the time, this seems to rely on the pattern of growth rather than growth itself. It is not assured that the process of economic growth must inescapably observe a particular pattern. Moreover, some of the distribution effects are a result of population growth rather than growth of output. It is also hardly clear that less growth means a slower rate of growth of population; indeed in the perverse sometimes. Historically both mortality and fertility rates have declined with a rise in per capita incomes; even for poor countries, there is some evidence of fertility rates being inversely correlated with income, although the evidence is not very convincing. It is true that some developing economies manage to attain a higher level of welfare, measured in terms of, say, literacy or the infant mortality rate , at a much lower level of economic growth than others. Some economies like Sri Lanka have obtained levels of welfare, measured by nutritional intakes or infant mortality rates, analogous to those with much higher per capita income (Sen, 1981). On the other hand, for a particular country it will be difficult to argue that economic growth reduces the level of income or worsens life prospects for the majority of the population over sustained periods of time.

It has been argued that the ability to accelerate the rate of economic growth depends upon whether we have correctly understood the causal process of growth (Gupta, 1983, p.1). In this regard, Terleckyi (1982, pp. 277-279) pointed out that theories of economic growth have been considered with three basic elements and their interactions: population growth, capital formation, and technological change. Adam Smith marked the realisation of economies of large-scale as an indispensable source of growth. In his conviction, realisation of these economies can be made by the growth of the markets, which enabled progressively more efficient organisation of production based on division of labour and the resulting specialisation of skills and methods of production. The principle of diminishing returns, evolved by Malthus and Ricardo, distinguished the confines to economic growth in the limited amount and capacity of land to yield constantly increasing produce even with advancement in agricultural techniques and increased applications of labour and capital in its cultivation. The neo-classical economists have developed theories of industrial organisation dependent upon available labour and capital and not subject to the limitation of land supply. In this context, economic growth is basically seen as a consequence of accumulation of ample capital to permit use of the economically most efficient combinations of labour and capital (Kasliwal, 1995, pp. 95-103). These methods are often thought to entail a deepening of capital structure and an increase in capital intensity of the economy.

Accordingly, a belief which has held sway among economists, is that capital accumulation is the most important source of economic growth. W. W. Rostow's well-known work, The Stages of Economic Growth, Cambridge University Press, 1960, contained an

implied suggestion that once an economy achieved a certain minimum level of saving and investment, it would be ready for take-off into self-sustained growth. The pioneering Harrod-Domar model of growth places capital formation at the centre of the platform (Kasliwal, 1995, pp. 106-107). The strength of this trust is apparent from the fact that policy makers in most developing countries are even today focused on raising the rates of saving and investment
(Gupta, 1983, p.2).

The one sector neo-classical growth model developed by Solow (1956 and 1970) provided the most basic version of the neo-classical theory of growth. In this model the production function assumed to be constant returns to labour and capital, with marginal productivity diminishing for each factor of production. The economy was also assumed to be perfectly competitive and savings rate and growth in the labour force was exogenous. In this model growth is driven by increases in capital employed per worker. This model predicts that in moving towards the steady state, higher per capita output growth would occur with high investment rates in relation to rates of growth in the labour force, thus, increasing the capital-labour ratio. When capital labour-ratio is low, the marginal productivity of investment will be high and attract further capital, should generate high growth in per capita output and convergence in the per capita output between poor and rich countries (Kasliwal, 1995, p. 110-111; Lucas, 1988 and Romer, 1986). Moreover, given technology is exogenous, thus, knowledge is relatively inexpensive to obtain and use in the production process, then all countries whether developed or developing should achieve in the long run the same technology in the production function. Therefore, the neo-classical growth theory indicates that countries with low per capita income will grow faster to catch-up with the developed economies as they acquire techniques and learn intertemporally how to use them efficiently. Then, eventually, a process of convergence should produce the same per capita income (Ghatak, 1995, pp.71-72; Kasliwal, 1995, p. 117).

On the other hand, a different theory of production system and economic growth was advanced by Schumpeter associated the process of development with 'doing things better' or technical progress. Therefore, his theory made inventions and their associated pulses of innovation the prime moves of economic progress. This has gained recognition in the neo-classical growth models in the form of the 'residual factor' in growth. The 'residual factor' alludes to the proportion of growth rate remaining unexplained by the additions to productive resources of capital and labour. Streeten as quoted by Gupta (1983, p.2) has called it, the 'coefficient of ignorance'.

As it has been asserted by Boltho and Holtham (1992), the most basic approach to neo-classical economic growth underlies the collective importance of factor inputs and, especially, technology. The latter is usually assumed to expand at a regular, if unobserved rate. Within the mainstream neo-classical growth model, Denison (1967) underlies the 'growth accounting' literature (Kasliwal, 1995, p. 113), which attempted to quantify the role of various proximate influences on growth. The results of this literature indicate that the growth of output could not nearly be accounted for by the growth of inputs. Thus, the role of the technological residual has appeared substantial and attempts were made to decompose it into different elements, such as education. This approach is subsequently further developed by Maddison (1987).

The vital works of Uzawa (1965) and Conlisk (1969) attempt to endogenise the rate of technical progress in the neo-classical model. Conlisk, in particular, draws drastically different conclusions from the orthodox neo-classical theory of economic growth and provides theories of endogenous growth. In this framework, they have built models where technological progress is endogenously determined by economic incentives and an equilibrium allocation of an economy's resources. Arrow's (1962) original learning by doing model is also an example of endogenising technology in the growth processes.

The current explosion of the new theories of economic growth (Barro, 1990; Barro, 1995; Barro and Sala-i-Martin, 1990 and 1994; Lucas, 1988; Romer, 1986, 1989, 1990; Grossman and Helpman, 1991) take the same direction set out by Uzawa and Conlisk and ameliorate orthodox neo-classical theory by offering an endogenous formulation of technical change. The new theories of growth deserts the presumption that production exhibits decreasing returns with respect to the use of capital. Instead, the definition of capital is augmented to allow for investment in many reproducible factors of production (such as land reclamation, accumulation of human capital through training , building-up of know-how through R & D, spend on infrastructure and other public goods, etc.). It does not then look plausible to assume constant or even increasing, returns to scale with respect to this very broad measure of capital (Romer, 1986; Lucas, 1988; Grossman and Helpman, 1990, 1991). Firms create new knowledge in the process of production and such knowledge enters the economy and contributes to the productivity of other production processes. In Romer's argument, the long-run rate of growth can also be affected by government policies which alter the incentive to invest, and the market left to itself would allocate a sub-optimal amount of capital formation due to positive externalities through spill-over effects.

Grossman and Helpman (1991) developed a theory of economic growth, which is based on continuing innovation. The thrust of their work lies in viewing technological progress as resulting from entrepreneurs allocating resources to research and development in response to the perceived yields on their investments. These returns on their rents which can be derived from imperfect competition in product markets. When firms allocate resources to research and development, part of the return can be appropriated by the other firms through patents or hidden processes. Because of the difficulties of retaining knowledge to themselves, however, firms have to admit that technological spillover is likely to occur. As the real cost of innovation falls, the whole process of knowledge creation endogenously generates gain in productivity which then sustains growth.

Theories of economic growth are usually conceived and developed for a closed economy. The prophecy of the new theories of growth about convergence and development, however, depends on the translation of these theories to the context of open and interdependent economies. Recent literature suggests that international spillover of investment may provide over and above the effects of capital mobility a strong reason for convergence of growth rates, although differences in levels of output and of consumption between countries may remain (see, for example, Grossman and Helpman, 1991).

Spillovers of technology causes the marginal productivity of a broad measure of capital in a developing area to exceed that in an advanced area, so that the incentive to invest in the former area is higher than in the latter area.

The new view of economic growth has inspired interest in the traditional theory of long run growth by drawing attention to such determinants as increasing returns to scale, investment in human capital and the effect of export-led growth. Increasing returns to scale are associated with the use of new technology and with the complementarities between human and physical capital. The dynamic externalities stem from export-led growth, as measured by export expansion. The new view of economic growth postulates non-convexity of the cost function related with semifixed inputs that incorporate non-rival inputs in Romer's theory. A non-rival input is that unlike an orange, use by one does not diminish or preclude use by another. Nevertheless, knowledge can also be excluded to those who do not pay for its use. Kasliwal has taken the prominent examples of cable TV, which is excludable, and broadcast TV that is not, and argues that new knowledge is often excludable even as it stays non-rival in use. Therefore, in the context of imperfectly competitive markets, an owner may be able to charge a monopoly rent by controlling access to Knowledge (Kasliwal, 1995, p. 118).

Non-rival input is also one for which subsequent use of such inputs has a significant lower cost of production than at first. The increasing use of non-rival inputs and the phenomenon that their subsequent units can be replicated at a very low cost has given a new convolution to commercial non-basic research that have led to a radical transformation of the structure of certain developing economies such as the Asian NICs which have experienced a massive growth of exports and shift from traditional to R & D intensive products.

Recognising that with rival inputs production can be doubled by duplicating all the rival inputs. With non-rival inputs, production will be more than double by duplicating all non-rival inputs. Thus, the production function can be denoted as:-

$GDP(zR, zNR) > GDP(zR, NR) = zGDP(R, NR)$ (2.2.1)

Where R= Rival inputs

NR = non-rival inputs

z = a positive integer greater than unity

Another feature of the new growth theory is 'learning-by-doing', which affects output per worker positively due to Knowledge spillover effects between the different elements of human capital, Arrow (1962). Dynamic externalities can be considered by formulating the production function as follows:-

$GDP = GDP(H, W, K)$ (2.2.2)

Where:- H- human capital

W- worker

If marginal productivity of physical capital (MPk) is also a function of H, K/W (physical capital-worker) ratios are incapable to capture the entire productivity level. Thus, despite the fact that developing economies have meagre physical capital relative to labour (consequently, MPk should be high in developing economies), the combination of low human capital stock and physical capital may not presuppose a high MPk in actual fact (Ghatak, et al 1994). Presume that the production function is:

$GDP = K^a W^b H^r$ (2.2.3)

and $[GDP_t-(GDP)_{t-1}] / GDP_t = y$ i.e the GDP growth rate; where t represents time then:

$$y = a[K_t-K_{t-1}]/K_t + b[W_t-W_{t-1}]/W_t + r[H_t-H_{t-1}]/H_t \qquad (2.2.4)$$

With constant returns to scale, $a + b + r = 1$. Nevertheless, the inclusion of H , one can now portray the exogenous technology and the possibility of increasing returns i.e $a + b > 1$. The learning-by-doing effect can be formulated as: - $a = r[H_t\text{-}Ht\text{-}1]/H_t$ In terms of GDP per worker i.e. $GDP/W = g$, then:

$$g = Ak^d h^i \qquad (2.2.5)$$

Where $k = K/W$

$h = H/W$

If the economy has an export and non export sector, the positive externalities effect of human capital in the export sectors can be regarded as that sector grows at a rate proportional to the employment in that sector, i.e.

$$Dhi/hi = uifi \qquad (2.2.6)$$

Where fi = the proportion of workers in the export sector; i= 1,2.

ui > 0= 'learning-by-doing' coefficient.

The long-run relationship between GDP growth and export expansion is not vigorously advocated in the neo-classical growth model. In the neo-classical growth theory (Solow, 1956) economic growth is driven by 'exogenous' technical progress and public policies have no effects on the steady-state growth rates of output or consumption per head. Similarly, differences in trade regimes will have no effect on long-term growth rates. Bhagwati (1988) and Krueger (1980), however, relied upon scale economies (external or internal) to authenticate the direct correlation between export expansion and growth. The substance of their reasoning is that an export-based growth strategy permits specialisation in those activities that possess large-scale economies and dynamic efficiency. In the endogenous growth theory, the argument about dynamic efficiency in export activities has been employed to demonstrate how export-led growth strategy can influence long-run growth by allowing developing economies to specialise in those economic activities with scale economies that stem from human capital accumulation, learning -by-doing and R & D activities (Ghatak et al 1994).

In this regard, Grossman and Helpman (1991), Buiter and Kletrzer (1991), and Alogoskoufis and Van der Ploeg (1991b, 1991c) have constructed examples in which growth rates of output differ between countries permanently. Even though international mobility of (physical) capital is perfect, differences can emanate in these examples when non-tradable and reproducible inputs are used in the production of a tradable goods. The results of Buiter and Kletzer and Grossman and Helpman rely on the assumption that international spillovers of knowledge are absent. Buiter and Kletzer focus on the accumulation of human capital.

Differences in intertemporal preferences of households or, more importantly, in public expenditure on schooling may cause countries to grow at dissimilar rates. Based on the assumption that invention and production of a variety are intrinsically related, Grossman and Helpman argue that a large country can, due to economies of scale, gain an (absolute) advantage in the research for and the development of new varieties. It follows that a large country can specialise in the conduct of R & D at the expense of innovative activity in a small country. Alogoskoufis and Van der Ploeg (1991b, 1991c) model international spillovers of knowledge and find convergence of growth rates, unless the costs of adjustment for investment projects differ between countries. These adjustment costs can, in fact, be considered as a non-tradable input.

The argument behind international spill-overs in the production process involves that there are decreasing returns to capital at a national level but constant (or increasing) returns to capital at a global level. This means that there is capital mobility and the importance of non-traded factors of production is not too large, while at the same time the growth rate of global economy is endogenous. Non traded factors of production such as roads, schools, hospital, communication systems and health care facilities are generally funded by public savings and is not traded on international markets may not be adequately accumulated in some developing countries thus can explain lack of convergence among countries. In this regard, if technology is endogenous, convergence among countries' per capita incomes and productivity catch-up process need never occur since domestic public policies and the presence of various forms of barriers in conducting international trade and technology transfer can affect output growth rates both positively and adversely. Thus, this may lead to divergence in per capita income and social capability across countries (Ghatak, 1995, pp. 73, Crafts, 1992, p.3).

The major contribution of the open-economy model in this new literature is that it shows how economic integration in the world economy, compared with isolation, helps long-run growth by avoiding needless duplication of research. World market competition gives motivation to entrepreneurs in each country to invent products that are unique in the world economy (Rivera-Batiz and Romer, 1991b; Grossman and Helpman, 1991: chapter 9). They argue that the stock of knowledge is an important factor in determining a country's economic growth. That is to say that a country's growth is determined by the amount of knowledge that the country possesses. Thus, if a country is a backward its complete productive capacity will be used to produce simple consumption goods. The level of education and research will also below that the country will be unable to contribute on its own to the common stock of knowledge that exists. They take this as fundamental explanation for the low-income countries that have low-income growth rates and for their inability to break out of the poverty trap in which they are caught. The low-income developing economies primarily produce simple consumption goods where the possibility of further improvement via learning by doing have been exhausted. They point out that research is basically a good that is neither 'rival' nor 'excludable'.

Accordingly, it is argued that as the world economy becomes increasingly integrated, one effect is that 'double-work' in research diminishes. If two large economies are integrated with each other the resources allocated to research in one country may produce the same amount of new knowledge that was produced in one in closed economy by the resources of both countries. If the same amount of research is maintained in both countries, the growth rate of knowledge and a new 'designers' will increase. Thus, they considered that this will have a positive effect on the growth rate, and the effects on learning by doing are also positive. Since the opening up of trade or an expansion of export means large markets, the scope for scale effects and for introduction of new products increases.

In this context, the new growth theories argue that exporting implies exchange of knowledge. It also means that a country will gain access to the stock of knowledge capital through trade. They have provided new and strong arguments in favour of export-led growth. The use of existing knowledge and the possession of new knowledge become factors of primary importance for a country's well being. For most countries, domestically produced technical progress usually forms a small, not to say insignificant, part of global knowledge. But contacts with rest of the world through exports are an excellent means to get access to new knowledge. Most countries in fact are forced to become free riders in terms of creating and acquiring knowledge. Restriction of trade will lead to backwardness, lack of knowledge and techniques, and in the end to poverty.

From the point of view of factor price equalisation theorem, the new theory says that if a country wants to be among the world's economic leaders, it will have also have to be at the lead of technological development and at least in some cases be the owner of exclusive designs and newly created knowledge. Thus, it is in fact only by owning some exclusive designs and newly created knowledge that a country can avoid having its factor prices equalised (Sodersten, 1991, pp. 13-21).

Freenstra (1990) and Grossman and Helpman (1991, chapter 9), however, argue that the assumption in this model of a common pool of knowledge capital created by international spillovers of technical information is not often appropriate for a poor country. When knowledge accumulation is localised largely in the developed economies and the developing economies are smaller in economic size, the developing economies may innovate less rapidly in long-run equilibrium with international trade than it does under autarky. Trade may reduce the profitability of R & D in the developing economies as it places local entrepreneurs to compete against rapidly expanding set of imported, differentiated products and may drive the economies to specialise in traditional, possibly lethargic, industries which use its relatively plentiful supply of unskilled workers. One should note the relevant R & D for a developing economies is, of course, more in the technological adaptation of products and processes invented abroad and imitation. Even this kind of a R & D sector is usually so small that major changes in aggregate productivity and growth on the basis of the trade-induced general equilibrium-type reallocation of resources into or away from R & D sector, as emphasised by Grossman and Helpman, will seem a little overdrawn if applied in the context of developing economies (Bardhan, 1991, p.24 and Rodrik, 1992).

The lack of diffusion of technology from rich to poor countries is often interpreted in the literature as reflecting the frequent laxity in the enforcement of patents in developing economies and innovators in rich countries thus the latter is obliged to protect their ideas through secrecy. This actually, ignores the cases of restrictive business practices of many multinational companies such as 'sleeping' patents where the old technology keeps on being used while the new patents are taken out simply to ward off competitors. Moreover, the flow of technology through direct investments by multinational enterprises to developing economies is often constrained not so much by restrictive government policy in the host country as by its lack of physical infrastructure the development of which in turn is constrained by the difficulty of raising loans in a severely imperfect international credit market (Bardhan, 1991, p.25).

The new growth theories, in the open economy context, emphasised the feature of monopolistic competition and in some aspects the Schumpeterian process of costly R & D races with the prospect of temporary monopoly power for the winner- aspects which were absent in most of the previous growth models. However, they have not formalised some other aspects of imperfect competition such as the case of 'sleeping' patents or international credit market imperfections in shaping comparative advantage by driving developing economies away from specialising in sophisticated manufactured products which requires more selling and distribution costs than traditional primary products (Mankiw, 1995; Kletzer and Bardhan, 1987)

Therefore, in the following section it will be attempted to consider economic growth in the open economy context with particular reference to the contribution of the export expansion to the growth process of developing economies. It particularly examines how the process of export-led growth is interrelated to their economic growth through an expansion of the export sector.[3]

[3] Alternative growth models such as Marxian model of economic growth (Sweezy, 1942; Adelman, 1962), Kaldor (1957) and Kaldor and Mirrlees (1962) models of economic growth, the disaggregated dual economy models (Lewis, 1954; Fei-Ranis, 1964), Jorgenson, 1961; Dixit, 1968; Kelly et al. 1972) are discussed in Ghatak (1995).

2.3. Gains from Export-led Growth

Theories of export-led growth are dominated by the variants of orthodox or classical and neo-classical trade and recent theories of international trade theorems (Meier, 1989). The most influential groups of writers range from Ricardo and Mill to Heckscher, Ohlin, Samuelson and Krugman. These classical and neo-classical theorems are modified in the current theories of trade to take into account explicitly the effects of technology and growth. Therefore, the development of new trade theories are an important contribution. These developments are well covered in the literature (Bardhan, 1970; Johnson, 1962, 1964 and 1967; Rybcznski, 1955; Bhagwati, 1958, Ghatak, 1995, Krugman, 1979, 1982, 1986, 1991 and 1994; Meier, 1989; Thoburn, 1977 and Thirlwall, 1992).

The conduits through which export-led growth could bring benefits are tremendous. These include: -

- enhanced resource allocation in line with social marginal costs and benefits;
- access to better technologies, inputs and intermediate goods;
- an economy is better able to seize advantage of economies of scale and scope;
- greater domestic competition;
- availability of auspicious growth externalities;

Consequently, the study shall concentrate on major issues in which the possible effects of an export expansion on economic growth can be realised. Accordingly, the argument is categorised into two broad effects, i.e. the static and dynamic once.

2.3.1 The Static Gains

In the traditional trade theory, the expansion of exports permits the increase in the value of output and real income from domestic resources by improving utilisation of existing factors of production (Thirlwall, 1992, p.361). This can be considered as the static effect of exports. Thus, can be discussed based on the principles of:-(i) 'vent for surplus ' (ii) the law of established or natural comparative advantage.

Vent for Surplus:- Adam Smith pointed out that export expansion can be an important stimulus to growth through the enlargement of the market for domestic producers and through increasing opportunities for the division of labour. The quote from the *Wealth of Nations* says:

> **Between whatever places foreign trade is carried on, they all of them derive two distinct benefits from it. It carries out that surplus part of the produce of their land and labour for which there is no demand among them, and brings back in return for it something else for which there is demand. It gives a value to their superfluities, by exchanging them for something else, which may satisfy a part of their wants and increase their enjoyments. By means of it, the narrowness of the home market does not hinder the division of labour in any particular branch of art or manufacture from being carried to the highest perfection. By opening a more extensive market for whatever part of the produce of their labour may exceed the home consumption, it encourages them to improve their production powers, and to augment its annual produce to the utmost, and thereby to increase the real revenue and wealth of the society.[1]**

Myint (1958) reformulated the Smith's argument into the famous 'vent for surplus theory'. Myint indicates that Smith's concept of surplus productive capacity is not only a matter of surplus land by itself but surplus land combined with surplus labour; and the surplus labour is then linked with his concept of 'unproductive labour'. According to Meier (1989, p. 37) this interpretation allows Smith's 'vent for surplus' model of export led-growth to be compatible with W. Arthus Lewis 's model of development with unlimited supplies of labour (Lewis, 1954), and the 'staple theory' (Caves, 1965, p. 103).[2]

An isolated economy, closed to international markets, might have substantial amounts of land and labour that is either idle or used in relatively unproductive ways if their products are restricted to domestic consumption alone. Thus, 'Once the opening-up process go into its stride,' (Meier, 1989, p. 36), export production provides an outlet for a country's surplus products which would otherwise go unsold and represent a waste of resources. Therefore, by augmenting the extent of the market, exports may activate the economy so that all factors of production are utilised entirely and the economy moves towards its production possibility frontiers.

Myint (1958) holds that the vent for surplus principle is a plausible theory in illuminating the rapid expansion of exports production in most parts of the developing

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[1]Adam Smith (1776/1937), An Inquiry into the nature and Causes of the Wealth of Nations, Edwin Cannan (ed.), New York: Modern Library, p.413.

[2] According to the vent for surplus theory, a given developing economy inters into the global economy with the surplus productive capacity over domestic consumption requirements. The role of exporting is, therefore, hardly to allocate given resources but rather to generate a new effective demand for the product of surplus resources that would have remained unutilised without exporting. Export output can then be increased without reducing domestic output. 'Exports become a virtually cost less means of acquiring imports and expanding domestic activity.' (Meier, 1989, p. 35). In this sense, the Smith's approach to export expansion contrasts with comparative cost theorem. The latter focuses on the efficient resource allocation role of exports between expansion of export sector and contradiction of domestic output.

economies in the nineteenth century. He has observed that when parts of African and Asian economies came under European influence, the consequent expansion of their exports enabled those areas to utilise their land and labour intensively to produce tropical foodstuffs such as cocoa, coffee, oil palm and rice, etc., for exports. Myint further applies these cases and as well as the case of unused land in the Americas and Australia.

Natural Comparative Advantage:- The orthodox classical and neo-classical economists considered comparative advantage as a determinant of the pattern of exports for a given economy. Thus, it is not the use of surplus resources but, it is the reallocation of resources allowed by exports that benefit a country by fostering a more efficient international allocation of resources. Without any increase in resources or technological change, every trading country is able to enjoy a higher real income by specialising in production according to its comparative advantage and trading. Exports have effectual significance as the intermediate goods used for 'indirect production' of imports: exports allow the country to 'buy' import on more favourable terms than if produced directly at home.

By specialising in products for which its costs are comparatively lower, a trading nation would, in Ricardo`s view that raises the sum of products and mass satisfaction (Ricardo, 1817: Ch. VII); in other words, exports optimise production (Findlay, 1984). In this sense, the gain from exporting is symmetrical and it promotes the attainment of Pareto global efficiency, hence, the whole exporting and importing business is a positive sum game.

Ricardo used the prominent and 'justly celebrated' (Meier, 1989, p. 35) illustration of Portugal and England trading wine and cloth to demonstrate how both can benefit through exporting to one another, each specialising in the production and exporting of that product in which it had a comparative advantage, i.e. where its productivity differential was the largest for an exportable product and smallest for an importable, even though one of them may have attained higher absolute levels of productivity in both lines of production. Given that resources are scarce in both economies, and have alternative uses, both benefit by concentrating on the production of that product in which it has a relative productivity advantage at the margin, and satisfying its demand for the other indirectly through trade. This would be so, as long as trade was voluntary and the terms of trade between the two commodities was determined somewhere between the productivity ratios in the two economies. The actual terms of trade depend on the shape of the two economies' offer curves (Kindleberger, 1973, pp. 36-40).

In his Essay on Profits, Ricardo points out that while exporting is beneficial in the sense that it has the effect of providing an exporting country with a higher level of output at a point in time, only exports of a particular pattern can help to ward off the 'stationary state'. Only export expansion that leads a country to economise on its scarce resources is relevant for growth. Assume one of the two trading economies is richer or more developed than the other. By assumption, diminishing returns to land has set in already, and declining productivity in agriculture and the rent squeeze is tending to eat up the capitalists' 'surplus'. This country could benefit in the long run only if it could exports manufactures, which do not use land as an input, and import agricultural products, which do. Any other form of exchange will temporarily increase the level of disposable output, but it will not help long-term growth. Ricardo himself saw no conflict between the two principles, because he assumed that, in the process of growth, comparative advantage will tend to move away from agriculture to manufacturing in the more developed country, through the operation of diminishing returns. This itself followed from a number of other assumptions, the most important of which are that the man:land ratio will be less favourable to the richer country, that the demand for agricultural product will increase proportionately to population (i.e. in effect, proportionate to labour incomes, if 'corn' is the only wage good), and the absence of land-saving technical progress.

Ricardo argued that two countries can each benefit from export expansion, based on mutual trade even if one country is more efficient in the production of all goods. [3]From the

[3] He demonstrated this with numerical examples on the hours of labour it would take England and Portugal to produce one unit of wine and cloth. Ricardo's example was as follows;

Labour required to produce one unit of

	Cloth	Wine
in England	25 hours	30 hours
in Portugal	45 hours	40 hours

Although England can produce both cloth and wine using less labour than Portugal, England should specialise in the product for which its lead in productivity is largest, viz., cloth. This is advantageous for England as for each unit of cloth exported to Portugal; it gets more units of wine than the domestic market is willing to offer. Portugal will also gain from trade.

Assuming that the value of the commodity is based solely on the quantity of labour that is used to make it, and that prices are equal to these values, one unit of cloth in England has a price of 0.83 (that is 25/30) units of wine before trade. In Portugal one unit of cloth can be sold for 1.1 (that is 45/40) units of wine. As John Stuart Mill found these pre-trade prices for cloth are the limits between which the international price for cloth will have to be to make trade mutually profitable. The precise (or equilibrium) international price or terms of trade may be determined by using offer curves, see, David Ricardo, The Principle of Political Economy and Taxation (originally published in 1887, edition used published by Dent, London and Melbourne, 1911 repr. 1984, p.82).

discovery of the principle of comparative advantage Ricardo draws the following conclusion: In a perfectly free commerce system, each economy commonly assigns its capital and labour to such engagement as are most advantageous to each. This pursuit of individual benefit is admirably linked with the collective good of the entirety. By invigorating industry, by rewarding creativity, and by using most efficaciously the peculiar powers conferred by macrocosm, it allots labour most effectively and most economically; while, by augmenting the general mass of productions, it diffuses general benefit, and binds together by one mutual band of interest and exchange, the universal community of global nations. At this point it can be said that the main elements of Ricardo's position are that given free trade, the productive resources of the participating economies will be utilised as efficiently as possible and all the participating economies will gain from their exporting activities (Meier, 1989, p. 35). This result is depending on the classical assumptions of perfect competition (economic subjects do not possess market power), of the presence of a public sector that produces only pure public goods (law and order) and of the existence of non-prohibitive transport costs (Varian, 1990).

R.A. Ballance et al. (1982, P.16) argue that classical political economy thus identified as a set of supra-historical laws- the impact of the increasing division of labour, the distribution of the gains from export expansion, the operation of the law of diminishing returns in agriculture, the relation between the share of capital, labour and land, etc.,- which determined the rate of economic progress. The attitude of the classical political economist to industrial development and industrial organisation was profoundly influenced by their insight of these laws. They believed that economic policy should be revised to promote certain economic dispositions and counter others. They were not concerned with the endorsement of utopian solutions but pragmatically connected their theory to proposition that were politically sensible. The enunciation of the theory in the dominion of policy making in particular was based upon a perception of an identification with the interests of a particular group of policy makers such as industrialists, bankers and civil servants and that was accountable for the termination of the Corn Laws in Britain in 1847 (Meier, 1989, p.40).

Ricardian theory, in its original formulation, based on the labour theory of value. Labour is considered to be the only means of production; value and output being determined by the labour content required in the production of each good (Harsaae, 1993). Given domestic factor mobility, international immobility of factors, constant unit costs in manufacturing and diminishing returns in agriculture (given a fixed supply of land) it is easy to demonstrate the comparative advantage principle of international exchange . The country with a lower ratio of the 'wage fund' to the supply of land would have a comparative advantage to produce and export agricultural products, hence exports these in return for imports of manufactures under free trade conditions (Greenaway and Milner, 1987, p. 13).

The advance of the literature after Ricardo was focused at illustrating that some of these conditions were not imperative, and that others could be generalised without any substantial change to the conclusion of the theory. Haberler (1936), for instance, demonstrated that of 'opportunity cost' could replace the labour cost doctrine. For the present purpose, however, two issues should hardly be escaped. First, Ricardian trade theory isolates differences in technology or labour productivity as the bases of export expansion. This is very relevant to particular argument on the nature of trade between developed and developing economies. Second, Ricardo himself built an implicit dynamic model of growth and exports. Thus, the gains from specialisation according to comparative advantage are not merely those static welfare gains from exports but the gains in economic growth. The implicit dynamic model of Ricardo's growth and export analysis is mainly explained in connection to the distribution of income. According to Findlay (1984) when Ricardo was justifying the need for the termination of the Corn Law, his reasoning was focused on the gains in growth rather than on the consideration of the static gains from exports. The former underlies the effect of the termination of the Corn Law in boosting the rate of profit for thrifty capitalists (industrialists) and diminishing the rent of land for non-thrifty landlords. Thus, Findlay (1984) further argues that Ricardo's static (pure) trade theory is a precursor of the authentic (dynamic) argument. [4]

Heckscher, Ohlin and Samuelson provided further explanation for the existence of comparative advantage. In a 'classical' situation with two goods, two countries and two factors of production, freely available technical knowledge and absence of mobility of factors of production over national borders, they proved that the source of comparative advantage is

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4 For a dynamic Ricardian Model of Trade and growth , see Findlay, 1974 or 1984.

a country's relative endowment with factors of production. They postulated that a country will export a product which intensively uses the factor of production with which it is relatively abundantly endowed. Other writers proved that the Heckscher-Ohlin theorem remained valid after the introduction of more goods, more factors of production and more countries.

A further extension of a classical theory was given by Stolper and Samuelson who proved that the opening of trade will change the distribution of income in favour of the factor of production that is used intensively in the exports sector. The factor-price equalisation theorem completed the theoretical argument by proving that free trade based export expansion will equalise the rates of remuneration of the factors of production in the countries that participate in global free trade. These argument is vital for developing economies that strive for higher levels of welfare and for the productive and remunerative use of their abundant resources such as labour and natural resources. While the Ricardian model isolates differences in the techniques of production, which would account for variances in labour productivity between developed and developing economies, as the basis for specialisation according to comparative advantage and for trade, the Heckscher-Ohlin (H-O) model focuses instead on differences between these economies in their relative factor endowments and differences between products in the intensities with which they use these factors. Costs of production will differ therefore in general between economies (in autarky), even when each product is produced by the same technique in each country. On this reasoning, the capital-poor developing economies advised by the H-O theorem to specialise in labour- or land-intensive products and export these in return for the capital-intensive products of the high-income/ developed economies (Kindleberger, 1973, pp. 53-58).

It is of course possible to extend the dimensionality of the H-O model to construct a 'chain' of comparative advantage in terms of factor intensities. There are, however, difficulties in universalising 'chain' proportions (see Deardorf, 1979 and Either, 1984). In its basic formulation it is supply side differences therefore that generate trade. Within same framework, income, thus, variances in demand between developed and developing economies could generate trade where there is no supply variances. Linder (1961) argues, however, that it is 'similarity of tastes' and the resulting scope for exchanging the benefits of scale economies which stimulates export of manufactures products. According to this view income (demand) and taste variances between developed and developing countries should not be a major source of growth in their two way trade in manufacture (Greenaway and Milner, 1987, p. 14).

The H-O model, therefore, provides an alternative explanation for the resource and pattern of mutually beneficial trade, but one with explicit implications for international income distribution. In Stolper-Samuelson proposition exports benefits the 'abundant' factor; the postulation is that labour is the abundant factor in most developing countries. However, the Leontief Paradox suggests that there is the possibility for factor intensity reversal (Krugman and Obstfeld, 1991, pp. 80-82; Leontief, 1953). The Leontief empirical evidence, therefore, seems to indicate that a country can be a net exporter of those products produced based on its factor inputs with which it is relatively poorly endowed. Thus, capital scarce economies can be exporters of capital intensive products. More recently, an important study conducted by Bowen, Leamer and Sveikauskas (1987) hold essentially the H-O idea that export in goods is actually an indirect way of exporting factors of production. They maintain that a country is a net exporter of the factors of production with which it is relatively abundantly endowed. Thus, the theory would appear to provide a basis for optimism in developing countries about the neo-classical perspective. However, it must be remembered that domestic labour markets are often neither competitive nor efficient, and that trade restrictions benefit the 'scarce' factor (according to the Stolper-Samuelson postulation). Policy makers in developing countries may well not share the anticipation of many champions of free trade regimes, either.

Finally, the vent for surplus and specialisation according to established comparative advantage yields the direct benefits of exports by participating in international division of labour and exchange. However, there are in addition, the dynamic aspects of exports that are relevant for the growth-transmitting effects of exports above and beyond the static effect. Classical and neo-classical economists did not make the dynamic aspects of exports central to their thought; but to the extent that they did consider the effects of exports on economic growth, they saw no conflict between the static and the dynamic effects. Thus, now let us turn to the dynamic effects of export-led growth as follows.

2.3.2 The Dynamic Gains

The dynamic economic effect of export-led growth was elaborated by various writers acquainting augmented factor endowments, economies of scale, learning by doing, a fall in the incremental capital-output ratio, dynamic specialisation, the realisation of x-efficiency, the extension of informational efficiency, forward and backward linkage effects of the export sector, effects of increased competition, trade induced technological advancement by the importation of capital goods embodying technological improvements, utilisation of plant capacity, creation of employment through exports of labour intensive products, a multiplier effect that gives rise to increased demand for intermediate inputs and increased demand by consumers, and growth of total factor productivity (Thirlwall, 1992, p. 363; Meier, 1995, p.483). Marginal factor productivities in export oriented industries also tend to be significantly higher than in the non-export oriented industries. The difference seems to evolve, in part, from inter-sectoral beneficial externalities provided by the exports sector (Meier, 1995, p. 483). Thus, it has been argued that the faster exports output grows, the faster is the growth in productivity. This is due to the fact that economies of scale, higher investment embodying capital of a more productive vintage, and a more rapid pace of innovation in the products and processes (Meier, 1995, p.484).

Actually, among the classical economists, John Stuart Mill who stated that exports, according to comparative advantage results in a 'more efficient employment of the productive forces of the world,' and that this might be considered as the 'direct' i.e., static economic advantage of exports. However, there are, besides, the dynamic effect of exports what he called as 'indirect' or dynamic effects, which must be counted as benefits of a higher order. According to Mill the introduction of exports may increase the motivation to produce more: "The opening of foreign trade, by making them acquainted with new objectives, or tempting them by the easier acquisition of things which they had not previously thought attainable, sometimes works a sort of industrial revolution in a country whose resources where previously underdeveloped for want of energy and ambition in the people; including those who where satisfied with scanty comforts and little work, to work harder for the gratification of their new tastes, and even to save, and accumulate capital for the still more complete satisfaction of those tastes at a future time," (Mill, 1848). The change of tastes has appeared in more recent theories as the concept of 'demonstration effects.'

The specialisation and the expansion of production in the exports sector is a necessary condition for the realisation of economies of scale, the inducement of technological innovations, and the attainment of other dynamic effects. These dynamic effects may further build up the comparative advantages of the country; in addition, the other sectors of the economy may be drawn to a higher growth rate as a result of indirect effects.

Kenen has argued that the expansion of exports has been a mechanism by which developing economies have owed the growth of their trade, and indeed their very permanence, to the movement, not merely of goods but of capital, labour, and entrepreneurship from the developed ; and the developed countries have in turn owed their further growth primarily to this movement. He further argues that any theory of international trade that does not approach the topic in this way may have very severe limitations as a guide to policy, (Kenen, 1994: p. 278).

Thus, for these several reasons, the traditional conclusion has been that the gains from export expansion do not solely result in a once-over change in resource allocation, but continually integrate to the gains from growth. Export expansion transforms existing production functions and increases the productivity of the economy over time. If export expansion increases the capacity for economic growth, then the larger the volume of exports, the greater should be the possibilities for growth.

More recently, various versions of export-based models of growth have been formulated to present dynamic view of how an economy's growth can be determined by expansion in its exports. The three important models can be presented as follows:-(i) The staple theory of export-led growth (ii) Verdoorn's Law (iii) The created comparative advantage approach of new trade theory.

The Staple Theory of Export-led Growth:- One version of the export-based model is that of the 'staple' theory of trade and growth (Kindleberger, 1973, pp. 70-71; Craves, 1965, p. 103). The term 'staple' denotes a raw material or resource-intensive product taking up a dominant place in the economy's exports. It has a structural resemblance to the vent for surplus view in so far as 'surplus' resources initially exist and are subsequently exported. It also has some resemblance with Lewis's model for development with unlimited supply of labour (Lewis, 1954) when the surplus to be vented through exports is one of the labour rather than natural resources (Meier, 1989, p. 37).

The staple theory postulates that with the discovery of a primary product in which the country has a comparative advantage, or with an increase in the demand for its comparative advantage commodity, there is an expansion of a resource-based exports commodity; thus, in turn, stimulates higher rates of output. Earlier spare or idle resources are brought into use, generating a return to these idle resources and being harmonious with venting a surplus through exporting. The exports of a primary product also has effects on the rest of the economy through declining underemployment or unemployment, causing a higher rate of domestic saving and investment, stimulating an inflow of a resources into the expanding export sector, and establishing links with other sectors of the economy (Meier, 1989, p. 37). Although the rise in exports is induced by greater demand, there are supply responses within the economy that increase the productivity of the exporting economy. Moreover, once the profitable opportunities in a particular domestic resources such as tropical agriculture, natural resources or labour intensive industries become evident, foreign investment is likely to be invited to the economy. The emergence of new lines of exports production is also likely to open up many new profitable ventures for domestic investors that foreign capital will not completely meet, whether in exports sector itself or in related industries. These opportunities as argued by Gillis et al. (1983, pp. 414-415) represent an outward shift of the demand for domestic savings and should induce some supply response, stimulates further boosting investment in the economy (Findlay and Lundahl, 1994).

Therefore, the expansion of potential for exports for primary products can lead to expanded supplies of foreign investment, domestic savings, labour, skilled manpower, and technology to complement the fixed supply of factors of production. Thus, not only do exports help push an economy towards its production possibility frontier but exports can also move the frontier outward, enabling the economy to produce more of all goods than previously possible (Gillis et al., 1983, p. 415).

The staple theory has some relation also to Rostow's leading-sector analysis in so far as staple-export sector may be the leading sector, growing more rapidly and driving the rest of the economy along with its growth. In Rostow's analysis, however, a primary-producing sector can be a leading sector only if it also encompasses processing of the primary product (Meier, 1995).

The critics of the staple theory provides insights into the diagnosis and treatment of the so-called 'Dutch disease' or 'Kuwait disease'. In this regard, the sudden increases in primary exports earnings may bring excess foreign exchange supply relative to its demand that exchange rate will steadily be appreciated. In such economies everything tends to be imported because the heavily appreciated exchange rate makes imports appear unusually cheap. This phenomenon was observed in 1970s and 1980s in economies such as Kuwait, Indonesia and Nigeria (Gillis et al. 1983, pp. 528-533). Nevertheless, this has been materialised for an enclave and undiversified export sector such as oil, partly because of the presence of easily taxed rents in oil and partly because of the weak linkages of most natural resource sectors with the rest of their economies (Gillis, et al. 1983, p. 533). The expansion of dynamic export oriented manufacturing sectors of Taiwan, Japan and Singapore have not produced the respective 'Taiwan disease', 'Japanese disease' and 'Singapore disease'.

Verdoorn's Law:- By virtue of its exposure to world competitive forces, the export sector is characterised by the highest sectoral rate of technical progress, then its relative expansion will foster the economic growth rate. Thus, this constitutes a general link between export expansion, factor productivity and output growth. Accordingly, there is an implicit proposition that technical progress derives from exporting, rather than being a prerequisite for doing so. Given an initial disadvantage (advantage) in exports, its slow (fast) expansion will ensue, fuelled by the resulting sluggish (high) investment. Former versions of this theoretical argument were criticised since any initial advantage could be dwindled as growth is taking place and as labour supplies are debilitated and real wages climbing push up costs (Cornwall, 1977, chs. 9-10).

To meet this criticism, some theorists summoned Verdoorn's Law so that the dynamic economies of scale realised through rapid demand growth maintained the relative advantage of high performing economy, while the sluggish growth of poor performing economies led to low investment and thus low realisation of dynamic economies of scale. The Verdoorn's effect is related to the idea that the possibility that export growth may set up a virtuous circle of growth, such that once an economy is initiated the path, it sustains its competitive position in world export trade and performs continuously better relative to other economies (Thirlwall, 1992, p.365). Exports are visualised as the leading sector, which leads to a faster growth and in turn to a faster expansion of productivity. Considering the demand factor, variant of this argument takes as its incipient point the assumption that the output of an export-based economy is constrained by demand, thus, it is the long run growth of an autonomous demand that governs the long-run rate of growth of economy. The main constituent of an autonomous demand in an export-based economy, in turn, is demand flowing from the outside world, i.e. the demand for an economy's exports (Dixon and Thirlwall, 1978; Thirlwall, 1992, pp. 136-137). This can be formulated as:-

$g_t = v(x_t)$ (2.3.1)

Where g_t is output growth rate and x_t is exports growth rate in time t, v is the elasticity of output with respect to export growth. In this equation the rate of growth of the economy as a whole will be driven by the rate of growth of exogenous demand. The viability of the domestic enterprises are largely depending on the potency of demand from the outside world. Export demand is considered as a more potent growth-inducing force than other element of demand in export-led developing economy. This is because: (a) exports may generate dynamic as well as static gains,(b) exports promote imports, and imports may be vital in developing economies which lack the capacity to produce development goods themselves,(d) if the exchange of information and technical knowledge is linked to trade, exporting facilitates the flow of technical knowledge which can improve the economy's supply capacity. In this conventional model, it has been considered that exports (X) are determined by home prices (Ph_t), foreign price (Pf_t) and foreign income (Yf_t) at a time t. Therefore:

$X_t = P^n h_t P^b f_t Y^r f_t$, (2.3.2)

Where n is the price elasticity of demand for exports (< 0), b is the cross elasticity of demand for exports (> 0) and r is the income elasticity of demand for exports (> 0). Taking the proportional growth rates of the variables in equation (2.3.2), where lower case letters stand for the growth rates:

$x_t = n(ph_t) + b(pf_t) + r(yf_t)$ (2.3.3)

yf_t and pf_t may be taken as exogenous to the economy. However, ph_t is endogenous. Assume that prices are established on the basis of a constant 'mark-up' on a unit labour costs, one can have:

$Ph_t = (W/L)_t (Z_t)$ (2.3.4)

Where Z_t is 1+ percentage mark on costs, L is the average productivity of labour, and W is money wage. From equation (2.3.4) one can write the discrete rates of change:

$ph_t = w_t - l_t + z_t$ (2.3.5)

Assuming that the growth of labour productivity as a function of the output growth (Verdoorn's Law), there can be equation (2.3.6):

$l_t = la_t + u(g_t)$ (2.3.6)

Where la_t is the rate of autonomous productivity growth at time t, u captures the Verdoorn coefficient (> 0)

Therefore, equation (2.3.6) generates the link between exports and growth via productivity growth and prices. A rapid export expansion leads to a rapid growth of output and a rapid growth rate of output also generates a quick export expansion as products sold at a very competitive prices due to growth of productivity. Combining terms from (2.3.1), (2.3.3) and 2.3.5) one can have: -

$g_t = v[n(w_t - la_t + z_t) + b(pf_t) + r(yf_t)]/1+ vnu$ (2.3.7)

Assuming that relative prices in international trade remain unchanged, equation (2.3.7) would be reduced to:-

$g_t = vr(yf_t)$ (2.3.8)

With equilibrium in balance of trade (imports equal to exports):-

$g_tq = r(yf_t)$ (2.3.9)

Where q is the income elasticity of demand for imports. Thus, with relative prices are remain constant, the elasticity of output growth with respect to that of exports (v) must be the reciprocal of the income elasticity of demand for imports (q). Therefore, it ends up with:

$g_t/yf_t = r/q$ (2.3.10)

Thus, equation (2.3.10) postulates that the relative growth rates are constrained by the ratio of income elasticities of demand and a country's exports and imports.

The cumulative causation approach of Kaldor's (1981) model is a variant of Verdoorn's Effect. Kaldor's version is explicitly demand-induced, unlike the Verdoorn's original formulation (Verdoorn, 1980). Investment, induced in a Keynesian manner by demand, is the key to factor growth by allowing pervasive scale economies to be realised and embodying new technology. The relative openness of economies means that domestic demand cannot simply induce such effects; the global market offers greater potential for these effects amongst rapid growing economies, but by the same token this will be at the expense of the domestic market shares poorer performing economies. In this variant there is no special role for international competition in stimulating technical progress, only in the size of the world market in increasing the potential for realising scale economies. Moreover, this implicitly assumes that there are close links between product and process innovation. If Verdoorn's Effect only bred process innovation then although the relatively low prices could continue to ensure demand growth this could lead to declining terms of trade and does not accord with Kaldor's emphasis on income elasticities of demand. Rather, the emphasis is on product innovation affecting income elasticities of demand through non-price factors. However, this implies some link with process innovation so that relative productivity growth rates are kept in line. The spirit of the theory implies that investment in new technology embodies both product and process innovation (see Weiss, 1984; Panchamukhi et al., 1989; Gomulka, 1971; Thirlwall, 1987, pp. 196-199).

Corden (1971) who emphasises growth in factor supplies and productivity also has considered a dynamic analysis of the effects of export expansion on growth. Accordingly, after a country is opened to world trade , five effects may be observed. First is the 'impact effect,' corresponding to the static gain from exports: current real income is raised. Then there may be the 'capital accumulation effect': an increase in capital accumulation results when parts of the static gain are invested. This amounts to a transfer of real income from the present to the future instead of an increase in present consumption. Third may be 'substitution effect,' which may result from a possible fall in relative price of investment goods to consumption goods if investment goods are import intensive. This would lead to an increase in the ratio of investment to consumption and an increase in the rate of economic growth. The fourth possibility is an 'an income- distribution effect': there will be a shift in income toward the factors that are used intensively in the production of exports. If the savings propensities differ between sectors or factors , this will have an effect on the overall savings propensity and hence on capital accumulation. Finally, there is the 'factor weight effect,' which considers the relative productivity of capital and labour and endorses that if the rate of growth of output is a weighted average of capital and labour growth rates (with a constant returns to scale aggregate production function), then if exports rise, exports use the faster growing factor of production, thus, the rate of growth of export will rise more rapidly. All these effects are cumulative and enhance the increase in real income over time as a result of opening a country to foreign trade.

New Trade Theory:- Many of the new trade models have provided an alternative basis to export-led growth than initial differences in the factor endowments or labour productivity. Again it can be mutually beneficial trade. There are the usual possible gains from exchange and specialisation, but these may incorporate additional gains associated with the widening of choice via increased variety or with the reaping of dynamic benefits from scale economies granted by enlarged markets. Of course, the character and the dilation of these gains depends crucially on the structural characteristics of the particular model applied. Although increased variety and consumer choice may not be an important consideration in many developing countries and some economists have even propounded that it may be socially undesirable (James and Stewart, 1981).

Since the late 1970s, a group of international economics theorists has developed a new approach to international trade and patterns of specialisation . The 'new' theory has contested the conventional understanding (Krugman, 1986 and 1994). While the latter is based on the models of behaviour in perfectly competitive markets, the former works on formal modelling of increasing returns in the trade that are drawn from the industrial organisation concepts in imperfectly competitive market assumption (see, Varian, 1990). Their arguments can be outlined as follows:

(1) Trading originates because of increasing returns, in a world of initially identical countries. It shows that the export drive need not be as a consequence of international differences in technology or factor endowments. Instead, exporting may simply a way of extending the market and allowing exploitation of scale economies, with the effects of exports being similar to the role of labour force growth and regional agglomeration.

(2) The new trade theory is identified by rigorous treatment of the process of product differentiation in the context of 'Chamberlinian approach,' which was ignored in conventional theory.[5] Dixit and Stiglitz (1977) and Spence (1976) formulate this work, and impose the assumption that each consumer has a taste for many different varieties of a product. Product differentiation is then simply takes the form of producing a variety yet being produced. The alternative approach, developed by Lancaster (1979), posited a primary demand not for varieties per se but for attributes of varieties, with consumers differing in their preferred mix

[5] The basic Chamberlinian idea is that one can think of at least some industries as being characterised by a process of entry in which new firms are able to differentiate their products from existing firms. Each firm will then retain some monopoly power-sloping demand curve. Given economies of scale however, this is not inconsistent with a situation in which derives economic profits to zero. Thus, Chamberlinian's vision was of an industry consisting of many little monopolists who have crowded the field sufficiently to eliminate any monopoly profits.

of attributes. Product differentiation in this case takes the form of creating varieties that were unavailable. The notable 'Chamberlinian' trade models that are in essence very similar can be found in Dixit and Norman (1980), Either (1982), Helpman (1981), Krugman (1994), Lancaster (1980) and Helpman and Krugman (1985).

(3) In the world characterised both by increasing returns and transportation costs, there is an ostensible incentive to focus on production of a good near its largest market, even if there is some demand for the good elsewhere. The justification is that by concentrating production in one place one effectuates the scale economies, while by locating near the large market, one minimises transport costs. This point, which is more persistently emphasised in economic geography (location theory) than in trade theory, is the basis for a common argument that countries will tend to export the kinds of product for which they have relatively large domestic demand. This argument is entirely dependent on increasing returns; in a world of diminishing returns, strong domestic demand for a good will tend to make it an import rather than an export. Nevertheless, the issue does not come through in models where increasing returns take the form of external economies of scale. Assuming that there are two economies and industries, with many differentiated products within each industry. When two economies of this kind trade, each will be a net exporters of goods in the industry for whose products it has relatively large demand (Krugman, 1994). It shows that if the two countries have sufficiently dissimilar tastes, each will specialise in the industry for which it has the larger home market. Thus, each economy will be a net exporter of the class of goods in which it specialises. Krugman has provided the elucidating conclusions on the conditions under which specialisation will not be complete. The possibility of incomplete specialisation is larger, the larger are the transport costs and the less significant are economies of scale (Krugman, 1994; Linder, 1970; Grubel, 1970).

(4) Economies with similar factor endowment will conduct two-way trade in similar products because of scale economies and intra-industry specialisation and trade. Such export expansion may take place without exuberant reallocation of resources or income distribution effects (Balassa, 1967; Grubel, 1970 and Kravis, 1970).

Technology and Exports:- The 'technology gap' (Posner, 1961; Vernon, 1966) and 'product Cycle' (Vernon, 1966; Hirsch, 1974 and 1975) models of trade are other variants of new trade theory. Such models might be viewed as a reaction to neo-classical orthodoxy, where the patterns of dynamic comparative advantage between developed and developing economies change as factor (including technological) endowments change with the international transmission of technology. However, contrast with neo-classical theory in terms of their view of the world. Knowledge is no longer a free good which is instantaneously transmitted between countries. Scale, ignorance and uncertainty play a role in determining trade patterns. This type of approach also presumes the existence of asymmetries between developed and developing economies in the structure of technology and likely gains from trade[6]. These models focus, thus, on the endogenous factors, which encourage continuous product or process innovation in the developed countries, and a resulting technological lead of these countries over developing economies. Trade patterns determined in manufactures in particular, by the vintages of products. The developed North has an advantage in producing and exporting new products, while the developing south has a comparative advantage in producing standardised or mature products and exporting them to the North (Krugman, 1979). In this sense, a country can have a dynamic (created) comparative advantage in an industry in which their firms gain a lead in technology, thereby allowing the innovation of new products or product improvement. Innovations based on a new technology initially gives a country a temporary monopoly position and easy access to world markets. For a period of time, the innovation industry may enjoy an export monopoly as long as there is an 'imitation lag' in other countries. However, eventually the technological gap is narrowed, the imitation lag is overcome, and other countries may then acquire a comparative advantage in the product (Meier, 1995, p.456). The product cycle explains how comparative advantage of a new product is first acquired in the developed economy and then transmitted to developing economies through trade and investment. The catching-up process in developing economies describes the series from imports to import substitution and eventual exportation of the standardised product as domestic costs come to a critical minimum of international competitive cost. As one country gains new comparative advantages in products with different input requirements, other countries on in the line move into a competitive position: for instance the Asian NICs (Newly industrialising countries) such as Taiwan, Singapore and South Korea become more competitive with Japan in the more labour-intensive products, while Japan moves on to the more skill and knowledge

6 For a survey of dynamic models of technological transfer, see Pugel (1981).

intensive products. In this regard, comparative advantage shifts as a country's factor endowment changes. Over time, a country that is initially labour endowed and capital scarce may become relatively labour scarce and capital rich as it accumulates more and more capital in the export process. Thus, it starts to export capital intensive goods. Then, over time, as it develops, a country tend to make upward movement pass on a lower ladder of Ricardo and H-O type natural comparative advantage to a Porter (1990) and Krugman (1979) type upper ladder created comparative advantage. Thus, a country tends to shift from initially exporting type of products that are resource intensive (coffee or rubber) to commodities that are unskilled labour intensive (textiles) to semiskilled and skilled labour intensive (electronics) to capital intensive (machines), and finally to knowledge intensive (computers, robotic equipment, modern digital data communications, highly educated personnel, and R & D activities) (Meier, 1995, p.458).

Ultimately, the elaboration of new trade theory, such as that proposed by Grossman and Helpman (1991), have emphasised the role of integration in the world economy in invigorating growth through a process of market scale whereby export expansion and the simultaneous removal of trade barriers allows developing economies to gain access to the large markets of relatively developed economies, do away with redundancy (developing economies do not have to reinvent processes that have already been tested and applied elsewhere) and inducing the transfer of technology, thereby permitting developing economies to share immediately in innovations made elsewhere. Similar to the orthodox theory, the new trade theory has advocated the possibility that export expansion may lead to the process of convergence. The initially weaker economies benefit from appropriate economic policies designed to spur development, and if the economies of the developing regions grow at rates of faster rates than those in the developed economies. Thus, export expansion enhances the increasing similarity in economic policies and, even more, to the economic performance of advanced and developing economies.

Other writers have, however, emphasised the difficulty of achieving this results in increasingly integrated world economies. Thus, they have formulated a divergence hypothesis to analyse the economic prospects of developing economies. Besides, they have identified export expansion in developing economies with the existence of increased disparities. Disparities increase as the logic of processes of export expansion serve to favour developed vis-à-vis developing economies. The rich get richer and the poor get poorer. Divergence continues due to the fact that the economies undergoing decline are not endowed with appropriate policies, conditions and performance levels necessary to reduce the gap and potential for growth that separates them from developed economies. These theories have shown very pessimistic approach to the export-based growth. Therefore, the next section discusses these divergence theories in the next two sub topics.

2.4. The Pessimistic Views of Export-Led Growth

The orthodox and new trade theory models have consistently emphasised the positive growth effects of export-led growth. However, critics argue that these beneficial mechanisms have not operated for the majority of developing economies. Export-led growth has not created dynamic linkages within the economy, in part because, first, foreign ownership of export activities, such as in mining or plantation agriculture, has resulted in a transfer of profits out of product being exported. Learning, technological innovation and linkages have been considered more likely in manufacture or mining (Haggard, 1990).

Second, an export-led growth has exposed developing economies to adverse international shocks and has increased their dependence on the international system. Declining terms of trade for tropical products have been held to perpetuate or even increase international economic inequality. In the short run, price volatility, which has been particularly damaging in economies specialised in one or a narrow range of exports products. Moreover, it has been claimed that dependence on exports created political vulnerabilities because more powerful developed economies could manipulate trade relations as a means of exercising political influence (Agnew and Corbridge, 1995, pp. 211-227), but the consequence has been thwarting the derive to self-reliant growth of developing economies (Larrain, 1989; Haggard, 1990; Thirwall, 1992, pp. 139-142).

Given this background, this chapter discusses the pessimistic argument against export-led growth from structuralist's and radical's hypothesises point of view below.

2.4.1 The Structuralist View

The initial set of structuralist hypotheses was formulated in the 1950s and 1960s by, among others, Myrdal (1957), Prebisch (1950, 1959), Singer (1950, 1974) and Nurkse (1962) as a challenge to the liberal trading and payment systems[7]. It must be seen at the outset in particular as a reaction to the neo-classical paradigm, the belief in the flexible

[7] For a review of the origins of structuralism (see Arndt, 1985)

market mechanisms, and a rejection of the 'engine of growth' view of export-led growth hypothesis.

Structuralist maintained that the historical role that international trade had played in the 19th century as an 'engine of growth' for the new countries of white settlement (the USA, Canada, Argentina, and Australia) was no longer available to the developing economies. Basing their case entirely on demand factors, they argued that this was because the demand for tropical products in developed countries could not be expected to grow sufficiently to enable developing economy primary producers to raise their national incomes through this source of at a satisfactory rate. They did not object to the developing economy seizing the trading opportunities available, but they were pessimistic about their future availability. The demand for the tropical products in developed countries did not, so they maintained, rise in line with the growth in their incomes because the 'income elasticity' of demand for these goods was low. There was also the danger that synthetic substitutes would be developed for many tropical products (Nurkse, 1962).

In 1957 Myrdal developed the cumulative causation theory, which is based on a criticism of the comparative advantage model of international trade (Myrdal, 1957; Vanhove and Klaassen, 1980). Myrdal argues that market forces do not bring about an equal distribution of production factors and income. The movement of capital, labour and services are the means through which developed economies are rewarded for their 'virtue' and developing economies are robbed of their future potential for making progress. Therefore, the success of developed economies is paid for by a reduction in the developmental potential of developing economies. As a result, a vicious cycle of underdevelopment is created that rips through peripheral economies, producing a backwash effect that pushes capital, skilled labour, entrepreneurship, technology and so on toward developed economies, reversing the impact of spread effects that encourage production factors to move in the opposite direction, that is, from the developed economies to developing regions.

Myrdal also recognises that economic growth in core areas has some positive effects for developing economies. These are labelled as 'the spread effects of development'. The initial spread effect, emphasising the role of developing areas as exporters of raw materials and agricultural products to developed economies. The second spread effect mentioned by Myrdal is the spill-over of technology into developing areas out from developed areas.

Prebisch and Singer argued that the exporting bias expresses itself through a secular decline in the terms of trade of primary commodity producers (crudely identified as developing economies) vis-à-vis those of manufactured good producers, resulting in a long-term transfer of income from developing to developed countries.

The effect of trade on the capacity to grow will depend, inter alia, on how much a country gains from trade. In any form of exchange, of which foreign trade is a particular case, the distribution of gains between participants depends on the price or the terms of trade between the two products. In the context of trade theory, the question arises whether there are reasons to believe that the terms of trade would be systematically biased against countries with relatively low levels of incomes. Some at least of the benefits of specialisation that might accrue to these counties from participating in international trade would then be offset through adverse movements in the terms of trade. If so, we have to ask whether this is related to the product pattern of exports or to some other characteristics of these economies. The matter has been very widely debated and the point in dispute is whether, given that the poor countries tend to specialise more in the exports of primary products, the terms of trade tend to be systematically biased against these countries' exports (Lal, 1983, p.21 and Spraos, 1980).

The concept that is generally used as the basis for debate is the ratio of the price of exports to the price of imports, or the net barter terms of trade, P (Kindleberger, 1973, pp. 74). Given that the study is discussing about a hypothetical situation where a given developing country specialises in primary products, P can be defined as the ratio of primary products prices (Pa) to manufactured goods prices (Pm) which is given by Pa/Pm (Kasliwal, 1995, p. 232). Spraos holds that the strongest argument on the demand side that supports the case for a worsening of the terms of trade relates to relative income elasticities of demand. In this regard, it is generally accepted that the demand for primary products tends to be inelastic because primary products are thought to be mainly necessities. Thus, the relevant income elasticity of demand is <1 that the demand for such products suffers from low growth as world income rises (Kasliwal, 1995, p. 1995). In a two product world, this implies that the income elasticity demand for other goods, i.e. manufactures, is >1 (Spraos, 1980). As far as industrial raw materials are concerned, the argument is not so much that the input coefficients are of an especial merit, but that they incline to fall over time, due to technical shift. The sway of demand would indeed be on the side of a worsening of the terms of trade.

However, if trade enables the productivity of the export sector to rise, and this leads to a fall in the export price, it does not necessarily follow that the exporting country is made worse off, assuming such productivity gains accrue autonomously (Chaudhuri, 1989, pp. 140-41). It may still obtain a larger amount of imports for a given amount of domestic resources. In the case of limited substitutability, where an export boom induced by a fall in export prices leads to fuller employment.

A weighted ratio called the employment corrected double factorial terms of trade (DFTT), DFTT= P(Πci/Πmii) (Kindleberger, 1973, pp. 75-77) where Πci is average productivity in primary products in developing country, and Πmii is average productivity in manufacturing in the developed country (Spraos, 1980) can be substituted for the net barter terms of trade to take some account of employment effects.

As an analogy to Prebisch's analysis which is based on data for period 1870 to 1930, Grilli and Yang (1988) has re-evaluated the empirical works by constructing a new series of primary goods prices from 1900 to 1986. Similar research by Bleaney and Greenaway (1993) has extended the data series to 1991. In this regard, from the depths of depression in 1930s to the commodity price boom of the 1970 the trend in primary goods prices was upward, however, the Prebisch's data for the period 1870 to 1930 indicated a downward trend. Nevertheless, to claim that a price ratio has worsened suggests a point of reference by comparison to which the change can be measured. There has been much, rather unavailing, debate about the choice of an appropriate period. Of course, rigorously elucidated it entails absurdity to argue that a relative price ratio cannot decline forever. In fact, a relative price ratio can decline overtime at least at a slowing rate. It is a matter of common sense rather of a creed to establish a time period which is long enough to have pertinence to growth, over which the relative trend rates of growth in the price levels of traded goods, can be measured.

Another statistical problem is that the trend can go up or down in unpredictable way because of structural breaks (random jumps) (Kasliwal, 1995). This, however, leads to another problem, which is one of aggregation. A trend in primary products must be distinguished from a trend in developing economies' terms of trade. After all, both developed and developing economies export primary products and manufactured goods. Besides, the world price of a particular product will rely evidently on supply and demand for it in the world markets. Given that most primary products are assumed to be sold in rich countries and primary products exports are generally speaking price-takers, one can assume that, for any given period, the demand conditions would be rather similar, being determined chiefly by growth of incomes and the income elasticity of demand for the particular product. However, it is extremely equivocal that the same can be said for supply factors, which would vary colossally from products to products for a given period, according to investment, productivity growth (or decline), or to seasonal factors. There are unlikely to be periods of which are exclusively good or bad for all primary products, as far as prices are concerned. So the debate is best conducted at a somewhat disaggregated level, by seeking to investigate the factors that are relevant for the determination of the terms of trade, and the likelihood of their obtaining in particular developing economy (Chaudhuri, 1989).

An explanation of the likely causes of lower productivity growth in primary production leads to the conclusion that the behaviour of the terms of trade is only part of the story. There are other forces which might tend to operate against the trading partner with a lower level of income. In most developing economies, cash crops and food crops tend to compete for available resources, mainly for land but also for capital, if there is excess supply of labour at the typical real wage in a 'labour surplus' economy. Initially, a low level of productivity in the production of the food crop tends to go hand in hand with a low productivity in the export sector (Chaudhuri, 1989, pp.142-143). This is in turn leads to lower incomes overall in the economy and with low rates of accumulation and technical progress. The capacity of the economy to raise its productivity is thereby restrained. The strain of population on land resources, on the other hand, leads increasingly to diminishing returns in the whole of the primary producing sector. The real resource cost of acquiring imports consequently keeps on scenting.

Moreover, the restrained growth of demand for the primary product in the international markets constrains the expansion of output of the exportable products and in turn bounds the prospects of expansion of employment in non-food production. If the gains from trade are indeed asymmetrically allotted, the greater causes are to be found in the low levels and the indolent growth rates of productivity in these countries rather than in any steady falling in relative price ratios (Spraos, 1980; Lewis, 1969).

However, structuralists argue that technological progress, which raises the productivity of primary producers' export industries, generates no benefit (where domestic consumption is insignificant) since the purchasing power in terms of importable declines. On the demand side the lower income elasticity of demand for primary products than for manufactured goods (due to Engle's Law), is seen as imposing lower growth on developing than developed economies, or an inherent tendency on the part of developing economies to payments deficits, currency depreciation and terms of trade deterioration. Labour in developing economies, also because of the additional pressure of population growth, is not able to take out productivity gains in the form of higher wages, in the face of the falling relative price of the exportable. The 'Prebisch-Singer' thesis lends itself to the policy recommendation, that the protection of developing economy's manufacturing industry will raise wages in all sectors and prevent over-expansion of the primary export sector.

Critics says that the secular decline is not well established empirically, (see Sapsford, 1985; Spraos, 1980). The arguments, however, that there is consistent asymmetry between developed and developing countries about how the productivity gains from technical change are diffused, are unconvincing on the theoretical ground. The possible equilibrating forces that might arrest secular decline in the terms of trade are neglected. (For a detailed analysis and critique of the Prebisch-Singer thesis, and of the related Lewis model (Lewis, 1954; Lewis, 1969; see Findlay, 1981).

Besides, Structuralists contend the export-led growth proposition arguing that the development of the export sector by foreign capital has created a 'dual economy,' in which production has been export-biased, and the resultant pattern of resource utilisation has deterred growth (Meier, 1995, p.465). However, it is difficult to substantiate the argument that foreign investment is competitive with home investment, or that the utilisation of resources in the export sector is at the expense of home production.

Another contention is that export-led growth has impeded economic growth by the 'demonstration effect'. It has been argued that the international demonstration of higher consumption standards in developed economies has allegedly raised the propensity to consume in developing economies and reduced attainable savings. By stimulating the desire to consume, however, the international demonstration effect may also have worked on incentives and been instrumental in increasing the supply of productive services (Myint, 1964). Therefore, the positive effect on the supply of factor of production may outstrip any negative effect on saving (Meier, 1995, p. 466).

Another dimension to the structuralist argument is that their concept of development, characterised as it is by rigidities that limit economic adjustments, and seeks to emphasise the key constraints on growth in a developing country. Attempts to formalise this concept in the light of the experience of many developing economies into the 1960s- an experience of limited capital accumulation apparently constrained by limited domestic savings capabilities and foreign exchange constraints - started with 'two-gap' models (Chenery and Bruno, 1962; Chenery and Strout, 1966; MacKinnon, 1964). These models attracted considerable academic interest and practical appeal during the 1960s and early 1970s, underpinning as they did the widely recommended and implemented import substitution policies in developed economies at that time.

In the two-gap theories, the structuralist pessimism was carried out to its logical extreme by assuming the export proceedings of developing economies could not be increased. Moreover, it was assumed that domestic production required imported inputs, in the form of capital and intermediate goods, in set proportions. Production could not , thus, be increased above that determined by the quantity of imports which the fixed export earnings could finance. Even if a country were willing to save and invest a large proportion of its income to finance growth, it would not be able to transform the savings into higher income and output since the inexorable limit set by the 'fixed' export earnings. the incremental savings could not be transformed into the foreign exchange to finance the import requirements of additional investment. The country was now stranded in a foreign exchange bottleneck. In this context, the theoretical formalisation of the two-gap approach (see Findlay, 1971; Findlay, 1973), requires the application of Harrod-Domar- type assumptions to an open economy in which growth is constrained by the domestic savings rate. If there is a technologically fixed ratio of imports to output, or of imports to investment, then an economy cannot substitute domestic resources for imports as output expands (Thirwall, 1992, pp. 375-376).

Alternatively if an economy encounters a fixed growth rate for its exports, then the economy can encounter a foreign exchange constraint even though domestic savings has exonerated resources for exports. If the savings deficiency is greater than the foreign exchange deficiency (ex-ante), investment conforms towards savings at a lower level of output (ex-post) that is, output is investment-constrained. Alternatively if the relative sizes of the ex-ante shortages are reversed, output is trade-constrained as the ex-post adjustments to savings and imports take place. This analysis and the resulting policy framework adheres crucially, therefore, to the developing country's incapability to translate increased savings into the foreign exchange necessary to sustain the required level of investment, and upon its inability to implement measures which bring about import saving or export promotion (for a given level of protection and foreign assistance). The disregard of relative prices insinuated by these structural assumptions of low elasticities of substitution in production and consumption, plus the assumption of exogenously given growth rates for exports and some tendency to confusion of ex-ante/ex-post relationships, invigorated considerable criticism of structuralist models, even as they were supplying the intellectual acumen for import substitution strategies during the 1960s (Greenaway et al., 1987).

Of course, the structuralist argument were not without merit, and sought to explain why some countries had not gained from export-led growth to the expected degree. Moreover, they had a profound political and ideological sway in the developing economies, providing the justification for the pursuit of import-substitution industrialisation through the protected trade policies. These arguments also provide the rationale for political efforts in the 1970s to institutionalise a New International Economic Order (NIEO) that would offset the disadvantage of export dependence through trade preferences and international commodity agreements. However, as the general propositions, the critical arguments did not hold up well. The applicability of primary products-based growth was considered as limited, but it did demonstrate that agricultural exports contributed to growth in some circumstances. The commodity boom and oil price increases of the early 1970s showed that international price trends would favour producers of primary products as well as disfavour them. As the developing countries learned to exploit their bargaining power, they were often able to rewrite contracts to their advantage. The establishment of linkages through the processing of tropical products was also not ruled out. Nor were countries as exposed to short run price fluctuations as had been thought. The critical issue was how to design international and national devices, such as compensatory schemes or domestic savings programs, for smoothing the financial impact of price fluctuations (see Meier, 1995, pp. 501-506).

The export performance of some developing economies emasculated the invocation of the structuralist inauspicious prognostication about export-led growth. An unpretentious and persuading development is that many countries, and especially the more successful exporters, have managed to diversify their exports over time. As it is documented in the World Bank's 1994 World Development Report, many developing economies have got on not only in diversifying their exports of primary products but also in penetrating the huge world market for manufactures. The most spectacular examples are South Korea, Taiwan, Singapore and Hong Kong where manufactures now form close to 90 per cent of all exports. These four Asian economies now supply more than half of developing economies exports of manufactures. But, quite a few other economies have succeeded in raising manufactures from a few per cent of exports. The list includes Mexico, Brazil, Pakistan, Philippines, Malaysia, Thailand and Indonesia.

However, if the old export pessimism focused on dim prospects for primary product exports and led to an import substitution strategy, the new export pessimism is sceptical about the potential of exports of manufactures from currently lower income developing economies. The new export pessimism rests on the belief that countries that have been able to follow export-led industrialisation have done so because of favourable initial conditions that cannot be replicated elsewhere, and on the asserts that future demand will not support exports from additional developing economies, which is known as 'fallacy of composition' (Clive, 1982; Riedel, 1984 and 1988; Lewis 1980).

According to Bhagwati (1988) the fallacy of composition is based on the assumption that markets cannot be able to absorb all the exports that will materialise if developing economies make a shift to an export-led growth strategy. Besides, it also assumes that while the markets can be available, high-level market penetration in developed economies can be blocked by the protectionist actions, aggravated by import penetration and clamours of market invasion.

Thus, the fallacy of composition is based on the proposition that if all economies shift to the export-led growth strategy, none will perform well (Martin, 1992). However, the argument against the fallacy of composition posits that export-led growth will not confine developing economies to specialisation in primary products, instead, it will lead them to the development of newer and more advanced industries. Riedel (1987, pp. 46-47) has also argued that for both manufactures and many primary products, developing economies have either small or very small allotments of global markets. They can enlarge their exports by increasing their market shares via price competition. Accordingly, market growth is not a restraining factor to exports from developing economies. The increase in manufacturing exports also increases the demand for primary products within developing economies, particularly for industrial processing with its further linkage and dynamic effects in the entire economy. Successful increases in exports of developing economies will increase their income level, which, in turn, increases the demand for imports from developed economies.

Balassa (1983) argues that it is unreasonable to expect all countries would make manufacturing exports at the identical time and at the identical rate and with the identical set of products. It is the very typical of the export of manufactures that the manufactured goods become even further increased in variety. Diversification is also possible within primary products. The increase in the export share of manufactures reflects an export diversification and a decline in the share of primary products in total exports. Moreover, there is a large potential for breaking through developed economies markets and trade among developing economies (Love, 1994). There appears to be wide scope for horizontal specialisation or intra-industry ladder of comparative advantage from specialisation in resource intensive exports, to unskilled labour intensive exports, to skilled labour intensive exports, to knowledge intensive exports. Thus, as a particular economy moves up the ladder, another country on line is able to follow it up another rung on the ladder. Therefore, as Japan has risen on the ladder, the East Asian NICs have become major exporters of Japan's former exports. Now as Asian NICs proceed through the various stages of comparative advantage, there is room for other nations to take over the markets vacated by the earlier exporting countries. However, the diametrically opposite argument to the export-led growth argument is the radical interpretation of the structuralist 'core' and 'periphery' relations. This can be discussed in the next sub section.

2.4.2 Radical Perspectives: Models of Exports induced Polarisation

The structuralist analysis of biased or asymmetrical interdependence seeks to provide a piecemeal critique of the optimistic views of export-led growth and a rationale for institutional reforms and policy interventions to influence trade relationships between developed and developing countries. Radical analysts in Marxist tradition concerned with 'dependency', 'exploitation' and 'unequal exchange' which attempts to explain the perpetuation and widening of differences between core (developed) and peripheral (underdeveloped) countries in a global capitalist system (Auty, 1995; Kasliwal, 1995, pp. 14-20). Writers in this tradition include Dos Santos (1970), Baran (1957), Frank (1967), Amin ((1977), Emmanuel (1972) and Wallerstein (1974), among others.

Dos Santos (1970) defines dependency as: '... A situation in which the economy of certain countries is conditioned by the development and expansion of another economy to which the former is subjected.' The relation is such that 'some countries (the dominant ones) can do this only as a reflection of expansion, which can have either a positive or a negative effect on their intermediate development.' Thus, inequality is seen as an integral part of the world capitalist system. Inequality is inevitable because the development of some parts of the system occurs at the expense of others. Monopoly powers in trade exercised by developed economies (centre) leads to the transfer of the economic surplus from the dependent countries to the centre, and financial relations which are based on loans and export of capital by the centre ultimately lead to reverse flows and strengthen the position of the dominant country in the dependent economy.

The authors of the 'dependencia' school offer a critique of an export-led growth. The kernel of the dependency thesis seems to be that 'centre' has exploited the 'periphery' for over 400 years, first through the 'colonialism' and 'imperialism' and more recently through 'neo-colonialism'. The exploitation consists of appropriating the 'surplus value' of the developing economies (Larrain, 1989). Of course, their views are not only concerned with economic aspects, but also incorporate political, sociological and cultural arguments.

The 'dependencia' writers start from the proposition that the developing economies are on the periphery of a world system in the centre of which are the rich countries. The centre-periphery relations originated in colonial times, but are now maintained by a subtle system of interest relations between the local power elite in developing countries and the centre of power (companies, state agencies) in the industrialised countries. It is in the interest of foreign companies to exploit the cheaper labour and natural resources of the dependent country. The benefits of export-led growth are distributed among the traders and companies from the centre countries and the local elite. The local elites invest their proceeds in " reproducing their economic and political power with a minimum of diffusion of economic and political benefits" (Dos Santos, 1970).

Different forms of dependence may be distinguished, as they have evolved historically:-First, there is colonial dependence based on trade and the exploitation of natural resources. Second, there is financial-industrial dependence, which consolidated itself at the end of the nineteenth century, and which has set the economic structure of dependent countries to the needs of the centre. Third, a new type of dependence has emerged in the post-war era since 1945 based on multinational corporations which began to invest in industries geared to the internal market of developing economies. This is a technological dependence. Based on his explanation for technological dependence, Dos Santos (1970) argues that the industrial development of developing countries is:-

(1) export sector to earn the foreign currency to buy inputs for industrial development; this forces developing countries to maintain their traditional (primary) exports. The Singer/ Prebisch/ Nurkse arguments are convened to reveal that export proceeds will not grow in proportion to world trade and their inputs or industrial development will increase in price compared to that of primary products. The remittance of profits by foreign investors diminishes the quantity of foreign currency that is available for industrial development.

(2) the technological monopoly that is manipulated by the centre countries has conditioned the industrial development of developing countries. To industrialise, foreign capital is invited to invest by high tariff protection, tax exemptions, loans from domestic and foreign banks etc., thus diminishing the financial gains from foreign investments. The technology used in these foreign- owned industries often too capital- intensive for the local resource endowments; as a result, relatively few jobs are created. Dos Santos concludes that in reproducing such a productive system and such international relations, the development of dependent capitalism reproduces the factors that prevent it from reaching a nationally and internationally advantageous situation; and it thus reproduces backwardness, misery and social marginalisation within its borders. The development that it produces leads to the progressive accumulation of balance-of- payments deficits, which in turn generate more dependence and more superexploitation.

Baran (1957), Frank (1967) and Amin (1977) focus their argument more squarely on the traditional Marxist ideas.[8] In the neo-Marxist analysis international relations and development, class conflicts and the growth of productive forces are important mechanisms by which capitalism in general, and international capitalism in particular, aid the rich in exploiting the poor. Emphasis is placed on the expropriation of and transfer of the surplus produced by labour to the owners of capital, which operates at different levels. Therefore, the multinationals are seen as the modern instruments for the expropriation of surplus value. Neo-Marxists allow for a residue of surplus, but argue that if it is reinvested in the periphery or left in the hands of local elites, it will not be used appropriately for development purposes.

[8] Marx expects that the inevitable integration of the colonies in the world capitalist system would bring to these countries capitalist economic development and growth. Lenin also held this view.

Because the system hinges on the collaboration of the governing elite who live in the capital city, who think like, and identify with, their ex-colonial masters. So poor economies, despite formal political independence, remain locked into an old system of economic dependence which perpetuates 'underdevelopment'.

Frank (1967), like Dos Santos, argues that underdevelopment is a natural outcome of the world capitalist system since the development of some countries inevitably means the distorted development or underdevelopment of others. Development itself perpetuates underdevelopment, a process which Frank has coined 'the development of underdevelopment.' Frank observes the origins of the process of colonisation, which started as a form of economic exploitation, and which has distorted the economic structure of developing economies ever since. The developing economies were forced into the position of suppliers of raw materials for industrial countries, thus effectively blocking industrial development in the primary producing countries themselves. The whole export-led growth process and foreign dominance of these countries has limited the growth of domestic market and establishment of basic national industries for widespread development throughout the economy.

In what might be described as a neo-Marxist contribution to trade theory, Emmanuel (1972) elaborates the concept of 'unequal exchange'- that is, in exchange for goods worth a day of its own labour, the South receives goods worth less than a day's labour in the North. This is clearly an idea that can be identified in other contributions such as the Prebisch-Singer thesis (see Bacha, 1978). Given international capital mobility which equalises profit rates and an exogenous real wage rate differential, Emmanuel argues that the 'unequal exchange' can only be prevented if real wages in South and North remain equal (Emmanuel, 1972; Thirlwall, 1992, pp. 140-143; Larrain, 1989, p.133-145).

The authors of the radical school have shared the 'export pessimists ' (Nurkse, Singer, Myrdal and Prebisch) views of a low expectation of development from export-led growth, the former group is more radical: not only are the gains from trade to be distributed unequally, but the international economic order as such would produce growing economic and socio-political inequalities inside developing countries (the development of underdevelopment).

The policy measures the radical authors propose are, delinking (retirement from international economic relations), self reliance, co-operation among developing countries for the North/South delinking and collective self-reliance, and the elimination of the political power of the local elites that are linked to the centre countries. It is obvious from these recommendations that these authors reject the possibility that the developing countries could develop autonomously in the existing international order (Lal, 1983, p. 44).

The radicals' policy prescription for developing economies is that only a radical break on the part of developing economies with global capitalist system will permit genuine development. However, Samuelson (1976) in his critique of Emmanuel's theory, points out that 'unequal exchange' is merely a tautological restatement of the fact that there is an assumed wage differential between developed and developing countries. This presumably requires either a constraint on productivity increase equally between workers in the North and South. Findlay (1982) argues, however, that simply raising wages in the South to improve the terms of trade will not help if the North's demand for the South falls. He presents labour migration as the only economically viable mechanism for achieving real wage adjustments- but that is unlikely to be an acceptable radical's policy prescription.

According to Smith (1980), the language and methodology of the radicals analysis often appears to lack precision (see Smith, 1980). The polarisation thesis for example (Amin, 1977) is based on a quite reasonable premise of international equality of profit rates and international inequality of wages. However, given productivity differentials, the inference drawn is that 'value' is transferred from peripheral countries to the centre. There are clear difficulties about the use of the value-form and about translating values into prices (Sraffa, 1960) which undermine the Radicals proposition that there is unequal exchange because of the wage differentials between centre and periphery are large than the productivity differentials. Moreover, neo-classical economists tend, however, to be critical of the 'universality' of the radicals approach. Lall (1975; 1985, pp. 3-24) questioned the usefulness of the concept of 'dependence' in analysing underdevelopment, he argues that the characteristics of the 'dependent' countries, to which underdevelopment is ascribed, are not unique to these economies. The conceptual schema is thus defective, uninformative or sterile that and runs into problems of circular reasoning- less developed countries are poor because they are dependent and the characteristics of poverty signify dependence (Greenaway and Milner, 1987, pp. 22-23; Smith 1980, pp. 11-13). Radicals' proposition that only a radical and complete break with the world capitalist system will provide the necessary conditions for genuine development as argued by Smith (1980, p.20) can only be described as dangerous arrogance.

Among the neo-Marxists, Bill Warren (1973) has questioned the premise that an independent industrial capitalism is not feasible in the developing economies. He argues that export-led growth is a feasible way of economic growth.

2.5 Conclusions

The literature of export-led growth has asserted that both historically and in the contemporary global economy, exports have been the engine of growth. Historically, David Ricardo (1772-1823) was the founder of the comparative cost. Before him Adam Smith (1723-90) stressed the importance of trade as a vent for surplus and as a means of widening the market, thereby improving the division of labour and the level of productivity. Smith's productivity theory has developed beyond a free trade argument into an export-led argument. Moreover, J. S. Mill (1806-73) emphasised the importance of the dynamic effect of export expansion.

Historically there appears to be an unanimity among economic historians that in the nineteenth century export expansion acted as an engine of growth, not only in that it rendered to a more efficient allocation of resources within an economy (static effect) but it transmitted growth from one part of the world to another. The demand in Europe, and in Britain in particular, for raw materials brought economic affluence to such countries as Canada, Argentina, South Africa, Australia and New Zealand. As the demand for their primary products increased, investment in these countries also increased. Such trade was mutually beneficial.

Contemporary exponents of export-led growth such as Hla Myint (1958, 1964 and 1977), Samuelson (1949), Meier (1989), Corden (1971), Lewis (1980), Reynolds (1985), Lal (1983), Krueger (1989), Krugman (1991, 1994), Sachs and Warner (1995) and Baldwin and Forslid (1996) among others support the case for export-led growth. Lewis (1980) who bases his theoretical discussion on terms of trade has deduced that there is a stable relationship between economic growth in developed countries and exports growth in developing countries.

Chenery and Strout (1966) denoted that there is almost no example of a country, which has for a long period endured a growth rate significantly higher than its growth of exports.

The staples theory, the Verdoorn's law and the new trade theory models have explained the dynamic impacts an export sector can generate in terms of, investment, employment, productivity growth, externalities, economies of scale and technological effect, etc. Economists like Thirlwall (1992, p.365) argue that the export growth relieves a country of a balance of payments constraint on demand, so that the rapid exports grow, the rapid output grows, can be without running into balance of payments constraints. Studies have also been conducted on the direct effect of exports on savings. Exports are vital not only through their effects on output but also because the export sector tends to have a higher propensity to save than the rest of the economy. Exports especially of primary products, tend to produce highly concentrated incomes which raises the level of saving for any given aggregate level of income. Besides, it is indicated that government saving in many developing economies depends heavily on tax proceeds from exports (Maizel, 1968). The optimistic view is that developing economies that pursue export-led growth can effectively converge to the income level of developed economies and can rapidly catch-up the latter productivity level.

However, the theoretical arguments in favour of export-led growth have been challenged. Schaerfer holds that international trade and investment is also a treacherous arena to the unwary. Extending beyond owns boundary is not an easy extension of conventional business and investment activities. Exporting however, has its own peculiar characteristics of increasing the risks of cross-border commerce, cultural, religious differences, poor communications, incompatible business practices, different economic and political institutions, etc. (Schaefer, 1995, pp. 1-3).

The important findings of Kravis (1970) indicate that export expansion may not act as an engine of growth rather it can serve as handmaiden of growth. The immiserising growth theory, unequal exchange, infant industry protection and dependency arguments have maintained that developing economies should be protected and that exports should not be thought to be necessarily a way to prosperity (Rossini and Burattoni, 1996). Therefore, critics of an export-led growth contend that the very forces of international trade have been responsible for inhibiting economic growth. They stressed that international trade operates as a mechanism of international inequality, but their views are rejected by those who argue that the export sector as driving force in developing economies growth process. However, it has been indicated that different export products will provide different inducements, according to the technological characteristics of their production. The nature of the export good's production has an influence on the extent of other secondary effects elsewhere in the economy, apart from the primary increase in export output. With the use of different input coefficients to produce different types of export products, there will be different strides of learning and different linkages effects (Helleiner, 1995). The extent to which the different types of export products are processed is highly significant in the determination of external economies associated with the learning process; the processing of primary product exports by modern methods is likely to benefit other activities through the spread of technical knowledge, training of labours, demonstration of new production techniques that might be adaptable elsewhere in the economy, and acquisition of organisational and supervisory skills (Caves, 1971; Hirschman, 1958; Perroux, 1968; Baldwin and Forslid, 1996).

Likewise, among other things, the growth stimulating forces of exports is higher under the following circumstances:-

(1) The higher the growth rate of the export sector, the greater is the direct impact of the export sector on employment and personal income.

(2) The more the expansion of export has externalities and linkage effects and a learning effect in terms of increasing productivity and infusing new skills.

(3) The higher the export sector is supplied through domestic inputs rather than import, the higher the distribution of export income favours those with a marginal propensity to consume domestic goods rather than imports. Some exports render these conditions more readily than others do and countries specialising in these exports will relish greater opportunities for economic growth (Meier, 1995, p.468). Nevertheless, a strong inducement from exports may not be an end to the game. Because the transmission of growth from the export base to the rest of the economy will still be bounded by multitude of other predicaments in the economy such as the degree of market imperfections in the domestic economy and non-economic deterrents in the general atmosphere. The integrative process is expeditious the more developed the infrastructures of the economy, the more developed are the market institutions, the more spacious is the human resources base, the less are the price distortions that sway resource allocations, etc. Consequently, to realise such conditions it also necessitates an effectual policy measures.

In this context, having discussed the significance of export-led growth from divergent theoretical tenet, trade policy considerations are going to be investigated in the next chapter.

CHAPTER THREE

TRADE POLICY, EXPORTS AND ECONOMIC GROWTH

IN

DEVELOPING ECONOMIES

3.1. Introduction

While the relationship between exports and economic growth has been the theme of profound contemporary economic debate, inseparably the interrelationship between trade policy, exports and economic growth is an illuminating area of economic contention. In works on trade policy, exports and economic growth a distinction is normally drawn between two trade strategies- import-substitution (IPS) and export-promotion (EXP). The former is oriented towards the promotion of production for the domestic market of once imported goods. The latter is understood as Export-led growth (ELG) strategy (Kirkpatrick, 1987, p.71).

ELG strategy can be understood as neutral or as the strategy to promote exports that the country has a comparative advantage, which is measured, in terms of world to domestic cost price structure. In recent developments, this is also regarded as trade liberalisation. It has been hypothesised that the volume and the efficacy of exports vary according to whether an economy is following the IPS or ELG strategy. Bhagwati (1978) has expressly defined ELG strategy as one, which equates the average effective exchange rate on exports to the average effective exchange rate on imports. In contrast, the IPS strategy is defined as one where the effective exchange rate on imports exceeds the effective exchange rate on exports and is biased in favour of IPS activities. Accordingly, the effective exchange rate on imports (eer_I) and the effective exchange on exports (eer_x) are formulated as follows:

$eer_I = s(1 + m)$ and $eer_x = s(1 + n)$ (3.1)

Where s = the nominal exchange rate, m = average tariff rate on imports, n = average rate of subsidies on exports. Thus, m should include all policy instruments, including tariffs and quotas, which bias policy incentives in favour of imports and n should include all incentives that involve in ELG activities.

Bhagwati then argues that on balance, given all factors influencing the flow of productive resources and their efficiency, an ELG strategy is likely to both attract a higher level of productive resources and promote their more efficient utilisation and resulting in a higher exports production than an IPS strategy.

In his early work, Balassa (1971) has stressed the need to alter the trade orientation of those developing economies that pursue IPS strategy. He believes that the IPS strategy leads to a general misallocation of resources as they provide few incentives for maintaining cost-price discipline and improvement in productivity. The association between trade orientation and performance in productivity can also be derived from direct relationship between real output growth and productivity growth (i.e. Verdoorn's law). The validity of such a law has been recognised for manufacturing and other secondary industrial activities by Kaldor (1967). The main cause behind such a positive association is deemed to be economies of scale achieved by the expansion of the market under ELG strategy. In developing economies, an important reason to regard to economic growth and structural change is the size of the market. A given developing economy can experience substantial economies of scale and a drop in costs of production as an outcome of an expansion of the exports market through ELG strategy. Thus, an ELG strategy is adhered to developing economies.

Richard Baldwin and Richard Forslid (1996) have introduced the 'q-theory' to illustrate liberalisation-and-growth links within the endogenous growth model approaches. Their theory is derived from the interpretation of Tobin's q-theory of investment (Tobin, 1969). Tobin emphasises that the rate of real investment determines the rate of capital accumulation that in turn determines the rate of output growth. Baldwin and Forslid analyse growth implication of trade liberalisation by boosting a given economy's q (stock value of market capital) by attracting resources to its accumulation sector. Liberalisation or trade policy variables, thus, viewed as an incremental reform rather than a shift from autarky to free trade (Baldwin and Forslid, 1996).

In the dual-gap theories, Chenery and Strout (1966) propounded another possible rationalisation of trade orientation and productivity performance. Due to structural inflexibility and production situations in many developing economies, imports of capital and intermediate goods are imperfect substitutes for domestically produced goods. Trade policies, which abate the availability of such critical foreign inputs for domestic production also, reduce domestic capacity utilisation and thus total factor productivity. An ELG strategy can increase the foreign exchange revenue, capacity utilisation and growth of factor productivity.

Furthermore, a more liberal trade policy, by opening up the domestic economy to foreign competition, enhances efficiency in domestic production as producers are forced to cut costs to retain their profit margins. Balassa (1989), in particular, argues that both 'export rivalry' and 'import competition' are necessary ingredients to raise domestic productivity because of the nature of a competitive market. In addition, IPS strategy by imposing import restrictions breaks the important link between domestic and world prices. Producers at home are now 'protected' from the oscillations in world prices. Such a trade regime would allow rising costs to be passed forward to consumers via the pass-through effect. It is also argued that movements in the world prices convey a lot of information on productivity trends in other countries of the world; policies and exchange rate distortions arising from IPS that prevent the transmission of the price signals can make the productivity performance trivial for policy analysis and reduce the dynamic productivity advantage in trade of a developing economy (Nishimizu and Page, 1991). It has been asserted that export expansion will be lower in protected than open economies, which stands for poorer economic growth and a convenient proxy for the nature of trade policy, and that this tends to lead to balance of payments constraints.

The trade theory approach predicts that trading will raise the rate of technical progress by promoting the flow of ideas from trading, stimulating the external competition to innovation, and saving the resource cost of attempted replication of existing developed economy technology.

In a comprehensive movement of the pendulum, developing economies have been shifting from protection to export-led growth strategy (see, Table 3.1 in section 3.2 of the chapter; Dornbusch, 1993, p. 83; Sachs and Warner, 1995). Accordingly, we are going to synthesis the implications of these trade policies in the following sections. In section 3.2 we consider the IPS-led growth strategy then in section 3.3 ELG strategy follows.

3.2. IPS-Led Growth Strategy

In the early stages of development, during the 1950s and 1960s, following the Singer-Prebisch theorems, arguments for import substitution were widely deployed and supported. Thus, policy makers in many developing economies sought to adopted IPS rather than export promotion policies. Growth was sought gradually through a protectionist environment, utilising tariffs and quotas, overvalued exchange rates, administrative procedures designed to result in a home market bias, foreign investment, technology transfer and foreign aid (Dornbusch, 1993; Lindert, 1993, pp. 252-57).

Therefore, IPS strategy wielded an undeniable pull for the majority of developing economies. This was in large due to the paramount political ambient. Decolonisation had created a large number of newly independent economies agog to parade self dependence (Little, 1982). As international trade was contemplated as a persistence of colonial dictum and foreign masterdom, the political milieu was very sympathetic to IPS policy counsel. This destined to a lessening of dependence on the outside world through foreign trade. Kirkpatrick and Nixson (1983, pp. 45-55) have argued that when economies faced with a balance of payments constraint, it appears easier to save foreign exchange through IPS than earn it by exporting manufacturing goods, together with the undoubted psychological appeal of demonstrating a knack to produce something for oneself rather than to depend on imports.

The intellectual foundation for IPS was provided by a set of ideas and arguments, which were characterised by, export pessimism. In this regard, it has been argued that the severe decline in export earnings from primary products in the inter-war depression period and wartime shortages of imports provided a major stimulus to IPS in Latin America. Subsequently, the liberalisation of the post-war economy, and structural changes within the developed economies, resulted in a changed structure of capital exports to developing economies, with direct investment by the transnational corporations playing a major part in the post war IPS process. However, the view of externally enforced IPS has been questioned by some observers (see Ingham and Simmons, 1981).

Given the low price and income elasticities of demand for the primary products produced by most developing economies, export revenue is likely to grow slowly, if at all. It was argued that a low-income elasticity of demand for primary products, the emergence of synthetic substitutes, and competitive world markets all contribute to ensure that the real prices for those primary commodities will decline through time. This provided an influential justification for moving away from a reliance on primary products toward domestically produced manufactures whose demand is income elastic and where product and factor markets are uncompetitive.

It was argued that the demand for primary products is price inelastic and that these markets are particularly vulnerable to random shocks in demand. The combination of these factors would therefore lead to unstable export earnings with a consequent inhibition of growth prospects. Thus, if growth is to proceed, it must be on the basis of the domestic market, rather than foreign markets. Initial adoption of such policies, particularly in Latin America, was a response to a near collapse of export markets of raw materials and to shortages of manufactured goods after the Second World War. In a world of stagnant demand for the type of primary products which the region had traditionally exported, it was hoped that IPS would provide a new dynamism and a greater amount of independence from economic fluctuations (Dornbusch, 1993).

The existence of price distortions has often been used as a rationale for import substitution. An example of this is provided in Lewis's model of economic development with surplus labour (Lewis, 1954). In this model labour in the traditional sector is paid a wage that is above its marginal product. One can think of a peasant family that divides the output of the farm equally among all members. The wage in the traditional sector is the opportunity cost of labour for the modern industrial sector. The latter employs labour up to the point where the marginal product of labour in industry is equal to the wage rate, as determined in the traditional sector.

The difficulty with the antecedent state is that employers in the modern sector have to attract workers from the traditional sector by paying wage at least equal to and perhaps greater than that which labour can earn in the traditional sector. Labour in the latter sector, however, earns its average product, which exceeds its marginal product (the social opportunity cost of labour). Thus, because the wage rate exceeds the social opportunity cost, too little of the latter will be hired by the modern industrial sector, and the level of production in this sector will be too small. If the foregoing is true, then the solution is for the state to step in to promote the expansion of the modern relative to the traditional sector, a policy that would result in a transfer of labour from the traditional to the modern. The state could achieve this goal by using tariffs and quotas to raise the return to capital in the modern sector, which would in turn lead to increased employment and production in this sector.

Another justification offered involves the existence of externalities. These externalities are thought to arise in a number of ways. For example, if firms expend resources to improve the productivity of their workers, they hope to reap the benefits of such productivity improvements through the future activities of the workers in their firms. If the workers leave the firm, however, then these potential benefits are lost and the firm is left with bearing the cost. As a result, firms are likely to be underinvested in the improvement of human capital. Thus, protection of industry will encourage the protected firms to expand production and expenditures related to growth, including expenditures on training (Gorden, 1984, p.92).

The unexceptionable justification for protection is, of course, the infant industry argument (Ghatak, 1995, pp.324-327). Developing economies establishing new or infant industries will find that they are unable to compete successfully against similar industries in already developed nations. Often this is explained by reference to economies of scale. Initially infant industries operate at such a small scale that per unit costs are extremely high and thus a price that covers such costs will be high relative to industries in developed countries operating at a large enough scale such that per unit costs are low. In order to over come this difficulty, the infant industry must be temporarily protected until it can attain an efficient scale of operation. Moreover, in competitive world markets developing economy producers can only sell if they have reached world productivity levels. Since they would not be expected to have done so from the inception for catch-up reasons a clear rationale for infant industry protection to allow them to catch-up with the world productivity frontiers, presumably from learning by doing.

For policy makers, one aspect of interrelationship between industrialisation and trade - the level of imports- became a focal point for their efforts to alter the industrial structure. Imports were taken, as a guide in identifying those industrial activities was policy encouragement might hasten the replacement of imports by domestic production. Thus, the strategy depended heavily upon the characteristics of domestic demand rather than income redistribution, employment maximisation, etc. for the selection of industries to be favoured by policy initiatives. Although exceptions can be found, policy makers generally considered that import substitution process must begin with the production of consumer goods. The process has, occasionally, started with the capital or intermediate goods, which are needed in connection with agricultural or transport activities. Examples include machetes, coffee hulling machines, trucks, fertilisers and spinning mills. In the long term, economists thought of import substitution as a serial step working its way from light consumer goods to heavy industry and capital goods. This line of thought was in contrast to that in some more lately industrialised countries- such as Russia- where immediate emphasis had been placed upon heavy industry.

Conditions in developing economies made their experiences with import substitution quite different from those of more advanced countries. First, the impetus for import substitution was stimulated mainly by a reduction of previously available imports. Imports largely consisted of 'luxury' consumer goods- a consequence of the inequitable distribution of income and wealth in the developing economies. In contrast, the import substitution, experience of Germany, Japan or Russia was initiated under conditions of expanding income partially derived from exports. Major consumer sectors of these economies were not cut off from supplies, either domestic or foreign. Second, the developed economies, even when they were predominantly producers of light consumer goods, were also producing capital goods for the same industries, if only by artisan means. Thus, they gained immediate experience in the matching technology to available supplies of inputs, and in overcoming technical problems in the use of these products.

The developing economies, in contrast, imported relatively complex technologies, but without the sustained experimentation in technological development and innovation that had been associated with the original emergence of these industries. There was no experience nor vested producer interest groups arguing for the protection of capital goods. The imperative of moving into the domestic production of capital goods was not extinguished in Latin America economists and policy makers, however (Ballance et al., 1982). Thus, the sequence of import substitution pictured by ECLA (1964) economists implied the existence of a systematic body of measures to encourage the development of different types of industries in different phases of the development process. In other words, the growth process was to be spurred first by consumer goods industries, followed by an expansion of the production of supplies and intermediates and, later, capital goods. The relative protection accorded in each category should have changed accordingly, favouring first one set of industries and then another.

Nevertheless, IPS has drawn its scholar expounding from arguments that have accented the cramps and distortions, which were common in the developing countries. As a result, it was felt that the price mechanism could not be reliable and had to be replaced by commands in order to generate sustained growth. This, together with the political objectives of self-dependence and economic independence, proved to be the motive force behind IPS scheme.

Since the early 1960s the empirical validity of the posits that have been underlying the arguments in favour of IPS has been questioned. Krueger (1961) and Cairncross (1962) were among the first critics in raising doubts about export pessimism. The study of MacBean (1966) and the survey of MacBean and Nguyen (1988) could found no support for a strong causal link between export instability and growth. Spraos (1980) found no evidence in support for a declining trend in the terms of trade. Greenaway (1986) argued that although there may be circumstances where intervention to encourage infant industries is defensible, some forms of subsidy will invariably be more efficient than a tariff or a quota.

Moreover, four decades of IPS programs in the developing economies generated considerable information about its shortcomings of such strategies. Among others, Diaz-Alejandro (1975), Bhagwati and Srinivasan (1979), and Krueger (1980 and 1990), argued that IPS led to half-way industrialisation that is promoted manufacturing development in relation only to home demand and promoted growth of manufacturing employment with respect only to a small proportion of total surplus labour. In addition, it was argued that IPS strategy caused a general rise in the cost level, a distortion of cost structures, low level of capacity utilisation and inefficiency in business due to protection from foreign competition. The manufacturing sector, therefore gradually lost its dynamic impact on economic growth.

In practice, the protection of consumer goods, which eventually became a permanent feature of industrial policy under import substitution growth strategy. The approach ran contrary to the original concept of a serial rung moving from consumer goods into intermediates and the capital goods. Although the use of protective measures were broadened to include industries other than consumer goods, this added up to reducing- not eliminating- the privileged footing relished by the producers of consumer goods relative to different manufacturers. The absolute level of tariffs accorded to consumer goods remained higher than those accorded to other groups of producers.

Retrospectively, this approach to tariff setting altered the pattern of economic activity and domestic resource allocation in two ways. First, it animated a movement of resource out of agriculture and mining into the import- competing manufactures. This move resulted in a 'home market' favouritism due to its astuteness against exporters. Economists maintain that apportioning a subsidy to production of all manufactures rather than a tariff could elude the home market inclination. This policy would lead to a shift of resources out of agriculture and into both import-competing manufactures and the export of manufactures. Eventually much of the manufacturing sector received some degree of protection, the main effect that was to raise domestic prices of manufactured goods. Furthermore, when policy makers discriminated in favour of one industry or sector they necessarily discriminated against some other activity. Most of those developing economies that vigorously pursued an import substitution strategy had a large agricultural sector, which was the main loser (Little et al., 1970, pp. 41-2). Within the manufacturing sector, the pattern of protection led to a shift of resources out of unfavoured lines of manufacturing, often potential exporters or producers of capital goods and industrial intermediates. Thus, import substitution exhibited a 'consumer goods' favouritism similar to its home market bias.

Given the high levels of protection accorded to consumer goods, the impact on investment, pricing policies and firm behaviour was substantial. Apparently, it was well worth the industrialist's effort to go to any length in the way of lobbying , bribery or political protection in order to achieve such levels of protection. The main beneficiaries were those industries and organisation that fail to minimise costs given the available technology. Protectionism often led to very high profits (and perhaps overinvestment) and an inefficient use of resources (Lewis and Gusinger, 1968).

At least two troublous corollaries may be accredited to the prevailed pattern of effective protection in developing economies. First, the production of manufactures for exports was considerably disparaged. The economic rent acquiring to domestic producers who sold in protected home markets was substantially greater than the returns from exports, which could only be sold at internationally competitive prices. Thus, the earnings-to-cost ratio associated with import substitution was often much greater than that from exporting, and firms behaved accordingly. Second, the high rates of protection recorded in developing economies led to unexpected, though not irrational, forms of behaviour on the parts of industrialists which did not coincide with the intended objectives of an import substitution strategy. Effective rates of protection were sometimes so high that value added by domestic industry, when evaluated at international rather than domestic prices, proved to be negative. Thus, the value of the industry's inputs at the world prices exceeded its output at the world prices and foreign exchange was therefore lost. The use of world prices in this link is not free of debate, however (Krueger, 1966, 1978 and 1983; Pearson, 1976; Bhagwati, 1978; Hirschman, 1986, p.18).

The cost of this policy is considerable. There are the static welfare costs of protection as the country foregoes the advantages of specialisation. The use of import licenses further stimulates the wasting of resources caused by 'rent-seeking' behaviour. As these import licenses constitute a source of windfall gain or rent (the difference between the world market price and the domestic price times the quantity that may be imported), potential license recipients will spend resources in activities that are aimed at influencing the decisions of persons or bodies that decide on the distribution of licenses so that these decisions are in their favour. Furthermore, successful protection diminishes imports and this causes the national currency to appreciate. This makes production for export and unprotected import competing production such as agriculture less profitable (Balassa, 1982a, p.19).

Industries which have been set up have often remained inefficient because of a smaller than optimal scale of production (small domestic product) and lack of competition. Furthermore, the structure of protection of many developing countries strongly discouraged technological innovation by concentrating industrialisation in the light of consumer goods and by the lack of incentives to develop technologies adapted to local factor endowments. As a result, many of the industries that have been encouraged are capital-intensive, employ a relatively small labour force and tend to accentuate income disparities. Shortages of foreign exchange have occurred as the substituting industries relied heavily on imported inputs and as the strategy as such discouraged exports and domestic production. In this regard, it seems that protectionist policies have resulted in more poor countries having the worst of both the worlds: on the one hand, by promoting import substitution they have discriminated against exports and thus reduced their own ability to earn foreign exchange, while on the other hand they have increased their technological dependence on the developed countries. It was even found that protection of the manufacturing sector failed to significantly promote this sector.

Note that the arguments or justifications for IPS are pessimistic in their view of how markets operate, but implicitly optimistic concerning the government's ability to solve problems. Also, protection in the form of quotas and tariffs can be, at most, a second-best solution to the problems involved. The best solution would be to intervene at the source of the problem directly. Specifically, 'it is usually more efficient to use those policy instruments that are closest to the source of the distortions separating private and social benefits and costs'(Lindert, 1993, p. 138).

The application of the foregoing rule to the price distortion in the Lewis model would involve the state's subsidising the employment of labour in the modern sector rather than protecting this sector. The former is less costly than the latter since prices to consumers are not increased. In terms of the externalities to worker training, it would be less costly for the state to directly subsidise such training rather than to protect domestic industry. Again, the latter course involves a cost to consumers whereas the former does not. Finally, with respect to the economies of scale argument, the real problem is that the capital market is not operating properly. Thus, a better solution would be for the state to foster the development of a capital market. Although the preceding arguments are theoretically correct, the point is often made that the best policy solutions are, in terms of transaction costs, too costly to carry out. The ability to allocate subsidies and construct capital markets requires skills and abilities beyond the administrative capacity of most developing economies. It follows that although tariffs and quotas may not be best solutions to market problems, they are the only ones that can be effectively implemented. Thus, the best option is ignored from this point of view.

Besides, the view taken earlier of the efficacy of government policy making ignores the very real possibility of government failure (Wolf, 1982). That is, governments, in an attempt to deal with perceived market failure, may impose an even greater cost on the economy in attempting to deal with such failures. This may be the result of the ineptitude of government bureaucrats, the effects of the influence of powerful interest groups, or the willingness of government leaders and employees to substitute their own private interests and goals for those of society.

In fact, the experiences of many developing economies would seem to support the foregoing view. Infant industries have had a tendency never to grow up. In addition, IPS policies accompanied by exchange controls have tended to promote the use of more capital-intensive techniques of production. The exchange controls themselves have resulted in a vast increase in the rent-seeking activities of private interest groups, dramatically increasing the costs of protection (Krueger, 1990).

As economic policy makers became aware of the costs of the strategy of import substitution in the second half of the 1960s and during the 1970s, several countries decided to change their trade policy so that there would be less insulation from international competition. Some of these countries lowered the general level of protection (Brazil after 1965, Colombia after 1970, South Korea after 1960); there were countries that established export processing free zones were economic policies where heavily pro-trade, sometimes in combination with the above mentioned general change in the trading policy. These changes often made the general direction of the trade policy less inward looking (import substituting); the changes often only partly compensated for the trade reducing effects of the remaining policy elements. The World Bank (1987) indicates that compared to the period of 1963-1973, fewer countries (from a sample of 41 countries) were strongly inward looking during the period 1973-1985. But the number of moderately outward-oriented countries decreased, and the number of moderately inward looking countries increased. According to Sachs and Warner's (1995) classification and timing of trade policies of developing economies, for the period from 1950 to 1994 only eight economies had never been closed, 42 developing economies had been closed throughout and 58 economies had been reopened after initial closure (see, table 3.1 below).

A general movement to free trade policies was not therefore be observed. However, in the struggle to beat a cesspool of poverty, import substitution is currently out of favour. So that, as a result of the catalogue of criticisms of IPS , it is not hard to think of an alternative (Balassa, 1991; Edwards, 1993; Strydom, 1996; Dornbusch, 1993; Sachs and Warner, 1995).

Table 3.1:- The Classification and Timing of Trade Policies of Developing Economies (1950-1994)*

I. Economies That had Never been Closed

Barbados	Mauritius
Cyprus	Hong Kong
Malaysia	Thailand
Singapore	Yemen A.R

II. Economies That Had Been Closed Throughout

Algeria	Rwanda
Bangladesh	Senegal
Burkina Faso	Sierra Leone
C. Africa R.	Somalia
Chad	Syria
Malawi	Tanzania
China	Togo
T. & Tobago	Zimbabwe
Ivory Cost	Armenia
Dominic R.	Azerbaijan
Egypt	Georgia
Ethiopia	Kazakhstan
Gabon	Russia
Haiti	Tajikistan
Iran	Turkmenistan
Iraq	Ukraine
Madagascar	Uzbekistan
Mauritania	Yugoslavia
Mozambique	Myanmar
Niger	Nigeria
Pakistan	P.N. Guinea

Continued over

III. Economies That Had Been Reopened After Initial Closure

Economies	Year of Opening	Temporary Liberalisation
Taiwan	1963	NA
Jordan	1965	NA
South Korea	1968	NA
Indonesia	1970	NA
Chile	1970	NA
Botswana	1979	NA
Morocco	1984	1956-64
Bolivia	1985	1956-78
Gambia	1985	NA
Israel	1985	NA
Ghana	1985	NA
Costa Rica	1986	1952-61
Guinea	1986	NA
Mexico	1986	NA
Guinea-Bissau	1987	NA
Guatemala	1988	1950-61
Guyana	1988	NA
Jamaica	1988	1962-73
Mali	1988	NA
Philippines	1988	NA
Uganda	1988	NA
El Salvador	1988	1950-61
Paraguay	1989	NA
Tunisia	1989	NA
Venezuela	1989	1950-59 and 1989-92
Turkey	1989	NA
Hungary	1990	NA
Poland	1990	NA
Benin	1990	NA
Uruguay	1990	NA

Continued over

...Continues...

III. Economies That Had Been Reopened After Initial Closure

Economies	Year of Opening	Temporary Liberalisation
Argentina	1991	NA
Bulgaria	1991	NA
Czech R.	1991	NA
Slovak R.	1991	NA
Slovenia	1991	NA
Brazil	1991	NA
Colombia	1991	NA
Ecuador	1991	1950-83
Honduras	1991	1950-61
Nepal	1991	NA
Nicaragua	1991	1950-60
Peru	1991	1948-67
South Africa	1991	NA
Albania	1992	NA
Estonia	1992	NA
Romania	1992	NA
Croatia	1993	NA
Latvia	1993	NA
Lithuania	1993	NA

Continued over

...Continues...

III. Economies That Had Been Reopened After Initial Closure

Economies	Year of Opening	Temporary Liberalisation
Cameroon	1993	1963-67
Kenya	1993	NA
Zambia	1993	NA
Belarus	1994	NA
Kyrgyzstan	1994	NA
Macedonia	1994	NA
Moldavia	1994	NA
India	1994	NA

NA= not applicable

The categorisation and timing of trade policy are based on the following Sachs and Warner's Criteria. Thus, an economy is considered as having a closed trade policy if it has at least one of the following characteristics:-

a. Non-tariff barriers (NTBs) covering 40 per cent or more of trade.

b. Average tariff rates of 40 per cent or more.

c. A black-market exchange rate that is depreciated by 20 per cent or more relative to the official exchange rate, on average.

d. A socialist economy system.

e. A state monopoly on major exports.

Source: Sachs and Warner (1995).

Thus, given the alleged weakness of the assumptions underlying IPS arguments and the alleged disillusionment with the IPS strategy became gradually apparent and strengthened the neo-classical case for the adoption of by developing economies of more outward-looking, export-oriented trade policies. Thus, export promotion policies gained favour (Kirkpatrick, 1987, p.75).

It has been argued that the implementation of an ELG strategy would generate superior results, in terms of allocative efficiency and economic growth, as compared to IPS strategy. Thus, we are going to discuss the ELG strategy in the following section.

3.3. Export-Led Growth Strategy

The ELG strategy can be described as the use of trade and industrial strategy to provide a set of incentives which are neutral as between the export and domestic market, or which actually result in a bias towards producing for the export market.

Thus, ELG relies on incentives to guide economic activity, unlike IPS, which relies on direct controls. These incentives are usually embodied in a realistic exchange rate or in favourable treatment of exporters through export subsidies, lower interest rates or tax incentives. Currently, the ELG strategy is also known as trade liberalisation.

Japan was the first country to pursue an ELG strategy and this was adopted through the "Okita Plan" in 1954 (Bhagwati, 1985, Ghatak, 1995). Since then a number of countries have followed Japan's way. The most famous case, often mentioned by ELG advocators, is the case of the Asian NICs, namely Hong Kong, the Republic of Korea, Singapore, and Taiwan. Several developing economies have been implementing this strategy. The most notable recent examples are Mexico, Brazil, Turkey, Ghana and Botswana (Dornbusch, 1993, p.83).

It has been argued that the high growth rates achieved in these countries are associated with high growth rates of exports resulting from ELG strategy (Krueger, 1985; Bhagwati, 1986; Page, 1994, p.1).

The current, enthusiasm for ELG or trade liberalisation stems from four interrelated factors (Dornbusch, 1993, p.83).

First, anti-interventionism:- There is a wide intellectual move away from emphasising the beneficial role of the state in economic growth, thus, protection is seen as one of the manifestations of an overly extractive state.

Second, poor economic performance:- Many developing economies have agonised thwarting economic performance and dwindling productive potential. The reason can be traced to an interventionist macroeconomic policies that begot debt crises and hyperinflation. Of course adverse external environment has its own part. Trade has given significant role to improve the productivity of the economy.

Third, information:- economic agents' world-wide are exposed to more information about the opportunities available in other economies. It is no longer possible to conceal that products in a particular economy cost two or three times the world price or that they are not available. Consumers want cheap goods that are available in a world markets; producers aware what technologies and inputs their competitors abroad can use and insist on the same access. It is no longer possible to dictate that export-led growth strategy must immiserise an economic growth; on the contrary, many actors access to imports a way of stretching their buying power.

Fourth, World Bank pressure and evidence of success:- The world Bank and IMF have documented the problems of inward-looking trade strategies and discerned the lessons from successful trade strategies. The research helped to arrive on a more conclusive judgement involving the importance of neutral trade regimes as opposed to regimes that are biased against export expansion. The favourable performance of economies which pursued export-led growth strategy served to make such strategy, broadly understood, as a central condition for international bilateral and multilateral lending, particularly the World Bank and IMF.

The argument for ELG strategy have been stressing in the light of gains from exporting discussed in the previous chapter, in the static and dynamic setting.

It is argued, for instance, that reliance on market and government incentives to guide economic activity stimulates the allocative and accumulative processes more efficiently than the administrative controls of IPS strategy. In this regard, developing economies that adopt the ELG strategy are expected to grow faster than IPS countries.

According to Balassa (1971, p.181) export- oriented policies lead to better export and economic growth performance than policies favouring import substitution. This result said to be obtained because export-oriented policies, which provide similar incentives to sales in domestic and foreign markets, and exposes domestic product activities to international competition, lead to resource allocation according to comparative advantages, allow for greater capacity utilisation, permit the exploitation of economies of scale, generate technological improvements in response to competition abroad, and, in labour-surplus economies, contribute to increased employment.

It has been argued that ELG strategy does not necessarily imply a preference for production for foreign relative to domestic markets. For some analysis, however, this strategy involves a neutral perspective. That is, the bias of IS for domestic- market should be removed so that incentives for foreign versus domestic production are neutral in nature. Of course, trade according to the principle of comparative advantage yields increased efficiency in terms of resource allocation. These efficiency gains are augmented by the ability of trade to curb the economic power of oligopolies and monopolies. This ability also improves the allocation of resources. These allocation gains are what are sacrificed when governments seek to protect domestic industries.

The economies of scale issue is advocated on the ground that domestic markets are too small to allow firms to achieve optimal scale. It is through the production for sale to foreign markets that firms can achieve increasing returns and, eventually, optimal scale (Craggier, 1990). In this respect, the advantage of ELG strategy is that by orienting production towards exports, and producers are able to set up manufacturing establishments of efficient size, thereby taking advantage of internal economies of scale and overcoming indivisibilities in the production process. Internal economies of scale, however, can be very small as compared with those external economies, which result from the general progress of the industrial environment. It is argued that the spreading of technological and organisational know-how from the export to non-export sector, creates human resources suitable for sustained growth. Besides, export growth affects economic growth (net of exports) through changes in incomes and costs-multiplier effects.

Another advantage of ELG is that developing economies can use the internal market to exchange their own, relatively labour-intensive goods. This ability contrasts with IPS under which labour-abundant developing countries produce the entire spectrum of manufactured goods. Given their small stock of capital, it proves difficult to employ the labour force productively, and the growth rate slackens.

Moreover, there are some additional gains from trade that may be more dynamic in nature. Deepak Lal and Sarath Rajapatirana (1987) have argued that the entrepreneur is the key to rapid growth. They hold that economic decision making involving possible future events (investment and innovation) is subject to ignorance, not risk. Risk occurs when it is possible to attribute probabilities to the occurrence of certain results, and thus firms can maximise expected profit. In this context, the entrepreneur has no role to play. In situations characterised by ignorance, such probabilities from investment and innovation are not even known. It is in this framework that the entrepreneur takes on a key role. He must search out investment opportunities and gamble on a future that is unknowable. Lal and Rajapatirana, thus, argue that an outward-oriented strategy of development provides greater opportunities and rewards for such entrepreneurial activity. With an IPS strategy governments are free to engage in policies that can distort the domestic economy in an attempt to guarantee the availability of the domestic market for domestic producers. In a free-trade environment, however, the options that the government has at least at disposal are limited. That is, the government is not capable of assuring domestic producers access to export markets except through the use of direct subsidies. These must come directly from the government budget and are not as well hidden as the subsidies provided through IS strategies. Thus, activities by the state aimed at distorting the market are likely to be restricted in an outward-oriented strategy of growth. Exports and Growth are likely to be higher as entrepreneurial activities become more intense.

Another possible dynamic impact of ELG strategy relates to the ability to import. It has been claimed that, under ELG strategy, export earnings grow rapidly enough to finance the increased demand for imports and thus alleviate the foreign exchange constraint and stabilise the balance of payments. Moreover, since most modern technologies are embodied in capital equipment that cannot be produced in developing economies, imports of such materials will have to be relied upon. Thus, the rate at which new technology can be applied will depend on the capability to import. The faster exports grow, the more rapidly new technology embodied in foreign produced capital can be imported. Thus, the overall rate of growth is likely to be increased as the rate of technical innovation increases (Grubel, 1994). Therefore, ELG strategy is associated with a higher inflow of technological goods and ideas that act as input to economic development.

The probability that an export-oriented policies stimulate employment also makes it probably that income will be more evenly distributed under this policy, because being unemployed entails having no or less income in most developing counties. If a country participates in international trade on the basis of its comparative advantages and disadvantages, international trade will to some extent even out the relative scarcities of factors of production. For developing countries that have relatively large labour force, but a scarcity of capital and know-how, this evening out process may increase the share of labour in the national income and the wage level. However, the existence of very large surpluses of labour may slow down this process. Even then, the distribution of income may improve as a result of a export-oriented strategy as there are no (any even less) remunerative alternative employment opportunities for labour outside the trading sectors (Helleiner, 1976, p.26; Stewart, 1977).

The above discussions showed that it is justified to suppose that in general, ELG strategy has a positive impact on export expansion and economic growth, and probably increases employment opportunities and has a positive effect on the distribution of welfare. This means that there is a general imperative for economic policies not to be anti-exports. In general, proponents of ELG stress the vital allocative function of relative prices in directing resources to their most productive uses and in generating those allocative process which are conducive to growth. In cases where intervention is required, this should involve the use of fiscal incentives and disincentives rather than regulatory instruments. In this respect ELG strategy is believed to responsible for the alleged successes of export oriented economies. The theoretical case for ELG strategy appeared to be confirmed by the experience of host countries that adopted export promotion since the 1960s. This group of countries, which became known as the newly industrialising countries (NICs), achieved remarkable economic growth in manufactured exports and output, and their record provided the 'model' recommended to other developing economies for emulation by, for example, the World Bank (World Bank, 1983 and 1987). Both national and international development favoured a shift towards export promotion policies since the 1960s. The international spread of manufacturing capacity extended the degree of interdependence and specialisation among countries.

The form of ELG pursued by the NICs has varied, reflecting differences in economic structure and resources, and in previous industrialisation experiences. For countries with substantial exports of primary products or raw materials, local processing has been an important means for increasing manufactured exports. In the larger NICs of Latin American, manufactured exports have often been based on industries based during the IS phase. In the Asian NICs, with more limited domestic markets or a lower level of IS activity, the production of manufactures intended primarily for external markets has been more significant. A further form of manufacturing export has been labour-intensive component assembly activities. This type of production resulted from Transnational companies' (TNCs') world-wide sourcing for the most economical location for various stages in their vertically integrated operations, and led to the transfer of unskilled labour-intensive activities to developing economies, where low wage costs offset the transport and communication costs incurred (Helleiner, 1973a, b; Kirkpatrick and Yamin, 1981; Kirkpatrick and Nixson, 1983, pp. 29-35; Kirkpatrick, 1987, p.76 and Nayyar, 1978). International economic policy accompanied the shifts in the pattern of industrial specialisation. Progress in the liberalisation to trade was substantial. Tariffs on manufactures were considerably reduced as a result of agreements reached in the Dillon, Kennedy, Tokyo and Uruguay round of tariff negotiations. Simultaneously, western firms, ranging from retail chains to transnational corporation (TNCs), became active in seeking favourable production sites abroad to take advantage of low-cost labour. Their efforts has been encouraged by the slow growth of the labour force and rising real wages in the developed economies as well as declining transport costs, new organisational structures and related innovations and a favourable international policy environment.

At the national level, shift in the allocation of funds for research and development (R and D) had a dramatic impact upon the industrial structure in western countries. The efficiency of developed economies in science-intensive industries increased greatly by comparison with their efficiency in other industrial activities. Structural changes such as these altered some of the basic conditions faced by the potential exporters in developing economies. The developed economies' demand for light manufactures like consumer goods rose, stimulated by a rapid growth in income. At the same time the resource claims of other sectors and activities such as science-intensive industries received a higher priority. Under these circumstances it is not surprising that the developed economies' technological and innovative lead in traditional industries such as textiles, clothing, footwear, leather products, etc. was reduced while predominance in many science intensive activities was extended. These structural change in conjunction with the adjustments in international policy, has made the shift to export promotion a more feasible alternative in since the 1960s. Structural changes with in the developing economies also has provided a major impetus for the transition to export promotion. The growth of commercial and industrial experience, managerial know-how, a skilled labour force and the acquisition of transport and communication facilities in a limited number of developing economies meant that exporting became a feasible alternative. As Maizels argued, 'The product of home manufacturing industry tends to spill-over into the export market'(Maizels, 1963, p.64.).

Outstanding performers have been the Asian NICs such as South Korea, Taiwan, Hong Kong and Singapore. During the period 1970-1990 manufacturing output in the East Asian and Pacific developing economies grew 10.5 per cent per annum- a rate far exceeding the pace of other sectors. Accordingly, as successful export performers, they demonstrated that this transformation involves a substantial increase in the share of manufacturing in GDP and a remarkable shift away from dependence on primary exports towards manufactured goods as a source of foreign exchange. By 1990 they accounted for 73 per cent of all the developing economies' exports of manufactures (Page, 1994).

However, the ELG strategy has not been free of criticism. In recent years, a new wave of export pessimism arrived on the scene. There are two main sources generating this second export pessimism (Bhagwati, 1986). The first source of protectionist sentiments is the assertion that during the recession years of the late 1970s and early 1980s, ELG strategies must have suffered a greater adverse impact than the IPS strategy in view of their exposure to the external environment. Riedel (1988), however, argues that the widely held view that prosperity in developed economies plays a preponderant role in determining long-term growth in developing economies, rests on assumptions that are increasingly inappropriate. Presenting evidence from 52 developing countries in the 1970s, Riedel finds that foreign market growth is not a binding constraint on exports from developing economies. Balassa's (1982) cross-section analysis of comparative performance of a number of ELG and IPS economies during this period, suggests little to confirm the assertion that ELG strategy has made countries far worse. In fact, the evidence seems to suggest that ELG economies adjusted better to the oil price shocks of the 1970s. One possible explanation is that an ELG economy inherently has more flexibility to respond to shocks than a relatively closed economy where the only goods imported are intermediate and capital goods essential to the maintenance of economic growth. The existence of a margin of imports of consumer goods means that a combination of expenditure-reducing and expenditure-switching policies can adjust the balance of payment without the need to curtail growth.

A further source of export pessimism is that the recession in the industrial economies in the 1970s coupled with fears of protectionist measures by these countries in the 1980s, implies that ELG strategy is no longer a viable option. It is argued that the Asian NICs model cannot be exported because if every developing country exports like them, the world cannot possibly absorb the resulting exports (Cline, 1982; Streeten, 1982). In this regard, any individual developing economy could certainly embark upon an ELG strategy. However, if all, or at least a large number, of developing countries embarked upon such strategy, this activity would certainly dramatically increase the penetration of the developed economies' markets, especially for manufactured goods. One would think that this would certainly lead the developed countries to seek to protect their markets from such a deluge. Thus, what might be possible for one or a few developing economies may not be possible for the group in general (Cline, 1982). However, there is no reason to conclude that an ELG strategy would yield for every country, the same share of exports to Gross National Product as for the current economies of Asian NICs. Even if this were true, Ranis (1985) argues that the substantial growth of per capita income resulting in the exporting developing economies would enable them to increase their imports from the industrial economies as well as each other. A boost in the developed economies' exports would prove a powerful counterweight to any protectionist lobbies (Lewis, 1980). Besides, extrapolation ignores the fact that trade can occur in all kinds of differentiated products and in unpredictable ways (Bhagwati, 1986).

Another line of criticism concerns the view of technology and its transfer. Pack and Westphal (1986) has noted that technology is characterised by a considerable element of tactics, difficulties in imitation and teaching, and uncertainty regarding what modifications will work and what will not. In other words, it is possible to master a particular technology appropriate to particular circumstances without actually applying it. Thus, the learning of a technology comes only from experience with its use. It would seem, then, that IPS strategy through protection may be a necessary first step in the process of growth.

On theoretical grounds, one might expect that participation in international trade would increase employment in developing countries, as these countries are supposed to have comparative advantages in products that are produced with labour intensive techniques of production. However, policies of import substitution have simulated relatively capital intensive techniques of production, which has led to less employment per unit of capital, or per unit of GDP. In a comparison between developing countries concerning their growth rates of employment in manufacturing, the World Bank found that this growth rate was higher in countries with outward-oriented economic policy.

3.4. Conclusions

The ongoing debate on economic performance under alternative trade strategies has been a spring of persisting controversy over a post-war period. Some economists have claimed that ELG strategy performs an impoverishing function in the growth process of developing economies. Others claim that ELG strategy is a means of enrichment in the new integrating world. The former strands of thought is based on the argument of structural distortions and unequal gains from international trade. Thus, they provide a rationale for a growth strategy that orients investment towards production for the domestic market. The latter strands of thought based on the argument that emphasises the interconnection between trade and growth and stresses the potential benefits for economic investment stimulated by openness, reliance on market mechanisms and orientation toward producing for the export market.

The debate has taken many dimensions, which include, among others, the examination of ELG strategy on economic growth, catching-up, employment, and income distribution, technology and the balance of payments. However, currently the developing economies have been witnessed an explicit tendency towards opening up their economies. The move towards international integration has been evident through successive rounds of trade liberalisation conducted. In this regard, ELG strategy is taken as an imperative.

Accordingly, having discussed ELG strategy issues, it is within this framework that we are going to investigate the econometric empirical works that have been conducted in analysing the role of export expansion in promoting economic growth in developing economies in the next chapter.

CHAPTER FOUR

IV. EXPORTS AND ECONOMIC GROWTH:

A SURVEY OF EMPIRICAL INVESTIGATION

4.1. Introduction

The relationship between export expansion and economic growth has long been an important topic of theoretical and empirical analysis. The outcome of this analysis has policy implications: whether the observed disparity in long-run growth across countries or time can be explained by the variations in the intensity of exports, and whether the future growth path can be potentially be affected by changes in trade policies.

On the empirical level a number of studies have examined the significance of export expansion in generating better economic performances in developing economies. These studies have been conducted in several divergent approaches. The work originally done on a bivariate level to test the correlation between exports and economic growth in levels and then in terms of rates of growth concentrating on simple correlation (Emery, 1967; Kravis, 1970 and Michaely, 1977) and OLS regression (Balassa, 1978) methods.

Michaely has worked with the growth in the share of exports in GDP as his export variable, arguing that since exports are part of the GDP a positive correlation of the two variables is almost inevitable. Latter writers, who have continued to use export itself in their empirical analysis, have challenged this. Tests were also conducted using other economic growth determining variables such as labour and capital in the production function type methodology. This methodology was originated in the work by Michalopoulos and Jay (1973) and was used by Balassa (1978 and 1984), Moschos (1989) and Salvatore and Hatcher (1991). Several studies have subsequently estimated aggregate production functions that include exports as an explanatory variable for cross sections and time series data of developing economies.

One problem often accentuated in the literature arises from the fact that exports, through the national income accounting identity, themselves are components of output. Four main approaches have been used in dealing with a problem. The first approach has ignored the problem. The second approach has net out the exports element from the output growth variable, and run what amounts to a regression of the growth rate in non-export GDP against the usual right-hand side set of variables. The third approach is to model the effects of exports on output explicitly as the sum of an externality effect and a productivity differential effect (Feder, 1983). A fourth approach has recognised this problem as arising due to endogeneity of the export growth variable within an output growth equation (Dorwrick, 1992). Simultaneous equation models have handled this.

From the point of view of demand side Keynesian macroeconomics, economic growth is determined by demand side variables (investment, consumption and exports among others). Accordingly, exports are considered as an injection to macroeconomic circular flows that their expansion have a strong multiplier effect on expenditure side of GNP growth.

There also exists an export pessimism in cross sectional studies undertaken by scholars such as Jaffe (1985), Bradshaw (1985), Dolan and Tomlin (1980), Rubinson and Holtzman (1981). These studies focus on structural characteristics of trade- the volume, composition, and concentration of trade which includes concentration of leading exports and leading trade partners. These characteristics are combined with other presumed determinants of economic growth into a single equation multiple regression model. These studies provide a pessimistic conclusion regarding the role of trade in developing economies development vis-à-vis the optimists argument (Sprout and Weaver, 1993). In fact, the empirical studies are essentially extensions of two competing perspectives on trade and growth in developing economies that emerged in the 1950s. The first perspective finds some of their foundation in the writings of Viner (1953), Myint (1954-55), and Haberler (1959). In its strongest expression, this perspective - sometimes referred to as neo-classical - has viewed trade as an "engine of growth". The second perspective has drawn from the theories of Prebisch (1950), Singer (1950), and Myrdal (1957). Some have embraced elements from dependency perspectives for example, from Frank (1969), Arghiri Emmanuel (1972), and Amin (1976). Scholars in this tradition have contended at least that the gains from trade are asymmetrically distributed. However, there are eclectic works that has aimed to bridge the two groups econometric studies; that is to shed light on the relationship between exports and economic growth by testing the relationship in an econometric model that draws on both groups. In this context the work of Sprout and Weaver (1993) is cited as an important example. Their study has been able to endogenise export growth in a structural simultaneous equation model.

Recently, great emphasis has been laid on the causality (un and bi-directional) between export expansion and economic growth. The issue of cointegration has not been considered in the above methodologies. With the creation of time series databases and the development of new time series techniques such as cointegration, studies followed the pioneering works of Junge and Marshall (1985) and Chow (1987). Bahmani-Oskooee and Alse (1993) and Ghatak and Utkulu (1994) and Ghatak et al. (1995 and 1997) have conducted cointegration approach for export expansion economic growth relationship. The formers have conducted Granger two step cointegration approach in bivariate context. Based on neo-growth models, Ghatak et al. (1995 and 1997) has conducted various cointegration approaches in bilateral and multivariate context using aggregated and disaggregated exports variables. Indeed, the last few years have witnessed an explosion of studies on different countries or aspects of the export-growth relationship using various time series techniques (Ghatak et al. 1995 and 1997). Many of the studies have considered export expansion as a main determinant of production and employment growth of an economy. They have obtained mixed results in substantiating the hypothesis of export-led growth arguments. It is within this framework that we are going to synthesise the existing empirical investigation of export expansion and economic growth.

4.2. The Correlation Test

Michaely (1977) examined the hypothesis that a rapid growth of exports accelerates the economic growth. He argues that since exports constitute a substantial portion of GNP, a positive correlation between the two growth rates is inevitable whatever the causal relationship between them. To avoid the problem related to GNP, he used an exports share of GNP for a sample of 41 developing economies for the period 1950-73, the correlation between the two magnitudes, as measured by the Spreaman rank correlation coefficient (r') was found to be 0.380, significant at the 1 per cent level. These countries were subsequently divided into two groups- one consisting of 23 countries with a 1972 per capita income of above $300, and the other of the 18 countries with a per capita income of $300 or less. In the first group, the coefficient of rank correlation between the two variables was found to be 0.523 (significant at 1 per cent level); whereas in the second group, it was particularly zero (-0.04). These results led Michaely to conclude that growth is more strongly affected by export performance when countries have achieved some minimum level of economic growth. Thus, Helleiner (1986), for instance, in a study of low- income countries heavily weighted towards Sub Saharan Africa, concluded that the results for 1960-1980 show no statistically significant link between the change in export share of GDP and growth. In other study of Sub- Saharan Africa, wheeler (1984) found similar results.

Heller and Porter (1978) criticised Michaely's empirical test on the grounds that his correlation is 'spurious'. Following their approach, let: - $Y = D + X$ (4.2.1)

Where: $Y =$ GNP

$X =$ Exports

$D = C + I + G - M$

Then: $y = (1 - X/Y)de + (X/Y)x$ (4.2.2)

Where C, I, G, and M represent consumption, investment, government expenditure and imports respectively, each lower case letter represents the per annum growth rate of the corresponding capital- letter symbol. In other words, identity (4.2.1) has been converted into identity (4.2.2), which relates growth rates. Taking into account the population growth rate (p), identity (4.2.2) can be written as:-

$y - p = (1 - X/Y)(de - p) + (x - p)X/Y$ (4.2.3)

Michaely tested the correlation between (y-p) and (x-y). Re-writing equation (4.2.3) as:

$$y-p = de-p + (x-y)[(X/Y)/(1-X/Y)] \quad (4.2.4)$$

It can be seen that Michaely's correlation contains a spurious element: any change in the growth rate of the export share of output (x-y) will change the output growth rate (y-p) in the same direction even if it causes no change at all in the growth rate of the other components of output (de-p). According to Heller and Porter the correct correlation is between (x-p) and (de-p) can capture how the growth of exports is related to the growth of non-export components of output. Using Michaely's data, r' was found to be 0.452, significant at 1 per cent. Separating the sample in to richer and poorer economies (the dividing line being $300 per capita output in 1973), r' was 0.568 for the richer group and 0.097 for the poorer group. This seems to reinforce Michaely's conclusion that the growth is affected by export performance only once countries achieve some minimum level of economic growth.

So far no explanation is given for the apparent lack of association of export expansion and growth in least developed economies. One possible explanation may be that the advantages of export- led growth (i.e. increases in productivity due to competitive pressures from abroad, internal scale economies, etc.) have more to do with exports of manufacturing goods (from the more developed economies) rather than with the exports of primary commodities (from the least developed economies). Even if this were not true, it could be argued that lack of infrastructure in least developed economies prevents the benefits associated with exports from being transmitted to the rest of the economy. Another line of argument relates to the first stage of IPS (as opposed the second stage of IPS). The latter is generally associated with countries that have achieved some minimum level of economic growth, involves the establishment of industries that produce durable consumer goods and more capital- intensive intermediates.

It could be argued that the first stage of IPS, which is generally associated with least developed economies, is characteristically easy because it involves the production of non-durable consumer goods whose production requirements are well suited to the conditions existing in countries without previous industrial experience. These goods are intensive in unskilled labour and unsophisticated technology, and there is no need for a network of suppliers of parts, components, and accessories. In short, IPS economies of this type should be able to produce economically their own non-durable consumer goods. This narrows the gap between the growth performances of relatively closed IPS economies and those of more open economies, and justifies the lack of a positive relationship between export expansion and economic growth in low-income economies.

Moreover, it could be argued that the 'high export performances' among low-income economies are not EP countries, and they do not therefore benefit from the market incentive related advantage of Export Promotion strategies.

The results reported thus far point to a positive but not very robust relationship between export performance and economic growth. However, once the low-income countries are excluded from the sample, the relationship seems to be strong. For example, utilising sample of 11 countries, which had established an industrial base, Balassa (1978) found positive and significant for Michaely and Heller and Porter- type correlation coefficients for the 1960-73 period.

4.3. Production Function Estimates

Aggregate production function is often used to estimate the sources of the developing economies' economic growth. It has been argued that an export is a key variable to account for an additional variable for several reasons: foreign competition leads to more efficient resource allocation and stimulates technical progress, an export allows the exploitation of scale economies in production.

In past studies an export variable has been taken as a proxy for the openness of an economy's trade regime and incorporated into an aggregate production function. There are two main variants of this function. The first, proposed by Balassa (1978) on the basis of Michalopoulos and Jay (1973), simply includes export volume or value growth as an additional variable with the growth of factor inputs. Accordingly, Tyler (1983) specifies a production function incorporating three productive factors such that:

$Y = AK^{a} L^{b} X^{c}$ (4.2.5)

Where: Y= GDP,

A= technological constant,

K= capital stock,

L= labour force,

X= exports.

The inclusion of exports in a production function type relationship is warranted on the grounds that exports tend to raise total factor productivity for reasons adduced in our previous and above discussions.

Total differentiation of equation (4.2.5) and subsequent division by (Y), yields:

$y/Y = A^{\square}/A + a(k/K) + b(l/L) + c(x/X)$ (4.2.6)

Making the assumption that investment growth rate corresponds to the increase in capital stock, the sources- of- growth equation (4.2.6) was estimated using cross-sectional data from 55 middle-income countries in the period 1960-1977. The coefficient for export growth was found to be positive and statistically significant (at the 5 per cent level). A 1 per cent level increase in exports is associated with a 0.057 per cent increase in GDP growth. The addition of the export variable, however, does little to increase the coefficient of determination (when compared to the original neo-classical model).

Allowing for a disaggregation of capital formation into domestic and foreign investment and using data for 39 developing countries in the period 1960-66, Michalopoulos and Jay (1973) found that inter-country differences in domestic and foreign investment and in labour growth explained 53 per cent of the intercountry variation in the GNP growth rates. Adding an export variable raised the coefficient of determination to 71 per cent.

Applying the same method to the pooled data of 10 developing countries in the 1960-73 period, Balassa (1978) showed that adding the export variable in the regression equation raises the coefficient of determination from 0.58 to 0.77. The coefficient of the export variable (which is significant at the 5 per cent level) has the same value as in Michalopoulos-Jay equation, indicating that a 1 per cent increase in the rate of growth of exports is associated with a 0.04 per cent increase in the rate of growth of GNP.

Feder (1983) proposed a variant of the above approach, which he decomposes the growth effect of export expansion into two: a part due to productivity differentials between export (X) and non-export (N) sectors, assuming that export production has the higher marginal factor productivity, and a part due to positive externalities from the export to the non-export sectors. Assume that the sample economies have two sectors, with export production having an externality effect on non-export production.

Feder develops an analytical framework that incorporates the possibility that marginal factor productivities are not equal in the export and non-export sectors of the economy. The implication of the beneficial aspects of ELG strategy is that marginal factor productivities may be higher in the export sector. Instead of an aggregate national production function, the output of each sector is a function of the factors allocated to the sector. In addition, the output of the non-export sector is dependent on the volume of exports produced. This formulation represents the beneficial effects of export expansion on other sectors. Following Feder (1983), Falvey and Gemmell (1989) and Greenaway and Sapsford (1994), the production functions for the two sectors can be formulated as follows:-

$$N = N(Kn, Ln, X), \qquad (4.2.7)$$

$$X = X(Kx, Lx), \qquad (4.2.8)$$

Where N = non-exports, X= exports, Kn, Kx = respective sector capital stocks, Ln, Lx = respective sector labour forces.

Since data regarding sectoral allocations of primary production factors are not readily available, a specification is required which will allow estimates of sectoral marginal productivities using aggregate data. This is accomplished as follows: Consider that the ratio of respective marginal factor productivities in the two sectors deviate from unity by a factor d, which Feder presents as $Xk/Nk = Xl/Nl = 1+d$, (4.2.9)

Due to the advantages of ELG strategy, marginal factor productivities are plausibly to be higher in the export sector (i.e., $d > 0$). Where ($^{\square}$) represents changes, differentiation of equations (4.2.7) and (4.2.8) yields:-

$$N^{\square} = NkK^{\square}_{N} + NlL^{\square}_{N} + NxX^{\square} \qquad (4.2.10)$$

$$X^{\square} = XkK^{\square}x + XlL^{\square}x \qquad (4.2.11)$$

Representing GNP by Y, and since by definition $Y = N+X$, it follows that:

$$Y^{\square} = N^{\square} + X^{\square} \qquad (4.2.12)$$

Using equations (4.2.8)- (4.2.11), equation (4.2.12) becomes:

$$Y^{\square} = NkK^{\square}_{N} + NlL^{\square}_{N} + NxX^{\square} + XkK^{\square}x + XlL^{\square}x = NkK^{\square}_{N} + NlL^{\square}_{N} + NxX^{\square} + Nk(1+d)K^{\square}x + Nl\,(1+d)L^{\square}x \qquad (4.2.13)$$

Presuming exogenous change in labour, consequently, equation (4.2.13) can be written as:

$$Y^{\square} = Nk(K^{\square}_{N} + K^{\square}x) + dNk\,K^{\square}x + Nl\,(L^{\square}_{N} + L^{\square}x) + dNl\,L^{\square}x + Nx\,X^{\square} = Nk\,K^{\square} + Nl\,L^{\square} + NxX^{\square} + dNkK^{\square}x + dNl\,L^{\square}x \qquad (4.2.14)$$

Recall that equation (4.2.9) and (4.2.11) imply:

$$X^{\square} = Nk(1+d)K^{\square}x + Nl(1+d)L^{\square}x, \text{ where } [X^{\square}/(1+d)] = [1/(1+d)](XkK^{\square}x + XlL^{\square}x) \qquad (4.2.15)$$

Using this outcome, equation (4.2.15) ultimately capitulates a simple equation for the sources of GNP (Y) growth where investment (I) equals $K^{\square}$:

$$Y^{\square} = NkI + NlL^{\square} + [Nx + d/(1+d)]X^{\square} \qquad (4.2.16)$$

Dividing equation (4.2.16) by Y, denoting $Nk = a$, and assuming further the production for the non-export sector satisfies the condition that $Nl = b(Y/L)$ (see Bruno, 1968) following some manipulation (4.2.16) is reduced to:

$$Y^{\square}/Y = a(I/Y) + b(L^{\square}/L) + [Nx + d/(1+d)]\,[X^{\square}/X][X/Y] \qquad (4.2.17)$$

The delineation of equation (4.2.17) is criticised by Ocampo (1986), since it assumes no diminishing returns to an increasing exports share.

The decomposition of the export-variable coefficient into its components is achieved by adopting a logical specification for the variable X. Consequently, involves both the superior productivity of the export sector (if d>0) and the positive externality creates for the non-export sector if Nx >0. Feder assumes that exports affect the production of non-exports with constant elasticity, i.e., $N = N(Kn, Ln, X) = X^h Q(Kn, Ln)$, (4.2.18)

Where h is a parameter:

It can be shown that $\Delta N/\Delta X = Nx = h(N/X)$ (4.2.19)

Equation (4.2.17) can now be written as:

$$Y^{\square}/Y = a(I/Y) + b(L^{\square}/L) + [h(N/X) + d/(1+d)](X^{\square}/X)(X/Y) \quad (4.2.20)$$

Using the fact that N = Y-X, (4.2.20) is rearranged as:-

$$Y^{\square}/Y = a(I/Y) + b(L^{\square}/L) + h(X^{\square}/X) + [d/(1+d)-h](X^{\square}/X)(X/Y) \quad (4.2.21)$$

The formulation in equation (4.2.21) provides estimates of the overall productivity and externality effects of exports upon economic growth. Note that if marginal factor productivities are equalised across sectors (d=0) and if there are no inter-sectoral external economies (h=0), then equation (4.2.21) reduces to the familiar neo-classical formulation of the sources of growth model.

Employing cross-sectional data from 31 semi-industrialised countries in the 1964-73 period, Feder found that a 1 per cent increase in export growth was associated with a 0.075 per cent increase in GDP growth via productivity differences, and a 0.131 per cent increase through externalities. The important difference between the Tyler (1983) and Feder (1983) approaches is that in the former export growth is taken as a proxy to the trade regime, but with the latter the direct impact of export growth on income growth is estimated. Both functions have estimated in cross-section studies of developing economies' growth, using average growth rates over a period of years. In general they have given significant, positive results for the export variable, although this does not always hold for low-income countries.

Using export expansion variables as a proxy for the nature of the trade policy pursued contains an implicit bias. Using an export expansion variable defines trade policy in terms of the export growth actually achieved, thus defining successful export promotion as superior to a neutral trade policy. While, other things remain equal, a more open trade regime may be expected to have a higher rate of export growth due to greater incentives for export production, this still depends on the response of agents in each country. Assume that developing economies are small in the trade theory sense, i.e. they face infinitely elastic demand for their exports. In this case their supply of exports will be completely supply-determined, although even here it will still depend on the propensities and capabilities of domestic entrepreneurs. Variations in the supply and capabilities of domestic entrepreneurs would therefore explain both comparative export and income growth rates, which would wrongly be ascribed to trade regime in these works. If the small country assumption is relaxed, then product characteristics, marketing abilities and knowledge may determine the growth of exports, along with trade regime.

Though the above works take the export growth variable as an indicator of trade regime and thus as a proxy for the static and dynamic gains of export-led growth, there is the alternative hypothesis that the primary gain from increased exports derives from the expansion in the capacity to purchase imports (Ram, 1985, p. 418). If this is the case then the growth of the purchasing power of exports over imports would give a better estimate in (4.2.10) than export growth, but these studies acknowledge the role of exports in financing imports though this has not been estimated directly. There is a further reason for considering this argument. It may be the case that differences in the apparent returns reflect differences in the terms of trade histories through different growth rates of import capacity for a given export growth. Some studies have divided samples by major products exported to test the hypothesis that productivity and externality effects will be stronger with manufacture exports (Tyler, 1981; Kavoussi, 1984; Balassa, 1985; Fosu, 1990 and Dodaro, 1991). Note that this would make the magnitude, or even the existence, of the hypothesised effects contingent on export structure.

4.4. Simultaneous Equation Estimates

Sprout and Weaver (1993) have undertaken their empirical investigation using a two-stage simultaneous equation model. Their model consists of three simultaneous equations. The first equation represents an effort to measure directly the effects of export growth on economic growth. They incorporate the export pessimist literature's focus on trade structures by including such structural characteristics in the second and third equations as determinants of domestic investment and export growth, respectively.

In this way, they measure the impact of trade structures on economic growth indirectly through two channels. They also measure the impact of trade structure-economic growth relationship directly by grouping some developing economies according to the composition of their exports. The third equation, which posits export growth determinants, addresses the issue of feedback from economic growth to exports. It also taps into literature that has been attempting to measure the extent to which the export sector is influenced by internal supply factors versus external demand forces. They investigate the extent to which export pessimism is justified based on the literature including the works of Singer and Gray (1988), Kavoussi (1985), Riedel (1984), Lewis (1980) and Kravis (1970). Their model equations are specified as follows:

$$GNP = a1 + a2(I/Y) + a3\,L + a4\,X \qquad (4.2.22)$$

$$I/Y = b1 + (b2)GDPPC + (b3)GNPPC + (b4)XS + (b5)FDI \qquad (4.2.23)$$

$$X = c1 + (c2)GNP + (c3)P + (c4)TPG + (c5)TPCON + (c6)TS \qquad (4.2.24)$$

Where:-

GNP = growth of real GNP

I/Y = Gross Domestic Investment as a percentage of GDP

L = Growth of the Labour force

X = Growth of real exports (X1), or Growth of export share of GDP (X2)

GDPPC = Real GDP per capita

GNPPC = Growth of real GNP per capita

XS = Export share of GDP (exports as a percentage of GDP)

FDI = Capital inflow (net imports of goods and services) as a percentage of GDP

P = Price competitiveness (inflation and exchange rate changes in the developing economy relative to its 5 leading trading partners).

TPG = Trade Partner's growth (weighted average of real GNP growth of the developing economy's 5 leading partners).

TPCON = Trade Partner concentration (proportion of total exports received by the LDC's 3 leading trading partners).

TS = Trade structure (composite average of the value of primary exports as a percentage of total exports (PRIMX) and the trade partner concentration).

In equation (4.2.22), they hypothesised that economic growth (GNP) is a positive function of the growth of the two primary factors of production, capital and labour, as well as the growth of the export sector. Gross domestic investment as a percentage of GDP (I/Y) and the growth of the labour force (L) are taken as the proxies for capital and labour respectively. They measured X in two ways: as the annual percentage change in the real exports and as the growth of the proportion of exports to GDP. In equation (4.2.23), they hypothesise that investment (I/Y) depends on the level of real GDP per capita income (GDPPC), the growth of real GNP per capita income (GNPPC), the size of the export sector (XS), and foreign capital inflows (FDI).

In equation 4.2.24, they hypothesise that the growth of exports (X) is a function of (a) the economic growth rate of the developing economy (GNP); (b) the price competitiveness of the developing economy relative to its trading partners (P); (c) the economic growth of the developing economy's main trading partners (TPG); (d) the degree to which the developing economy's exports are confined to a few trade partners (TPCON); and (e) a composite measure of the developing economy's composition and concentration of exports (TS). Following from Kravis and others, they viewed these dynamics as either determinants or indicators of external demand or internal supply conditions or both. TPG and TPCON are considered as proxies and/or determinants of external demand, GNP of internal supply, and P and TS as combinations of the two. They have tested the data for 72 developing economies over a 15-year period, 1970 through 1984. Their analysis is cross-national. Each observation represents a country; each figures a 15-year average. Their results show that differences in the size of the X coefficient among the three groups. Using the growth of real export (X1) and the growth of exports share (X2), they find a 1 percent increase in export growth associated with a 0.31 percent and 0.63 percent increase in domestic investment and economic growth, respectively, in the small non-primary product exporting developing economies (SNP). This contrasts with 0.10 and 0.03 for the small primary product exporters (SP), and 0.18 and 0.54 for large developing economies (L). Statistical significance is achieved at roughly either the 5 percent or 10 percent level in the results of the SNP and L tests. For SNP and L, the X coefficients in particular are quite large relative to most previous measurement attempts. Thus, they come to the conclusion that export growth may contribute more to economic growth among these groups of developing economies than previously believed.

They have found that the positive and generally statistically significant XS-(I/Y) relationship in all three groups of countries. While supporting the export-led growth hypothesis findings, their study is also compatible with test results in the export pessimist literature. Specifically, most of the export pessimist studies while theorising an adverse impact of XS on economic growth found little to confirm this hypothesis. Here, XS seems to have the greatest effect on FDI among the largest developing economies.

In equation (4.2.24) they found some indications that economic growth contributes to export growth, though the results are mixed. With X1, SNP and L show results of a positive and statistically significant (at the 10 percent level) GNP-X relationship. The effect of economic growth on export growth is greatest among the large developing economies. SP exhibits a negative (and statistically significant) GNP-X relationship. With X2, however, the GNP-X relationship is inverse with SNP while positive among SP. The GNP coefficient is again the largest among L, though not statistically significant. Their result show that greater price competitiveness (P) may contribute as theorised to greater export growth among the small developing economies. The positive relationship seems to be the strongest among SP. Only in the X2 test results of SP, however, is statistically significant achieved. The P-X relationship is inverse in both models for L. With X2, however, the P coefficient in L is quite small; in both models, the results are statistically insignificant. Only for SNP they have found greater economic growth among the major trading partners (TPG) to be associated with greater export growth. In the other two groups, the TPG coefficient is curiously negative. Statistical significance is not obtained in any of the three groups in this relationship. The contention that demand for developing economy products, thus, export growth is constrained by insufficient growth in the industrialised countries finds little support in this particular work.

In contrast to the dependency perspective, one finds greater concentration of trading partners to be associated with greater export growth. Only among SP with X2 that the positive relationship is statistically significant. Besides, the hypothesised inverse relationship, between the proportion of primary exports and concentration of export goods is justified by their empirical results in all three samples. While the relative strength of the relationship between groups varies, statistical significance is more prevalent in the large developing economies. Their work shows that trade structure characteristics do seem to adversely affect economic growth via export growth.

Lee and Cole (1994) in their empirical investigation of simultaneity in the study of exports and economic growth have employed a two-stage simultaneous equation model for 72 developing economies excluding the OPEC countries for the two time periods: 1960- 70 and 1970- 77. Thus, the rate of growth of exports is then treated as an endogenous variable with the equation in a number of cases in which various plausible combinations are assumed for the system. The 2SLS results in this case amplify the earlier findings but tend to show that exports probably play a more important role than was previously indicated.

Khan and Saqib (1993) have examined the relationship between export performance and economic growth in time series simultaneous equation framework in the case of Pakistan. The influence of exports on economic growth has been measured by specifying an exports augmented neo-classical production function. Exports on the other hand, have determined by the combination of both the domestic and the foreign factors. Besides total exports, their work have taken the analysis down to the level of manufacturing and primary goods exports and examined their relationship with the economic growth. Furthermore, they have attempted to measure the indirect effects of exports on economic growth by estimating the relationship between export performance and growth of GDP net of exports. They have employed the Three-Stage Least Squares (3SLS) technique to estimate the systems of simultaneous equation. Thus, they find a strong association between export performance and GDP growth as a support to earlier studies. They have also argued that if simultaneity between exports and economic growth is ignored the contribution of export expansion on GDP growth will be understated. In their further disaggregation they have revealed that marginal contribution of primary goods exports on GDP growth is higher compared with the manufactured exports. This is consistent with the fact that Pakistan has been rely more on primary goods exports.

Their work also has shown that more than 90 percent of the contribution of exports on economic growth is indirect in nature. The foreign income elasticity of demand for exports is found to be much higher compared with the domestic income elasticity of supply of exports. Their finding indicates that Pakistan's exports are more responsive to changes in foreign income rather than in domestic income. Moreover, the foreign income elasticity of the demand for manufactured exports is found to be considerably higher than the demand for primary goods exports. Based on these two information they have suggested that Pakistan should orient her exports towards manufactured goods based on open development strategy emphasising export-orientation rather than import substitution.

By and large, the above empirical observations demonstrate that developing countries with a favourable export growth record tend to enjoy higher rates of growth of national income. A number of studies, however, have demonstrated that export growth tends to be associated with GNP growth by a factor greater than would be expected merely from their place in the national income identity. This result has been interpreted as evidence in favour of export promotion. Some of the studies have introduced the exports as one of the arguments of the production function, using a Solow-type analysis to differentiate the contribution of capital accumulation, labour force expansion and exports to the growth of GDP. The significance of the export variable has been viewed as a documentation of the advantages of export-led growth strategy. Dominick Salvatore and Thomas Hatcher (1991) have articulated the shortcomings of such studies. First, the results of the econometric cross-national studies tend to be quite sensitive to the choice of samples and estimating techniques. This probably applies even more so in the case of simultaneous equation models. Second, the simplifying assumption of similar production functions across sectors and countries is a gross oversimplification. Third, the direction of causality between trade and growth remains unclear from these regression analyses. Finally, and probably most importantly, these econometric models cannot hope to capture but a partial aspect of the trade- economic growth relationship, in particular, short-run static relations. The long run and the more dynamic aspects elude the models. Even more partial is what is being captured as regards the role of trade in development. There is much more than economic growth to the development process, and much more than economics that is affected by international trade.

4.5. Testing for Causality between Export Expansion and Growth

Most of the studies have assumed a direct relationship between export expansion and economic growth, they have implicitly assumed the causality runs simply from the former to the latter. However, this assumption cannot be made without supporting evidence, while causality testing in principle might offer a solution to the inevitable correlation position. In fact, there has been a time series Granger (1969) causality test that seeks to establish whether over time a particular variable regularly precedes another.

The Granger (1969) test essentially states that variable X 'causes' variable Y if lagged values of X are significant in explaining Y_t in a regression with lagged value of Y. The Sims (1972) test, regresses Yt on past, present and future values of X. Jung and Marshall (1985), Darrat (1987) and Bahmani-Oskooee and Shubgigh (1991, p. 412) have applied the Granger causality test to determine whether exports cause growth or vice versa. These studies have obtained mixed results.

The most surprising result is that Jung and Marshall's (1985) estimate indicates that in the case of South Korea output growth was leading to reduced export growth. This may be a spurious association: South Korea's exports grew rapidly from a small base levels in the 1960s, and for this reason the export growth rate may have fallen over time as income growth accelerated. Chow (1987) made a similar study on the export-manufacturing output growth for eight NICs. In one case no causality was detected, with another export-led manufacturing growth was indicated, and in the other six cases two-way causality was indicated. Hsiao (1987) made further estimation on the direction of causality between exports and GDP growth amongst the East Asian four. These were generally inconclusive except for Hong Kong, where significant GDP growth to export growth, without feedback effects, was indicated. Ahmad and Kwan (1991) applied this analysis to African countries, finding little support for causality between exports and growth in either direction.

However, the interpretation of these causality tests is suspect. As an econometric techniques they may not be robust. The Granger definition of causality is not equivalent to causation as the term is normally understood: precedence is not sufficient for causality (Leamer, 1985), and causality is a rather strong term for such relations. Moreover, the choice of lags and periods could be crucial with these studies: GDP growth at t-1 might appear to cause export growth at t when it had actually been caused by export growth at t-2. Moreover, the test of whether, exports cause growth will fail to detect the effect on growth of contemporaneous innovations in exports. Finally, the exclusion of other variables from the information set will result in specification errors. Bahmani-Oskooee and Shubgigh (1991) have found evidence of export-led growth amongst East Asian economies, but not amongst inward looking developing economies. However, again the largest group is those for which no significant estimate could be made. This is not surprising with their efforts to explain output growth solely by export growth, or vice versa, and by using relatively short lag periods. It is nevertheless quite implausible that export expansion and economic growth have no impact each other. One of the most important problem with the past causality tests are they have not considered the time properties of time series data considered. The have not conducted unit roots and cointegration tests. Moreover, bilateral causality test (e.g. between exports and GDP) does not incorporate the impact of other variables that may not provide dependable empirical result.

4.6. Conclusions

The idea that export expansion is one of the major determinant of output growth (export-led growth strategy in this context) is a legitimate and interesting area of research in international economics. In this regard, export-led growth or liberalisation in this context is considered as, or lead to, more rapid export expansion (Colman and Nixson, 1994, p. 319). In order to substantiate the analytical argument, extensive econometric empirical studies have been conducted. Thus, there exists an extensive empirical literature on exports expansion and economic growth.

Recently, these works have been reviewed by Ahmad and Kwan (1991), Edwards (1993), Ghatak et al., (1995 and 1996), Ghartey (1993), Greenaway and Reed (1990), Greenaway and Sapsford (1994), Junge and Marshall (1985) and Love (1994). Many of these works find evidence of some association between exports expansion and economic growth for the support of export-led growth hypothesis. Some studies identify a 'threshold effect', thus, economies must reach some minimum level of per capita income before the full benefit of export expansion can be realised (Colman and Nixson, 1994, p. 319). Particularly, since 1960s there have been a steady flow of cross-section econometric tests of export expansions and economic growth (Sprout and Weaver, 1993). Most of these studies have tested the export growth-economic growth relationship in a single equation. The most widely cited studies of this kind have included Michaely 's (1977) which is entirely based on Spearman rank correlation, Bela Balassa (1978 and 1985), Kavoussi (1984), Feder (1983), Tyler (1981). Other scholars have attempted to capture the relationship in a simultaneous equations model (Esfahani, 1991; Kader, 1988; Karunaratne, 1986; Salvatore, 1983; Sprout and Weaver, 1993; Khan and Saqib, 1993). There have also been efforts to test time series data to measure better the direction of causation between export growth and economic growth by various single equation techniques (Chow, 1987; Darrat, 1987; Hsiao, 1987; Jung and Marshall, 1985; Khan and Saqib; and Sprout and Weaver, 1993).

In general, the correlation- type results reported earlier point to a positive and significant relationship between exports and economic growth in middle-income economies. These findings, however, do not bear directly on the question whether Export-led growth strategy is associated with a higher rate of economic growth. Similarly, the regression-type results provide evidence favouring the export-led growth hypothesis, but do not bear directly on the question whether export-led growth strategy causes more growth.

Feder recognises the association between exports and economic growth, indicated by his 1983 paper, stems from the fact that exports are the main source of foreign exchange (in terms of foreign- made capital and imports of intermediate goods). In considering the foreign exchange aspects of exports, Feder concludes that both the earlier explanation based on marginal productivity differences and the trade-gap explanation may be valid simultaneously. However, Feder was unable to detect the extent to which either explanation is important. The theoretical analysis has shown that imports of goods and services can have a significant positive impact on economic growth. Since exports are the principal means for payment for imports, the export-related parameters in the Feder model also capture the positive impact of imports on economic growth. This 'interpretation' problem, however, can be resolved by introducing imports to the growth process.

The addition of imports to the sources- of- growth equation (4.2.20) carries with it many problems. First, imports are a part of the GDP identity. Second, import and output growth rates are simultaneously determined. In fact, the impact of output growth on imports is likely to be substantial. Third, the positive correlation between imports and export is likely to exacerbate the problem of multicollinearity.

A solution to the identity and simultaneity problems ensuing from imports, as well as exports, requires the use of instrumental variables for both imports and exports. However, instrumental variables estimators are, in general, biased in finite samples and their variances difficult to ensconce. So it is implausible that the technique mentioned above will yield unbiased estimators in either the cross- country or the individual-country-time -series sample, since both samples have a very small size. Levine and Renelt (1992) use extreme bounds analysis to investigate the robustness of a range of explanatory variables which are typically incorporated in growth models. Thus, they find that a relatively small number of variables appear to be robustly related to cross-country growth rates. An export is one of such variables.

However, two subtle refinements are accentuated. First, imports or total trades substitute very well for exports. This is not a unanticipated finding, but it serves to emphasise that it is perhaps not exports per se which are important , but openness to trade , for which exports is acting as a proxy. Second, the relationship between exports and growth only robustly holds when physical and human capital are included, there being a robust and positive link between exports and capital accumulation. In this context, Greenaway and Sapsford (1994) have suggested that the link between exports and growth may operate through improved resource accumulation rather than via improved resource allocation. Moreover, despite the popularity of export-led growth hypothesis, the empirical result is rather mixed. The recent time series evidence fails to dispense uniform evidence for the ELG hypothesis whereas a substantial literature, applying a range of cross-section type of methodologies, rigorously supports an association between exports and growth.

In other words, cross-section results appear to find a close and robust relationship, while time series are less conclusive. Therefore, the validity of the export-led growth hypothesis has been brought into question, contrary to the strong earlier empirical support. Recent works, markedly those by Afxentious and Serletis (1991a), Ahmad and Kwan (1991), Bahmani-Oskoee Shubgigh (1991), Chow (1987), Dodaro (1993), Greenaway and Sapsford (1994), Hsiao (1987), Junge and Marshall (1985), Kwan and Cotsomitis (1990), Kugler (1991), Love (1994) Oxley (1993), cast some scepticism on the soundness of the export-led growth hypothesis. Other works, noticeably by Afxentious and Serletis (1991b), Bahmani-Oskooee and Alse (1993), Dutt and Ghosh (1994), Ghartey (1993), Ghatak et al., (1995 and 1997), Khan and Saqib (1993, Kugler and Dridi (1993), Sengupta and Espana (1994), give fairly robust evidence which support the export led-growth hypothesis.

Most of the time series studies have employed the Granger or Sims methods in order to investigate the causal relationship between real export growth and real economic growth. Only a few of them (Bahmani-Oskooee and Shubgigh (1991), Ghartey (1993), Giles et al., (1993), Love (1994), Oxley (1993) follow the approach of Hsiao (1979, 1981) which combines the Granger test with the Akaike's Final Prediction Error (FPE) criterion to determine the optimal lag length in the Granger causality test. Hsiao's synthesis allows determination of the optimal lag length for each of the variables employed in the Granger test on the Criterion of minimum FPE , and thus avoids abstruseness in the arbitrary choice of the lags (Ghatak and Utkulu, 1994 and Ghatak et al. 1995 and 1997). Apart from this, except the works of Afxentious and Serleitis (1991b), Bahmani-Oskooee and Alse (1993), Dutt and Ghosh (1994), Giles et al., (1993), Kugler (1991) Kugler and Dridi (1993), Oxley (1993) , Sengupta and Espana (1994), Ghatak and Utkulu (1994), Ghatak et al., (1995), almost all the empirical works in the study of export expansion- growth relationship have assumed economic variables in export-growth models as stationary, thus they have not dealt with the problem of non-stationarity of the exports and income data properly. Moreover, they have not considered whether exports and income are cointegrated. Accordingly, previous results do not necessarily indicate that there exists a "latent" or long run causal relationship between the long run expansion of exports and growth (measured either by GDP or GNP), as they may arise from a purely short run relationship. A necessary precondition to causality testing is to check the cointegrating properties of the economic variables in the model since standard tests for causality are not valid if there exists cointegration (see, Granger 1988b, Bahmani-Oskooee and Alse, 1993 and Ghatak and Utkulu 1994).

However, recent developments in advanced econometric theories indicate that macroeconomic variables including exports are non-stationary in their levels but stationary at first difference. Thus, empirical works those that have been based on stationary assumption are misleading. They could not give plausible empirical support to design appropriate trade policy for a given developing economy under consideration.

In this regard, it is the objective of the present work to undertake econometric analysis of the dynamic long-run impact of export expansion on economic growth in the light of current developments in econometric models. The study covers developing economies with different export structures and income levels. Accordingly, in the next chapter, we are going to consider the issue of unit root test, and error correction mechanisms and cointegration, in order to apply these approaches to the developing economies considered.

CHAPTER FIVE

V. ECONOMETRIC METHODOLOGY: AN OVERVIEW

5.1. Introduction

Conventional methods of econometric estimation are surfaced on the assumption that the means and the variances of variables are well-defined constants and time invariant (Rao, 1994, p. 2). Nevertheless, recent surges in time-series econometrics and methodological innovations in applied economics have exhibited steady disinclination towards stationarity and ergodicity[1] assumptions upon which the conventional theory of econometrics has been based (Rao, 1994, p. 2; Nelson and Plosser, 1982, pp. 139-62; Psaradakis, 1989, p.1).

Several studies that have examined the time series properties of variables concluded that most macroeconomic time-series data follow random walks. These inferences have asserted that most of macroeconomic variables are non-stationary (stochastic) in their level but stationary in the first difference. Phillips (1986) and Ohania (1988), among others have demonstrated that if time-series variables are non-stationary, all regression results with non-stationary series will vary from the traditional theory of regression. Consequently, regression coefficients with non-stationary series will be dubious or nonsensical.

Albeit a time series can be non-stationary in infinite ways, one especial class of non-stationary processes has come to dominate the interest of econometricians, namely that of integrated processes. The consequential and highly influential articles of Granger and Newbold (1974, pp. 111-20) and Nelson and Plosser (1982, pp. 139-62) should be considered greatly responsible for this development. The former argue that estimating regressions using ordinary least squares (OLS) technique with non-stationary variables gives rise to the phenomenon of 'spurious' or absurd regression thus, they are adhering to the use of differenced series in econometric analysis in order to avoid such outcomes while the latter provide evidence for the integrated (stochastically trending) rather than trend stationary (deterministically trending) character of many macroeconomic series (Hall 1978, pp. 971-987).

It is an empirical fact that while many particular time series, in their levels, are trending stochastically over time and individually non-stationary, there exist certain linear combinations of them which appear to be stationary, jointly or together stationary. In this regard, in modelling of time series economic data applied economists require not only to retain long run information but also they must ensure that the statistical results based on such models capture the co-movement of economic variables which originates from the underlying equilibrating behaviours of economic forces. Thus, the statistical results are free from common, but unrelated, time trends in economic data. Granger (1981) put forward the idea of cointegration, considering this empirical observation and explaining the stationary combinations are long run or equilibrium relationships among the variables. Further work established interesting links between systems of cointegrating variables and some widely applied econometric models . At the same time, a variety of tests for cointegrating and alternative estimating ways for cointegrated systems have been developed (Engle and Granger, 1987, pp. 251-76); Cuthbertson, Hall and Taylor, 1992; Johansen, 1988 a and b, 1992, 1994 and 1995).

As has been mentioned earlier, it is the aim of this research work to conduct the econometric test for export expansion and economic growth relationship for the countries under consideration in the light of recent developments in econometric theory. The purpose of this chapter is, therefore, to provide a synopsis of some recent developments in econometric methodology with particular reference to the analysis of non-stationarity and cointegration of time series before conducting the actual empirical test. However, this chapter is not a survey, which would be superfluous given the existence of many recent and thorough surveys on these issues, like Pagan (1987), Ericsson (1992), Psaradakis(1989), Dolado, Jenkinson and Sosvilla - Rivero (1990), Campbell and Perron (1991), Muscatelli and Hurn (1992). Instead, it is a brief selective outline of the main aspects of those topics on which much of the subsequent work will be based. Consequently, in the next sections integrated processes are examined. Alternative procedures for testing the degree of integratedness and issues in the theory of cointegration are discussed. Moreover, tests for detecting cointegration in the multiple time series are discussed , as well as different ways of estimating the equations of cointegrated system.

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[1] I.e., generally mean that the sample mean and variance for a finite series of the variable go toward their population values as the length of the series of the variable gets infinite (Mills, 1993, p.8).

5.2. Integrated Time Series

5.2.1. Representation

A great deal of applied econometric work uses time-series data, and there are numerous econometric problems that are often encountered and notably associated with the use of this type of data. One of these is serial correlation. One of the other serious problem is the existence of 'spurious' regression problem between economic time series (Davidson and MacKinnon, 1993, p.669; Granger and Newbold, 1974; Kwiatkoski et al. 1992; Beaulieu and Miron, 1992 and Schwert, 1988). Thus, if the first and second unconditional moments of the non-stationary series are time variant, all the estimated statistics in a regression model, which use these moments, are also time dependent and fail to converge to their true values as the sample size increases, thus, they incline to depart ever further from any given value as time goes on. Even, neither the mean nor the variance is a meaningful concept for such variables, (Dickey, et al. 1994 and Kwiatkoski et al. 1992). Likewise, conventional tests of hypothesis will be seriously biased towards rejecting the null hypothesis of no relationship between the dependent and independent variables (Rao, 1994, p.2).

If the time series movement is largely in one direction (up or down) it can be said that the series exhibits a trend.

Since Nelson and Plosser's (1982) seminal paper, many economic time series have been 'described as non-stationary, either deterministically (caused by linear trends, regime shifts or particular political/ economic events) or stochastically (integrated variables), usually integrated of order one and denoted I(1). It is particularly difficult to make a clear marking between the two types of non-stationarity, as variables which look like integrated may particularly have a deterministic linear trend with a break, as Perron (1989) shows.

Many trending series can be predominately characterised by one of the subsequent two models:

$$PCI_t = g_1 + g_2T + u_t \qquad (5.2.1)$$

$$PCI_t = d_1 + d_2PCI_{t-1} + e_t \qquad (5.2.2)$$

Where PCI is real per capita income, the error terms u_t and e_t will, in general, be neither independent nor identically distributed. They will, however, be stationary if the model is appropriate for time series in question (Nelson and Plosser, 1982). Model (5.2.1), is trend stationary process (TSP), that is PCI_t is trend-stationary, that is, stationary around a trend. In contrast, they call model (5.2.2) is difference stationary process (DSP), that is PCI_t follows a random walk with drift. The drift parameter d_1 in (5.2.2) plays much the same role as the trend parameter g_2 in (5.2.1), since both cause PCI_t to trend upward over time. Both models exhibit a linear trend. However, the appropriate method to eliminate the trend differs because the behaviour of PCI_t is very different in the two cases, thus, in the first case detrending it will produce a variable that is stationary, while in the second case it will not (Davidson and MacKinnon, 1993, pp. 669-670). There has been a great deal of literature on which of these two models, best characterises most economic time series (Nelson and Plosser, 1982; Campbell and Mankiw, 1987 and Stock and Watson, 1988).

It should be obvious that if two variables, say PCI_t and X_t (exports), both trend upward, a regression of PCI_t on X_t is very likely to find a conventional t-test to indicate a relationship between them when none exists. In fact, the R^2 for regression of PCI_t on X_t and a constant will tend to unity as $n \rightarrow \infty$ whenever both series can be characterised by (5.2.1), even if the two stochastic parts of PCI_t and X_t are totally unrelated variables (Davidson and MacKinnon, 1993, pp. 670-671). In this context, the assumption of finite and constant means and time invariant variances as the sample size n tends to infinity will be violated.

Two obvious ways to keep standard assumptions from being violated when using such series are to detrend or difference them prior to use. However, detrending and differencing are very different operations; if the former is appropriate, the latter will not be, and vice versa. detrending a time series PCI_t will be appropriate if it is trend-stationary, which means that the data generation process (DGP) for PCI_t can be written as (5.2.1), where T is a time trend and u_t follows a stationary autoregressive moving average (ARMA) process. On the other hand, differencing will be appropriate if the DGP for PCI_t can be written as (5.2.2) where again e_t follows stationary ARMA process (Enders, 1995, pp. 179-180).

Integrated series have properties very different from those of the I(0) ones. In contrast to the latter, the unconditional moments of which are time invariant, I(1) series have moments that are functions of time. Because of a long memory characteristics of the series the effects of a random shock on the level of PCI_t are of a permanent rather than transitory character (Enders, 1995, p. 185).

Moreover, forecasting with I(1) series is quite misleading since the variance of the forecasting errors diverges to infinity as the forecast horizon attenuates. Besides, all of the conventional asymptotic theory is thus inapplicable to such models, and econometric analysis with integrated processes can be useless if conducted in the traditional context. Davidson and MacKinnon (1993, p.670) argue that the fact that standard asymptotic theory is unsuitable to such a model does not to say that no such theory appeals to them, however, requires different normalising factor. The choice between detrending and differencing comes down to a choice between (5.2.1) and (5.2.2). The main techniques for choosing between them are various tests for what are called unit roots. The terminology comes from the literature on time-series processes (Schwert, 1988; Kwiatkowski et al. 1992 and Beaulieu and Miron, 1992).

A series that follows a random walk, with or without drift, is often said to be integrated of order one, or I(1). The idea behind this terminology is that the series must be differenced once in order to make it stationary. Thus, a stationary series may said to be I(0). In principle, a series could be integrated of other orders as well. One might occasionally run into a series that is I(2), and if one mistakenly differences a series that is I(0), the result will be I(-1). However, the vast majority of the time, applied econometricians deal with time series that are either I(0) or I(1). If a series is initially I(1), it may be differenced once to make it I(0) (Davidson and MacKinnon, 1993, p. 673).

It has been further argued that Macroeconomists aware that many macroeconomic time-series are not stationary in their levels and that meant time-series are most adequately represented by first difference. That is, formal statistical tests often cannot reject the null hypothesis of a unit root. The results of these tests however, are sensitive to how the tests are performed that is, whether, moving average (MA) or autoregressive (AR) data generating processes is assumed, as in Schwert (1987), and whether the test is performed using classical or Bayesian statistical inference (see Sims, 1988; Sims et al., 1990). These sensitivities are partly due to the lack of power these tests have against an alternative hypothesis of stationary but large root.

Granger (1988) defines a time series to be integrated of order zero, I(0), if its spectrum is finite but non-zero at all frequencies, this is a weaker requirement than the usually encountered one of second-order stationarity. A univariate process PCI_t is then said to be integrated of order d at zero frequency, denoted as $PCI_t \sim I(d)$, if $(1-L)d\ PCI_t$ is I(0), when L is the lag operator, there is a possibility that d may be other than integer. The series is then called fractionally integrated (see, Granger and Joyeux, 1981).

The concept of integration can be extended to frequencies other than the long-run one. According to Hylleberg et al. (1990) and Engle et al. (1989), given the strong seasonal patterns that many economic time series exhibit, integration at the seasonal frequencies of the spectrum seems to be of practical importance. If PCI_t is integrated of order d at the zero frequency and of order d_s at all the seasonal frequencies it is said to be seasonally integrated of order (d, d_s); in this case the series $(1-L)^{d-ds}$ $(1-L^s)^{ds}$ PCI_t has a finite but non-zero spectrum at all frequencies, when data are recorded s times a year. Seasonally integrated processes have properties similar to those of I(d) ones: they have long memory, variance that increases over time and are asymptotically uncorrelated with processes integrated at other frequencies of spectrum (Beaulieu and Miron, 1992; Enders, 1995, pp. 111-118).

5. 2. 3. Testing the Order of Integration

In recent years formal ways of identifying the order of integration of a time series, by testing the number of unit roots in its finite autoregressive representation, has attracted a great deal of attention. There are a considerable number of different testing methods for a single or multiple zero frequency unit roots, as well as seasonal unit roots. Since an exhaustive survey of this literature is out of the scope of the present chapter, the focus will be only on those tests that appear in its applied work.

The influential works of Fuller (1976) and Dickey and Fuller (1979, 1981) have inspired the investigation on testing the unit root hypothesis. Consider the simple AR(1) data generating process (DGP) which is random walk without drift for level series PCI_t,

$PCI_t = dPCI_{t-1} + u_t$, $t = 1, 2, \ldots, T$ (5.2.3)

with PCI_0 fixed and u_t white noise, Dickey and Fuller suggested testing the null d=1. The test can be conducted by including either a time trend or drift term or both under the alternative data generation process. An auxiliary regression with the intercept can also be tested as follows for first difference of series PCI_t:-

$DPCI_t = \mu + gPCI_{t-1} + e_t$ (5.2.4)

Where D=1-L, the auxiliary regression (5.2.4) implies the testing of the null of g=0 against the stationary alternative g<0.

Given the nature of economic data, more general alternative which includes a time trend (T) and drift terms should also be considered. Accordingly, (5.2.4) must be augmented as:-

$DPCI_t = \mu + aT + gPCI_{t-1} + e_t$ (5.2.5)

Nevertheless, augmenting the auxiliary regressions by deterministic terms, such as intercept and linear trend, is not without difficulties. Specifically, both the limiting and the finite sample distributions of the test statistics depend on the particular auxiliary regression used, as well as on the deterministic components actually present in the DGP under the null.

There should be a little doubt after the preceding discussion that before embarking on testing the unit root hypothesis one should first ascertain the significance of a drift or/ and a trend under the null. This can be easily done by regressing $DPCI_t$ on a constant or a constant and a trend, and ensures that the correct critical values are used for the unit root test. For the latter the general auxiliary regression (5.2.5) seems to be the most appropriate one at the outset. In addition to being the only one valid in the case of a significant trend under the null, it allows for the plausible alternative of stationarity around a deterministic trend; in fact, if this alternative is the correct hypothesis rather than the null, the unit root test in (5.2.4) is inconsistent (see West, 1988) and Perron (1988). If the trend is not significant under the alternative, the auxiliary regression (5.2.4) can be adopted, the appropriate critical values depending on the significance of the drift under the null. The simple auxiliary regression without an intercept and trend should be used only if the drift is not significant and the mean of PCI_t is zero, such a "general -to-specific" testing strategy is also endorsed by Dolado and Jenkinson (1987) and Perron (1988). Dickey et al. (1986), on the other hand, embrace model (5.2.5) as the starting point since the use of the difference filter removes any linear trend in the process. Perman (1989) also prefers the latter procedure.

Dickey-Fuller, or DF, tests is the simplest and most widely used tests for unit roots, however, it is authentic only under the assumption that the error term in the test regression is serially uncorrelated. This assumption is recurrently untenable, because the regression function for the test regression does not depend on any economic variables. This makes it very likely that the error terms will display serial correlation. Thus, it requires unit root tests that are asymptotically valid in the presence of serial correlation. There are two quite different ways to compute such tests. Perhaps, surprisingly, the new tests turn out to have the same asymptotic distributions as some of the tests that have already been addressed. The simplest unit root test that are valid in the presence of serial correlation unknown form are modified versions of the Dickey-Fuller t tests. Therefore, the above testing procedures can be extended to the case of DGP's more complex than the first order autoregression. Higher order stationary autoregressive dynamics, causing $DPCI_t$, so that

$$DPCI_t = \mu + aT + gPCI_{t-1} + \sum^{k}_{i=1} b_i DPCI_{t-i} + e_t \qquad (5.2.6)$$

The relevant distributional results for the t-statistics from the augmented Dickey-Fuller regression, the normalised bias unit root test is not, however, valid any more since it is not invariant with respect to the true population values of b_i, i=1,2,...k. Moreover, (5.2.6) is asymptotically valid for testing the unit root hypothesis even if PCI_t is a general ARIMA process, provided that the lag length k increases at the rate $T^{1/2}$ as the sample size increases, it should be noted that correct augmentation of the auxiliary regression is of paramount importance. Too low an augmentation leads to size distortions of the unit root test because of autocorrelated residuals in (5.2.6), while too high an augmentation results in loss of power (see Said and Dickey, 1984; Kwiatkowski et al. 1992 and Schwert, 1988).

The second way to capture unit root test statistics that are valid albeit the presence of serial correlation of unknown form is to use non-parametric unit root tests. It can be taken as an alternative to the Dickey-Fuller parametric augmentation. Phillips (1987) and Phillips and Perron (1988) suggest this non-parametric correction. The tests are called nonparametric because no parametric specification of the error process is involved (Davidson and MacKinnon, 1993, p. 712; Kwiatkowski et al. 1992). The error sequence driving the DGP of PCI_t is allowed to be a weakly dependent and heterogeneously distributed process, so that the resulting tests are invariant within a wide class of time series models. The estimation of these complex models is not, however, necessary for testing the unit root hypothesis. All that required is a simple modification of the usual Dickey-Fuller test statistics, using the residual autocovariances, to account for the correlation in $DPCI_t$.

Although the Phillips-Perron nonparametric unit root tests seem to offer a quite appealing way of overcoming the difficulties associated with the correlated errors in the Dickey-Fuller regressions, their validity is only asymptotic. Monte Carlo experiments have indicated that in finite samples the performance the Dickey-Fuller tests are generally more satisfactory than that of the Phillips tests, (see Godfrey and Tremaynee, 1988; Hands and Ma, 1989). In particular, the Dickey-Fuller tests appear to be robust to non-normal (but still i.i.d.) or heteroscedastic errors, while they perform rather poorly if the errors are autocorrelated. In the latter case the Phillips tests are to be preferred, as well as in the heteroscedastic case, if the sample size is fairly large. Moreover, under the alternative of i.i.d. observations, the Dickey-fuller tests seem to be more powerful than the non-parametrically modified ones.

Unfortunately, the list of difficulties does not end here. If the DGP for PCI_t contains moving average components, the experiments in Schwert (1989) demonstrate dramatic size distortions or all the tests, even for quite large sample sizes, leading to too frequent rejection of the null. Furthermore, all the tests seem to have difficulties in discriminating between a genuine I(1) process and a stationary one with a shift in its mean. In particular, the null of a unit root tends to be favoured when the true process undergoes a regime shift than contains a stochastic trend component (Rappaport and Reichlin, 1989). A completely different idea for testing the unit root null has been put forward by Sargan and Bhargava (1983). They suggest the use of the Durbin-Watson statistic from the regression

$PCI_t = \mu + e_t$

The null hypothesis is that e_t follows a random walk, and is rejected against the stationary AR(1) alternative if the Durbin-Watson statistic is greater than the appropriate critical value tabulated by Sargan and Bhargava. Bhargava (1986) extended the procedure to test the null of a random walk, with or without a drift, against both stationary and non-stationary first order autoregressive alternatives.

The discussion so far has been based upon the assumption that there is exactly one zero frequency unit root in the autoregressive polynomial of PCI_t. If additional unit roots exist at either the zero frequency or at the seasonal frequencies, the above tests are not valid.

Considering the case of multiple zero frequency unit roots, for such a situation Hasza and Fuller(1979) advocated the testing of the null $PCI_t \sim I(2)$ by an F-test in the auxiliary regression

$D^2PCI_t = g_1PCI_{t-1} + g_2DPCI_{t-1} + \Sigma^k_{i=1} b_i D^2PCI_{t-i} + e_t$ (5.2.7)

Where $D^2=(1-L)^2$. The parameter null hypothesis is $g_1 = g_2 = 0$ and is rejected if the usual F-statistic for the joint significance of g_1 and g_2 is greater than the appropriate critical value of $F_2(2)$ and $F_3(2)$ respectively. Dickey and Pantula (1987) pointed out that a more powerful way of testing the null of multiple unit roots is through a sequence of one-sided t-type tests, rather than the above F-tests. Pantula (1989) extended the results to the case of general ARIMA processes.

Provided the strong seasonal features of many economic time series, it is quite possible that they have unit roots at some seasonal frequencies as well. For simplicity only the quarterly case is considered here.

Dickey et al. (1984) investigated the problem in the context of the multiplicative seasonal autoregressive mode:

$(1-aL^4) F(L)PCI_t = u_t$

Where F(L) is a lag polynomial of order k with F(0)=1. The null $PCI_t \sim SI(1,1)$ is equivalent to a=1 and can be tested through the t-statistic for g in the auxiliary regression

$D_4 PCI_t = gF_e(L)PCI_{t-4} + \Sigma^k_{i=1} b_iD_4PCI_{t-i} + e_t$ (5.2.8)

Where D=1-L and $D_4=1-L^4$, the coefficients of $F_e(L)$ are obtained from a prior regression of D_4PCI_t on k lagged values of itself, notice this is the Osborn and Smith (1989) modification of the original auxiliary regression; the test statistic is invariant to this change, while the choice of the appropriate lag structure becomes easier. The limit percentiles of the distribution of the test statistic under the null are tabulated by

Monte Carlo methods for three different models, i.e., zero mean, single non-zero mean and seasonal means.

A test for the higher order null $PCI_t \sim SI(2,1)$ against the stationary alternative was developed by Haza and Fuller(1982), when the process is, like in the previous case, a multiplicative seasonal one (simpler processes are also examined). The null can be tested by an F-test for $g_1 = g_2 = 0$ in the auxiliary regression, this is, again the Osborn and Smith (1989) modification of the original auxiliary regression; the test statistic is invariant to this change, while the choice of the appropriate lag structure becomes easier.

$DD_4PCI_t = u + \sum^3_{j=1}a_iD_{it} + b_1DPCI_{t-1} + b_2DPCI_{t-4} + \sum^k_{i=1}b_iDD_4PCI_{t-i} + e_t$ (5.2.9)

Where u is a constant , D_{it} is the seasonal dummy corresponding to quarter i (i=1,2,3), e_t is a white noise error term, $D_4=(1-L^4)$ and $DD_4=(1-L)(1-L^4)$. A t-test for $b_1=0$ provides a test of a long run unit root; a t-test for $b_2=0$ provides the analogous test for seasonal unit roots and a long run unit root simultaneously. Both statistics have non-standard distributions with appropriate critical values given in Osborn (1990). She also obtained critical values for the individual t-tests for the significance of p_1 and p_2 in (5.2.10). Under the null SI(2,1), $p_1=0$ implies zero frequency integration, while $p_2=0$ implies seasonal integration (Beaulieu and Miron, 1992).

This test has two important shortcomings: it does not allow for the existence of a trend under the alternative, and it only allows for the test of all seasonal (and long run) unit roots simultaneously. A disadvantage shared by all the preceding tests is that they do not allow for the possibility of a unit root at some but not all the seasonal frequencies. Hylleberg, Engle, Granger and Yoo's (1990) seasonal unit root test overcomes these shortcomings, as it allows a test which, by looking at the separate roots implied by the seasonal filter $(1-L^4)$, distinguishes between unit roots at the zero frequency and unit roots at the various seasonal frequencies of the spectrum. The overall null is $PCI_t \sim SI(1,1)$ and it can be tested by the t-statistics on p_1, p_2 p_3 and p_4 in the auxiliary regression

$D_4PCI_t = p_1PCI_{1,t-1} + p_2PCI_{2,t-1} + p_3PCI_{3,t-2} + p_4 PcI_{3,t-1} + \sum^k_{i=1} b_i D_4PCI_{t-i} + e_t,$ (5.2.10)

Where $PCI_{1t} = (1+L+L^2+L^3)PCI_t$

$PCI_{2t} = (-1 + L-L^2 + L^3)PCI_t$

$PCI_{3t} = (L^2-1)PCI_t$

If the null hypothesis $p_1=0$ cannot be rejected using a t-test, PCI_t has a zero frequency unit root. whereas if the null $p_2=0$, PCI_t has a unit root at the biannual frequency; finally, if $p_3=0$ and/or $p_4=0$ cannot be rejected using t-tests or a F-test for the joint null $p_3 = p_4 = 0$, PCI_t has a unit root at the pair first/third quarter frequencies. The alternative for all these tests is stationarity, with $p_i < 0$, for i=1, 2, and not both p_i equal to zero for i= 3,4. To 'whiten the errors', 'K' additional lags of D_4PCI_t should be included in (5.2.10), thus creating the usual 'augmented' version of unit root tests. The finite sample distributions of these test statistics are calculated by Monte Carlo methods, allowing for the existence of deterministic components, such as intercept, seasonal dummies or linear trend, under the alternative and tabulated by Hylleberg et al. (1990).

Having discussed some important procedures for testing for unit roots, the following general remarks should be noted. First, the various tests perform reasonably well if used in the context of the model for which they were designed. Using a Dickey-Fuller test, for example, when multiple zero frequency unit roots or seasonal unit roots exist is not theoretically justified and may be very misleading. It seems, thus, necessary that a testing procedure starts from the higher order hypothesis and test downward. If the higher order hypothesis is not rejected, then there seems to be no need for testing the lower order ones, since the tests for them are in fact invalid (Muscatelli and Hurn, 1992).

Second, using more observations to test the unit root null does not necessarily imply higher power. Monte Carlo experiments in Shiller and Perron (1985) indicate that the power of a test for the random walk null depends more on the span covered by the sample rather than the sample size. For a given span more observations are certainly preferable, improving the power of the test, and so does a longer span for a given sample size. Davidson and MacKinnon (1993, pp. 714-715) argue that autocorrelation is not the only complication that one is presumably to face in computing unit root test statistics. One very serious problem is that these statistics are severely biased against rejecting the null hypothesis when they are used with data that have been seasonally adjusted by means of linear filter or by the methods used by government statistical agencies. If possible, one should, thus, avoid using seasonally adjusted data to compute unit root tests. One possibility is to use annual data. This may cause the sample size to be quite small, but the consequences of that are not as severe as one might be concerned. They further indicated that the power of these tests depend more on the span of data (i.e., the number of years the sample covers) than on the number of observations. The reason for this is that in the case of $PCI_t = B_0 + aPCI_{t-1}$, if a is in fact positive but less than 1, it will be closer to 1 when the data are observed more frequently. Thus a test based on n annual observations may have only slightly less power than a test based on 4n quarterly observations that have not been seasonally adjusted and may have more power than a test based on 4n seasonally adjusted observations. If quarterly or monthly data are to be used, they should if possible not be seasonally adjusted. Besides, the use of seasonally unadjusted data may make it necessary to add seasonal dummy variables to regression and to account for fourth order or twelfth-order serial correlation.

Moreover, any test for unit roots cannot be expected to have high power against stable alternatives near unity. Consequently, one should be very careful in uncritically accepting the null, bearing also in mind the biasedness of the tests towards not rejecting the null when there is a structural break rather than a stochastic trend. Recursive unit root testing could be very useful in addressing this latter problem; see, for example, Dolado et al. (1988), Clements (1989) and Siklos (1989).

The other major problem with unit root tests is that they are very sensitive to the assumption that the process of generating the data has been stable over the entire sample period (Kwiatkowski et al., 1992). Perron (1989) showed that the power of unit root tests is dramatically reduced if the level or the trend of a series has changed exogenously at any time during the sample period. Even though the series may actually be stationary in each of the two part of the sample, it can be almost impossible to reject the null that is I(1) in such cases. Perron, thus proposed techniques that can be used to test for unit roots conditional on exogenous changes in level or trends. His tests are performed by first regressing PCI_t on a constant, a time trend, and one or two dummy variables that allow either the constant, the trend, or both the constant and the trend to change at one specified point in time (Perron, 1989; Davidson and MacKinnon, 1993, pp. 714-715).

Much empirical work, following the classic paper of Nelson and Plosser (1982), has seemed to show that the unit roots are very often present in macroeconomic time series. Perron argued that when one takes account of either the great crash of 1929 (for annual series's that end prior to 1973) or the oil shock of 1973 (for quarterly post-war series), these results change dramatically and most U.S. macroeconomic time series appear not to have a unit root (Davidson and MacKinnon, 1993, p.715).

There has been a great deal of empirical work that uses unit root tests, prominent examples include Nelson and Plosser (1982), Campbell and Mankiw(1987), Perron (1989), and DeJong et al. (1991). Because of the various problems that have been discussed, and because different tests tend to yield different results, it is difficult to draw conclusive inference about whether economic time series do or do not have unit roots. This suggests that, when one is building regression models that involve time series which may or may not have unit roots, one should not employ a strategy that will work well only if they are in fact either I(0) or I(1)(Davidson and MacKinnon, 1993, p. 715).

Having discussed the implications of stochastically trending variables for regression analysis, as well as alternative ways of testing for such behaviour, the study now turns its attention to a more thorough examination of the properties of groups of integrated variables. The possibility that combinations of variables from such groups be stationary has already been mentioned, and this idea is being discussed in some detail as follows.

5.3. Cointegration

5.3.1 Definition and Representation

Neo-classical economic theory often suggests the existence of long-run equilibrium or steady state relationships among economic variables. Although the variable may drift away from equilibrium in the short-run which is most likely, due to random shocks, these deviations are indeed bounded since economic forces act as stabilising mechanisms so as to restore the equilibrium (Davidson and MacKinnon, 1993, p. 715, Psaradakis, 1989, p.20). Examples of pairs of economic variables which make such a link might include interest rates on a sets of different maturities, price of similar commodities in different countries (if purchasing power parity holds in the long run), disposable income and consumption, government spending and tax revenues, wages and prices, the money supply and the price level, or spot or future prices of commodity. There is no reason to restrict attention to pairs of variables, of course, although it is often easiest to do so. There may well be groups of three, four, or more variables that can be expected to be linked by some long-run equilibrium relationship (Davidson and MacKinnon, 1993, p.715).

Most of the variables mentioned in the previous paragraphs are I(1), or at least they appear to be when some (but not necessarily all) unit root tests are employed. It is known that variables which are I(1) tend to diverge as $n \to \infty$, because their unconditional variances are proportional to n. Thus, it might seem that such variables could never be expected to obey any sort of long-run equilibrium relationship. But in fact it is possible for two or more variables to be I(1) and yet for certain linear combinations of those variables to be I(0). If that is the case, the variables are said to be cointegrated. If two or more variables are cointegrated, they must be in an equilibrium relationship in the long run, although they may diverge substantially from equilibrium in the short run (Clarida, 1992; Lee, 1992; McAleer, 1994; Johansen and Juselius, 1994).

The concept of cointegration is fundamental to the understanding of long-run relationships among economic time series (Boswijk and Franses, 1992; Psaradakis, 1989, p.20; Johansen 1988b;

Mosconi and Giannini, 1992). Granger (1981, 1983) and Granger and Weiss (1983) are probably the earliest references of the statistical counterpart of these ideas, while it is further developed in the best-known paper of Engle and Granger (1987), Stock and Watson (1988a) and Johansen (1988b and 1995).

Cointegration allows individual time series to be stationary in first differences, while some linear combinations of the series are stationary in levels. By interpreting such a linear combination as a long-run relationship or 'attractor' of the system, cointegration implies that deviations from this attractor are stationary, even though the series themselves have infinite variances (Juselius, 1994).

The need for information about such long-run relationships among the levels of the variables to be retained in econometric models has been long recognised by the advocates of the error correction mechanisms (ECM). These models, introduced in econometrics by Sargan (1964) and popularised by David Hendry and Von Ungern-Sternberg (1981), have the advantage of incorporating both the short-run dynamics and any long-run solution about the levels of the variables. In this way, the inefficiencies caused by the disuse of available long-run information, when modelling in terms of differenced variables only, are avoided, while statistical inference is considerably facilitated (see Enders, 1995 and Mills, 1993).

There is, however, an impressive relationship between error correction mechanism and the concept of cointegration. Granger(1983) showed that if a set of variables is cointegrated, then it has an error correction representation; conversely, an error correction mechanism always produce a set of variables that are cointegrated. This means that in the case of variables that move stochastically together over time the error correction model provides a parameterisation which, in addition to its other merits, is also capable of adequately representing the time series properties of the data set.

Following Granger (1983) and Engle and Granger (1987), let Y_t be a p-dimensional vector of non-deterministic random variables. The series in Y_t are said to be cointegrated of order (d,b) [$Y_t \sim$ CI(d,b)] with cointegrating rank r, if all the series are I(d), d>0, while there are r linearly independent linear combinations of the series are I (d-b) with b>0.

The case usually studied and practically important with more empirical relevance is when $d = b = 1$. Then from Granger's Representation Theorem (GRT) there exists an error correction mechanism representation of the system, and vice versa. However, this representation is only one of the different representations, a cointegrated system can have , as shown by Engle and Granger (1987) and Hyllebreg and Mizon (1989a). They Generalise Granger's Representation Theorem for systems with more than one cointegrating vectors, and show that these systems can have alternative and observationally equivalent representation. Thus, Y_t can have various forms of representations.

Excellent surveys, such as Psaradakis (1989), Dolado et al. (1990), Campbell and Perron (1991), and Muscatelli and Hurn (1992), among others, cover all issues on cointegration theory, testing for cointegration and estimation of cointegrated systems. Therefore, the study will concentrate its efforts on the two methods that the study will use in this work, though with different emphasis, for testing for cointegration and estimated cointegrated systems:- Engle and Granger's and Johansen's procedures.

5.3.2 Engle and Granger Procedure

Engle and Granger (1987) propose a two step procedure to estimate a cointegrated system. The first step consists of a residual-based test for cointegration amongst the variables; given cointegration, the second step consists of the estimation of the error correction model.

Illustrating the procedure for the bivariate case, let Y_t and X_t be two I(1) variables. In the first step the OLS method is used to estimate the static regression.

$$Y_t = u + BX_t + e_t \qquad (5.3.1)$$

From the definition, if the two variables are cointegrated, e_t will be I(0), and :-

$Y_t = u + BX_t$ from (5.3.1) is called the long run equilibrium relationship; if they are not cointegrated, e_t will be I(1). Therefore testing for non-cointegration is equivalent to testing for a unit root in the residuals of (5.3.1). The null hypothesis is 'no cointegration' (i.e., $e_t \sim I(1)$) and the tests most commonly used are Dickey and Fuller's DF and ADF, Phillips and Perron, (1988), and Sargan and Barghava's (1983) version of the Durbin-Watson test usually denoted CRDW. The critical values to be used here are not the same as the ones used in testing for unit roots in single series, as e_t is a generated series. In general, they depend upon the number of integrated regressors and deterministic components included in (5.3.1) and the nature of the deterministic components of those regressors. Engle and Yoo (1987), Phillips and Ouliaris (1990), MacKinnon (1991), and Haug (1992) provide appropriate critical values for those statistics under different specifications of (5.3.1), and for up to five regressors.

After rejecting the null hypothesis in the first step of this procedure (i.e., reject no cointegration), in the second step the parameters of the error correction model driven from (5.3.1) are consistently estimated using OLS. As mentioned before the GRT, if X_t and Y_t are cointegrated then there exists an error correction model. Through inclusion of the equilibrium error no long-run information present in the data is 'lost', as it would if a simple specification in differences of I(1) variables. Engle and Yoo (1991) responded to some of the criticisms by adding a third step to this procedure that retains its advantage of using of OLS, and makes inference possible in the first step. Their procedure is asymptotically equivalent to maximum likelihood methods like the one described in next subsection under Johansen procedure.

Albeit these residual based testing procedures have been widely used in empirical research (see, inter alia, Jenkinson, 1986; Carruth, 1987; Miller, 1993; Baillie and Selover, 1987; Muscatelli and Hurn, 1992; Enders, 1995 and Ghatak et al., 1995 and 1997) they do have some serious drawbacks. First, the procedures are not invariant to alternative normalisation of the cointegration regression. Different normalisation lead to different cointegrating vectors and, consequently, different values of the test statistics, in the bivariate case the differences between the residuals from the alternative cointegration regressions are smaller the larger the correlation between the two series is, see Engle and Granger (1987). Besides, the arbitrary normalisation imposes the untested restriction that the corresponding variable enters the cointegrating vector with a non-zero coefficient. Moreover, the test statistics do not also have well-defined limiting distributions. The critical values of the DW test vary considerably with the DGP, while the ADF test, despite its reasonably good power properties and stable critical values, is quite sensitive to the choice of the lag structure in the auxiliary regression. Finally, the testing procedure is confined to the case of cointegrating systems with a unit rank. However, when systems with dimension higher than two are considered, there is, a definite possibility that there may exist more than one cointegrating vector (Lee, 1992; Clarida, 1992; Boswijk and Franses, 1992; Enders, 1995 and Johansen, 1995). Thus, the Stock and Watson (1988) procedure considers such a p-dimensional CI(1,1) system of Y_t to test for a number of common stochastic trends in Y_t based on its first order serial correlation properties.[2] However, recently, the maximum likelihood framework adopted by Johansen (1988b) and Johansen and Juselius (1988) in their analysis of cointegrated systems attracts considerable attention.

[2]Under the stock and Watson approach, the null $Y_t \sim CI(1,1)$ with cointegrating rank r, Y_t obeys a common trend parameterisation and thus can be decomposed into a stationary part ($F^*(1,1)u_t$) and p-r common stochastic trends (Fh_t). The analysis is based only on the latter, which are the p-r largest principal components of Y_t, by using principal components to select the cointegrating vectors, the normalisation difficulties encountered in the Engle-Granger procedure are avoided, for details (see, Stock and Watson, 1988 and 1989 and Rao, 1994).

In this work, a maximum likelihood procedure developed by Johansen (see Enders, 1995; Johansen 1988b; Johansen, 1995; Johansen and Juselius (1990, 1992) is used to perform the analysis of cointegration amongst any number of variables in a system, testing for cointegration and estimating the cointegrated system simultaneously.[3]

5.4.3 Johansen Procedure

Johansen (1995) has illustrated the procedure based on the statistical technique centred on reduced rank regression in connection with autoregressive model as applied to time series analysis by Johansen (1988b). Thus, Cointegration for a multivariate n-dimensional autoregressive process is formulated within the context of I(1) models by equation:-

$Y_t = P_1Y_{t-1} + ...+ P_kY_{t-k} + e_t \quad t=1,...,T$ (5.3.2)

Where each Pi is an (nXn) matrix of parameters. Where e_t is independent Gaussian n-dimensional with mean zero and variance, W which is constant.

The system of equations (5.3.2) are reparameterised in the ECM form:

$DY_t = G_1 DY_{t-1} + G_2DY_{t-2} + ...+G_{k+1}DY_{t-k+1} + G_kY_{t-k} + e_t$ (5.3.3)

$G_i = -I + P_1 + ...+ P_k = -P(1), \quad i = 1...k$ (5.3.4)

The P matrix is called the long run response matrix, where the rank of G_K is equal to the number of cointegrating vectors, $P = -G_K = ab'$ (5.3.5)

If the rank of P, denotes r(P), is r, there exist three important cases:-

(i) if $r(P) = r = n$, the n variables in Y_t are I(0) that there is long run relationship among the variables;

(ii) if $r = 0$, then all the n variables in Y_t are I(1) and DY_t is stationary, apart from any deterministic non-stationarities the variables may have (there is no long run relationship amongst the variables);

(iii) if $0 < r < n$, then there are r cointegrating linear combinations of Y_t, and the remaining (n-r) linear combinations of Y_t act as common (shared) stochastic trends . In this case $(0 < r < n)$, the matrix P be factored as $P = ab'$, where a and b are (nxr) matrices of rank r. Thus, the null of cointegrating rank r, Y_t has the interim multipliers with rank $[P(1)] = r$ or $P(1) = ab'$. As a consequence, the null of at most r

[3]Phillips and Ouliaris (1988) proposed a different way of testing for cointegration in a CI(1,1) system, exploiting the fact that under cointegration the moving average matrix F(1) has reduced rank. Since zero frequency spectrum of Y_t is F(1)F'(1), a F(1) matrix of rank p-r clearly implies a singular zero frequency spectral density matrix S with r zero eigenvalues.

cointegrating vectors H_0 (r): rank [P(1)] = r can be tested against the alternative of no cointegration H_1: rank [P(1)] = 0 by a likelihood ratio test for the restriction P(1) = ab′ imposed by $H_0(r)$.

The likelihood function can be concentrated with respect to the unrestricted parameters G_i by using the residuals R_{0t} and R_{kt} from regression of DY_t and Y_{t-k} respectively on k-1 lagged values of DY_t and the next step is a reduced rank regression of R_{0t} on R_{kt}. To describe this let the product moment matrices (S_{ij}) are defined as:-

$S_{ij}= T^{-1}\Sigma^{T}_{t=1}R_{it}R'_{jt}$, i, j = 0, k. Since the study is interested when 0< r< n and thus P = ab′, it can use the theorem 4.1 from Johansen and Juselius (1990). Therefore, the maximum likelihood estimator of b is found solving the determining equation $|S_{kk}-S_{k0}S^{-1}_{00}S_{0k}|=0$ (5.3.6)

which has solutions for eigenvalues $\Lambda_1> \Lambda_2 >...> \Lambda_n > 0$ with corresponding matrix of eigenvalues vectors $V= (v_1,..., v_n)$ normalised so that $V'S_{kk}V = I$. The maximum likelihood estimator of b, is given by $b_e = (v_1,...v_r)$, the estimate of a is $a_e = S_{01}b_e$ and finally the estimate of W is $W_e = S_{00} - a_e a_e'$. It can be understood that the r normalised eigenvectors are the canonical variates between R_{ot} and R_{kt}, and the corresponding eigenvalues are the squared canonical correlations between R_{ot} and R_{kt}. The estimates of a and W are obtained substituting b into their respective equations, while the value of the maximised likelihood function becomes

$L^{-2/T}_{max} = |W| = |S_{00}|\ \Sigma^{r}_{i=1}\log(\Lambda-\Lambda_{ei})$ (5.3.7)

Therefore, the likelihood ratio test for $H_0(r)$ against H_1 herein after trace test is

$Q_r = - T\Sigma^{n}_{i=r+1} (\Lambda-\Lambda_{ei})$ (5.3.8)

Similarly, the likelihood ratio test statistic for $H_0(r)$ against $H_0(r+1)$ herein after maximum eigenvalue (lambda) test is

$Q_{r+1} = -T\log(\Lambda-\Lambda_{er+1})$ (5.3.9)

These test statistics have well-defined null limiting distributions depending only on the dimension of the system. However, Johansen (1995) showed that they are not invariant to the inclusion of an intercept in the model, as well as to the way the intercept is included.

The existence of a constant term in (5.3.3) implies a linear trend in the non-stationary part of Y_t under the null $H_0(r)$. If is, however, included with the restriction $a_1 = 0$, when a_1 is a px (p-r) matrix of rank p-r with columns orthogonal to those of a, then the existence of an intercept term in the cointegration relationships is implied, rather than a linear trend in the non-stationary part of Y_t. Estimation in the former case proceeds as described above $a_1=0$, the only difference being the inclusion of the constant term as a regressor in the calculation of R_{ot} and R_{kt}.

The empirical quantiles of the limiting distributions of the statistics (5.3.8) and (5.3.9) for various cases are tabulated in Johansen (1988b and 1995), Johansen and Jüselius (1989) and Enders (1995). Applications of the procedure can be found in Juselius (1988, 1989), Johansen (1988, 1989b, 1992, 1994 and 1995), Johansen and Juselius (1988, 1989), Juselius (1994), Enders (1995), Rao (1994) and Clements (1989).

5.4. Conclusions

As it has been discussed above, many economic time series seem to be integrated of order one. Such economic series include per capita income (PCI), exports (X), physical capital (K), human capital (H) and labour (L). Consequently, as time passes, each of these variables increases in size so that their mean values will also increase. This immediately causes a problem if the interest is to estimate their means, observing their values over a particular period say 1950-70, gives a different mean from, say, 1971-90. In these circumstances, the variables are said to be non-stationary. More formally, a variable is stationary if displacement over time does not alter its means, variance and covariances. From the results of previous discussions on spurious regressions, it is clear that regressing the levels of a series that is I(1) on the levels of one or more other series that are also I(1) is generally not a good thing to do. At worst, the study may identify an entirely spurious relationship. At best, it may consistently estimate the elements of some cointegrating vector, but standard asymptotic theory will not apply to such estimates, and it may therefore be led to make incorrect inferences about the parameters that have been estimated (Lee, 1992).

The classical approach to dealing with integrated variables, especially in the time-series literature, has been to difference them as many times as needed to make them stationary (Muscatelli and Hurn, 1992). This approach has a credit of lucidity. Once all series have been transformed to stationarity, dynamic regression models may be specified in the usual way, and standard asymptotic results apply. The problem with the differencing approach is that differencing eliminates the opportunity to estimate any relationships between the levels of the dependent and independent variables. Cointegration implies that such relationships exist, and it has been suggested that they are often of considerable economic interest. Thus, simply using differenced data is often not a pertinent procedure (Davidson and MacKinnon, 1993, p. 723). A second approach is to estimate an error-correction model, or ECM.

It was observed earlier that a CI(1,1) system can be parameterised in a number of alternative ways. Since all of them are observationally equivalent, which one is to be preferred depends on the problem being analysed, the parameters of interest and the statistical properties of the relevant estimators and test statistics (Lee, 1992).

Engle and Granger (1987) advocated the use of a two-step estimation procedure, in the context of an error correction framework.

The simplicity of the Engle-Granger procedure, along with its ability to deliver estimators with good asymptotic properties., has greatly enticed the concentration of empirical researchers. However, one could think of a series of difficulties that considerably overshadow the credentials of simplicity and satisfactory asymptotic realisation. In addition to the already noted problems of arbitrary normalisation of the cointegrating vector and unclear and unsatisfactory generalisations to systems with cointegrating rank higher than unity, serious doubts have also been raised by the rather questionable finite sample realisation of the procedure.

Simulation results by Stock (1987) and Banerjee et al. (1986) have demonstrated that the OLS estimator of the cointegrating vector from the static cointegration can be substantially biased in small samples with large biases in cointegration regressions with low R^2. In addition, the convergence of the regression coefficient to its true value does not appear to be at the rapid rate predicted by asymptotic theory. Alternative ways of estimating cointegration system have been propounded by Phillips (1988), Stock and Watson (1988), among others.

Johansen's (1988b and 1995) maximum likelihood framework is particularly appealing if one is interested in estimating multiple cointegration and common trends. It delivers consistent estimates of cointegration space, while inference on the cointegrating rank of the system can be proceed through a sequence of likelihood tests. Another notable advantage of the procedure is that it enables the testing of linear restriction on the cointegration space, with test statistics that have well-defined standard limiting distributions, see Johansen (1995) for a summary of theoretical results and applications.

Therefore, in order to test for the long-run dynamic equilibrium relationship between export expansion and economic growth for developing economies under consideration, the study is going to apply both the EG and Johansen approaches. Based on economic arguments in the previous chapters, the study includes exports as an additional variable to the growth and catching-up models variables. Thus, first, the study conducts its econometric test based on the EG procedure and its accompanying ECM in the multivariate context, second, it examines its data based on the Johansen system approach. The Johansen cointegration approach has distinctive advantage to identify the existence of more than one cointegrating vectors and overcome the normalisation problem which could be faced in Engle and Grange cointegration model in this multivariate analysis. Moreover, it can establish the common trend, error correction mechanism and restriction test to determine whether the variable of its interest in this case exports can be excluded or not from the long run relationship. However, before the study is going to undertake the cointegration test in its empirical works unit roots test should be conducted for each variables of particular countries. In this regard, the ADF test is employed because it is widely used in applied economic research. Accordingly, it the study is going to specify its specific approach and conduct the empirical tests in the next chapter.

CHAPTER SIX

VI. EXPORT EXPANSION AND ECONOMIC PERFORMANCE: AN EMPIRICAL TEST

6.1. Introduction

In this chapter, the study takes as its inspiration the current developments in open economy issues to empirically investigate whether and how export expansion, catching-up process and long-run economic growth are related in developing economies. Consequently, it provides an empirical evidence of the connection of export expansion and economic growth in a dynamic long-run context using an econometric method that consider the possible non-stationarity of the time series observations. Its approach is to test a model of growth that has exports and human capital as its arguments, based on the cointegration and common trends econometric approach.

The specific data series that have been included in the model are purchasing power parity based per capita GDP (PCI), gross value of exports, export share of GDP, non-fuel primary exports, fuel exports, manufactured products exports, human capital, physical capital accumulation, labour input and catch-up variable (measured by labour productivity gap between a given developing economy and USA as base economy). All the variables are real figures in logarithm series. Based on IMF, OECD, UN and World Bank's classifications (World Bank, 1994), 185 developing economies have been considered for empirical investigation. However, the actual tests are conducted only for 46 sample countries. In the framework of recent developments in econometric methodology any empirical analysis from which valid inferences could be drawn must ensure that their nature and order of integration are investigated to avoid the problem of spurious relationship and the doing of erroneous conclusions. OLS regression based Engle and Granger approach (1987) and a vector autoregression model developed in the Johansen and Juselius (1992) are particularly useful for this purpose.

In this regard, this research work examines the export expansion-growth relationship by conducting unit root series tests for each variable considered. Besides, it further investigates the existence of the long-run dynamic equilibrium relationships among the export-growth and export-catch-up variables. It also establishes their short-run deviations from such cointegrating relationships by establishing their error correction mechanism counterpart.

This Chapter is organised as follows: section 6.2 briefly restates the theory in the light of discussion conducted in the second and third chapters. Section 6.3 specifies the methodological approach, section 6.4 deals with the data quality and coverage and section 6.5 conducts the empirical tests and discusses the empirical results on export expansion-growth relationship, and section 6.6 concludes the chapter.

6.2 Restating the Theory

As discussed in chapter two, recent arguments about the link between exports and growth emphasis the gains from scale effects and externalities that arise because of export expansion. Contemporary endogenous growth models stress apart from a human capital endowment a link between exports and the long-run rate of growth of output. This can occur through the favourable impact of exports on technological change. For example, export expansion increases growth rate because it provides access to a variety of imported inputs that constitute new technology (Helleiner, 1991; Grossman & Helpman, 1992; Romer, 1986; Torstensson, 1994, pp. 235).

It has been argued that economic growth in developing economies is largely determined by the acquisition of new technologies and other knowledge. Beyond the endogenous evolution of new technologies, growth depends on a country's success in acquiring and adapting knowledge from foreign sources. Thus, trade promotes technological progress in developing economies because of technological spillovers through international technology diffusion (Webb, 1993). In his review of empirical studies, Westphal (1990) find ample evidence that trading arrangements foster flow of technology. In studying Korea, Westphal et al. (1984) find that export activity appears to accelerate the acquisition of technology mastery. Learning by trading in developing economies can be traced to either entrepreneurs or workers, with externalities created by the flow of new information through the economy (Webb, 1993). Entrepreneurs often gain knowledge by coming into contact with foreigners who possess superior technologies. Trade contacts can bring technological changes that significantly increase productive efficiency change, product design and improve management practices. Both importers and exporters can obtain technological information from foreign suppliers and customers because of user-producer interactions.

Developing economies' exporters can enjoy costless access to a tremendous range of information diffused to them in various ways from the buyers of their products. Foreign clients and suppliers may provide not only technological information, but also market information and guidance on management techniques, often regarding to quality control. Firms can benefit from information transfer of technology, including advice on product engineering, design and marketing. In addition, both import-competing and export firms may observe and copy the marketing and other activities of their foreign-based competitors, and exporters can monitor feedback to their own activities in a foreign market. Other entrepreneurs can gain by observing and copying the activities of trading firms, creating externalities from trading activity. An increase in the opportunity to export increases incentive to search for more cost-efficient technology (Webb, 1993).

By and large, countries through learning-by-trading benefit from greater growth in technical efficiency and total factor productivity growth. Because when such learning is absorbed by nationals and becomes part of the indigenous base of human capital and technological infrastructure. In such cases it can enhance over all national and international industrial competitiveness. However, preparing-by-doing (indigenous technological capability) and adopting-by-doing (degree of tactics, difficulties in imitation, uncertainty regarding what modification will work and what will not work to a particular environment) can determine how much local firms gain from the availability of new technologies.

Another channel of favourable impact is that greater size of the market facing domestic exporters (Krugman, 1988) raising returns to innovation and thus enhancing the country's specialisation in research intensive production. Therefore, a country can switch from traditional exports sector to skill intensive acquired or created comparative advantage (see Ghatak, 1995; Meier, 1995).

Export expansion is an important variable linking the developing economy to the international environment, linking the domestic economy to an international technological progress in developing technological capability. By making the foreign exchange needs available increases the real importing capacity. Thus, encourages the flow of imported capital goods with its embodied technology remained to the economy. The specialisation in internationally competitive industries also implies that the country does not strive for self-sufficiency at any cost but rather attempts to benefit from the increasing international division of labour within the capital goods sector. Moreover, the economy is in more favourable position regarding foreign exchange shortages, as they often encourage traditional export sectors and the diversification of the export structure. Export-led growth, reduces the distortion in domestic production, especially in the manufacturing sector, and provides incentives for the production of intermediate and capital goods. However, exports as an additional variable does not substitute labour or capital but complements and encourages the substitute of the abundant inputs for the scarce one.

6.3. Methodological Specification

6.3.1. Basic Model

Based on the existing growth theory literature that has been discussed in chapter two, this section formulates a cointegration model to assess the effects of export expansion and other fundamental inputs on per capita income growth and catch-up process. The analysis in this work adopts supply side description changes in per capita income. In so doing, it follows a practice widely used in the empirical study of sources of growth. The pioneering work in this literature is that of Harrod and Domar in which physical capital accumulation and the expansion in the labour force are postulated to play the essential role in determining economic growth (Harrod, 1939; Domar, 1946). More recent growth theory contributions include Solow (1957), Hicks (1965), Kuznets (1965), Barro (1991), Romer(1986), Dorwick and Nguyen (1989). The contributions made by these and several other economists have provided the theoretical foundations for the typical empirical growth model found in the growth and development literature over the last three decades or more.

Assuming disembodied technical progress, the examination of the effect of export growth on total factor productivity can be accomplished through a country specific time series analysis based on the following Cobb-Douglas production function.

$$PCI = TK^{B1} L^{B2} \quad (6.3.1)$$

Where

PCI = Real Per capita Income (Real GDP/Population)

K = Real Physical Capital Stock

L = Labour Force,

T = Technological progress captured by time

B_1 and B_2 are the elasticities of PCI with respect to capital and labour input respectively.

Assuming that the elasticities of PCI with respect to capital and labour inputs are constant, and technical change is Hicks-neutral and its rate remains unchanged, equation (6.3.1) can be expressed in terms of logarithmic transformation as follows:

$logPCI_t = A_1 + B_1 logK_t + B_2 logL_t$ (6.3.2)

Where $_t$ stands for time period, and log PCI_t, A_1, $logK_t$ and $logL_t$ are the logarithmic forms of PCI, T, K and L respectively.

The hypothesis that export expansion and human capital accumulation enhances the growth in technical efficiency and total factor productivity can be incorporated in this model by changing the assumption about the rate of technical change within the context of an endogenous growth model. Instead of assuming that it is constant, the study hypothesises this rate is a linear function of exports ($logX_t$) and human capital ($logH_t$). Thus, the aggregate production model can be written as:

$logPCI_t = A_2 + B_1 logX_t + B_2 logH_t\ B_3 logK_t + B_4 logL_t$ (6.3.3)

In this work the real economic variables PCI, human capital, physical capital, labour and exports are denoted by PCI_t, H_t, K_t, L_t and X_t, respectively. A_2 captures an autonomous productivity change, which is constant over time. The logarithms of these series are considered to form the equation.

The estimation disaggregates the exports variable to examine the significance of particular export product categories. Exports are disaggregated into non-fuel primary products, fuel and manufactured products. The general econometric formulation is the form:-

1) Aggregate Model (Model I)

$logPCI_t = A_3 + B_1\ logX_t + B_2\ logH_t + B_3\ logK_t + B_4\ logL_t + V_t$ (6.3.4)

2) Disaggregated Model (Model II)

$logPCI_t = A_4 + B_{11}\ logXp_t + B_{12}\ logXf_t + B_{13}\ logXm_t + B_{14}\ logH_t + B_{15} logK_t + B_{16}\ logL_t + v_t$

(6.3.5)

Where:

Xf_t = Fuel Exports in real terms

Xp_t = Non-fuel Primary Exports in real terms

Xm_t = Manufactured Products Exports in real terms

The term 'log' stands for logarithmic transformation of the linear form, and V_t and v_t capture error terms in their respective equations. B_{11}, B_{12} and B_{13} are the elasticities of PCI with respect to relevant variables. A_3 and A_4 represent autonomous productivity changes in the respective models.

In general, in the above two models (Model I and II), $logPCI_t$, $logK_t$, $logL_t$ and $logX_t$, $logXp_t$, $logXf_t$, $logXm_t$, and $logH_t$ are the logarithmic series of real per capita income, real capital stock, labour, real value of total exports, real value of non-fuel primary products export, real value of fuel export and real value of manufactured export and human capital variables respectively. A_3 and A_4 and are intercepts in their respective equations. B_1, B_2, B_3, B_4, B_{11}, B_{12}, B_{13}, B_{14}, B_{15} and B_{16} represent the structural coefficients for their respective variables. V_t, and v_t are the residual terms, which are assumed to be independently and identically distributed.

The percentage share of real investment in real GDP is a proxy of capital input. PCI Growth is taken as a measure of economic performance. The number of primary and secondary school enrolments represents human capital variable.

In empirical studies of economic growth, investment is often used as a proxy lacking capital stock. However, it has been suggested that when capital stock data is available it be used in preference to investment data (Scott, 1991; Alexander, 1994). Because of data constraints the study employs investment variable as a proxy for capital stock.

The third empirical model, which is based upon the catching-up hypothesis, is formulated and discussed below.

III. Catching-up Model (Model III)

In the recent renaissance of the analysis of economic growth, there has been great interest in the issue of whether the developing economies are converging in income and productivity levels to the well performing high income and productivity level of developed economies. Generally, these arguments are based in one of two different traditions.

First, in the neo-classical growth model pioneered by Solow (1956), the rate of return on investment and the rate of growth of output per capita are expected to be decreasing functions of capital stock per capita (Hansson and Henrekson, 1995). As a consequence, developing and developed economies would tend to converge in terms of levels of per capita income.

Second, based on the premise that it is much easier for latecomer in terms of economic development and industrialisation to imitate already existing technologies than it is for the technologically leading economies to advance the technological frontier through innovation, one should expect a long run tendency towards convergence of per capita income or productivity levels. This is often cited as the catching-up hypothesis. At least in the simple versions of these two theories, unexpected eventual income convergence implies that at any point in time a poorer economy should be growing at a faster rate than a richer economy.

Although the predictions of the two theories are identical, the theoretical points of departure are virtually incompatible. In the neo-classical growth theory it is assumed that all economies have access to the same technology. Further, they assume that differences in macro and microeconomic parameters are actually taken as transitory discrepancies that will generate stationary differences in per capita output and productivity level and will not imply different growth rate. However, the catching-up hypothesis assumes that counties are at different technological levels and that diffusion of technology from leaders to followers is the main driving force towards convergence. Accordingly, it has been suggested that convergence is conditioned by the level of countries social capability to adopt technology from abroad (Alam, 1992; Dollar, 1992, Sachs and Warner, 1995; Hansson and Henrekson, 1995). In the new growth literature, technological progress depends on a wide array of variables. In contrast to the neo-classical approach in which technological change is exogenously given. Among the most emphasised determinants of convergence and catch up process are R & D policies (Romer, 1990a), fixed capital investment (Romer, 1986), Human capital (Lucas, 1988; Barro, 1990, 1991; Murphy and Rebelo, 1990; Romer, 1990b), public expenditure (Barro, 1990), tax policies (Jones and Manuelli, 1990), financial policies (Ghatak, 1995, pp. 122-144), trade policies (Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991a,b). Other factors such as income distribution and political stability have given attention, either (Barro, 1990). Lucas and Romer have shown that divergence in long-term growth can be generated by social increasing returns to scale associated with both physical and human capital.

An empirical literature exploring convergence and catching-up has developed in parallel of the new growth theory (Baumol, 1986; Bernard and Durlauf, 1991, 1995 and 1996; Delong, 1988; Barro, 1991; Mankiw, D'Amato and Pistoresi, 1997; Romer and Weil, 1990). The research on developing economies has interpreted a finding of a negative cross section correlation between initial income and growth rates and initial productivity level and growth rate as evidence in favour of convergence and catching-up respectively. The use of cross-section results, however, suffers from its shortcoming that it is unable to capture the long run dynamics. Besides, the cross section results are based on the statistical hypothesis that no economies are catching up and the alternative hypothesis that all economies are, thus excluding a host of intermediate arguments (Bernard and Jones, 1996).

Thus, the purpose of this section is to test the catching-up hypothesis for each of 46 samples developing economies in dynamic settings based on time series methods.

The organising principles of the empirical test is related to time series studies conducted on developed economies, among others, by Bernard and Durlauf (1996) and Bernard and Jones (1996) which come from employing stochastic definitions for both long-term economic fluctuation and catch up. These definitions rely on the notions of unit roots and cointegration in time series.

The individual productivity series can be modelled as equation (6.3.6):

$a(L)C_t = u_i + e_t$ (6.3.6)

Where:

C_t= catching up variable (the ratio of a given developing economy's labour productivity to the USA's level),

$a(L)$ = first difference,

u_i= a drift parameter,

e_t= error term

It is assumed that $a(L)$ has one root on the unit circle and e_t is stationary process of mean zero. This formulation allows for both linear deterministic and stochastic trends in relative productivity series. The interaction of both types of trends can be formalised in general definitions of catching-up and common trends.

A given developing economy can catch up between fixed time t and t + T if the deviation in productivity in a developing economy and a leading economy (developed economy) is expected to decrease. If productivity level of a leading economy is greater than a developing economy at a time t,

$\lim_{T\to\infty} E(1/C_{t+T}) < 1/C_t$ (6.3.7)

The definition of catching up asks whether the long run forecasts of relative productivity tend to unity as forecasting horizon tends to infinity (Bernard and Jones, 1996). Under definition (6.3.6), if C_t is a mean zero stationary process then unconditional catching up will be satisfied. This has natural testable analogies from the unit root, cointegration and common trend literature. In order for a given developing economy to reveal unconditional catching up, the level series of relative productivity variable of a particular developing economy must be trend stationary.

Under definition (6.3.7), to exhibit technological spillover, the developing economy's productivity series must be cointegrated with the leading economy's productivity series. Thus, if the relative productivity level series are stationary, the trends for each economy must be the same. The United States' labour productivity level has been taken as the base to which the developing economies' converge. Because in the post war period USA has prevailed over all other countries in achieving a large labour productivity level (Dollar, 1992, pp. 4-5). Since data on total productivity is not available the study has taken labour productivity as proxy to the former. Accordingly, the catching-up variable (C_t) hereafter is measured for each developing economy under consideration as the ratio of a particular developing economy's labour productivity level to that of the USA level. The logarithmic form of C_t is applied in empirical tests.

Besides, in an endogenous growth model, technology is not an exogenous and cannot be freely available and easily disseminated. However, its spillover to a given economy should be subject to social capability of that particular economy. In the present context, in order to further identify the possible determinants of the catching-up process, the study tries to be as comprehensive as possible and gives special attention to exports, human and physical capital in a particular economy context. The assumption is that since export-led growth is vital conduit for the spread of technology from leading to follower economies it raises a developing economy's social capability along with physical and human capital accumulation. Thus, export expansion accelerates productivity growth and positively interacts with the catching-up variable.

The following functional form captures the above argument:

$$\log C_t = A_5 + B_5 \log X/Y_t + B_6 \log H_t + B_7 \log K_t + U_t \qquad (6.3.8)$$

Where $\log PCI_t$, $\log K_t$, $\log X/Y_t$, $\log C_t$ and $\log H_t$ are the logarithm series of real per capita income, real capital stock, percentage share of real total exports in real GDP, catching-up index and human capital variables respectively. A_5 is an intercept. B_5, B_6 and B_7 represent the structural coefficients for their respective variables. U_t is the residual term, which is assumed to be independently and identically distributed.

One of the central requirements for applying the above regression models is the stationarity of the regression variables. Variables in a regression model which incorporates a stochastic trend, lead to the problem that "... the usual techniques of regression analysis can result in highly misleading conclusions..." (Stock and Watson, 1988, p. 163) like the acceptance of so-called spurious regression relationships. The commonly used critical values for the t- and F-statistics are not valid. As it has been discussed in the previous chapter, an appropriate way to tackle the problem of non-stationary variables is the application of cointegration methods on the levels of variables. The general requirement for the cointegration technique is to have variables of the same order of integration at hand but the Johansen approach does not propose it as a prerequisite (Johansen, 1995). The following major steps are accordingly necessary: first, determination of the order of integration for each variable; second, the estimation of the long run relationship for particular cointegration models formulated above.

6.3.2. Test for Non-stationary: Univariate Unit Root Test

The stationarity assumption implies that the mean and the variance of the process are constant and that the autocovariances, do not depend on the lag or time differences. However, non-stationary series exhibits time changing levels mean and variances.

The formal test of stationarity is a test for a unit root. Variety of unit root tests have been developed recently; most require the use of special critical values, even when the test statistics takes a familiar form. In this work, the Augmented Dickey- Fuller (ADF) test is used because of its the most popular class of test to determine the level of integration of economic variables (H.M. Pesaran and B. Pesaran, 1991). Therefore, the series test for unit roots will be undertaken in the following way:-

Consider the following autoregressive representation of vector variables Y_t for the series in 6.3.4 - 6.3.8):-

$Y_t = \lambda o + \beta T + \lambda_1 Y_{t-1} + e_t$ (6.3.9)

Where e_t is assumed to be a white noise, stationary error term; T is a time trend variable that is applicable only in the trended case to test for unit roots. So, the DF (Dickey-Fuller) test of stationarity in the trended case is taken as:

H_o: $\beta = \lambda_1 = |1|$ (6.3.10)

H_1: $\beta = \lambda_1 < |1|$ (6.3.11)

H_o is null Hypothesis (non-stationary) and H_1 (stationary) is its alternative. For non- trended case β does not exist that only λ_1 is considered. Now reparameterise (6.3.9): -

$\Delta Y_t = \lambda_0 + \beta T + \beta_1 Y_{t-1} + u_t$ (6.3.12)

H_o: $\beta = \beta_1 = 0$ (6.3.13)

H_1: $\beta = \beta_1 < 0$ (6.3.14)

β_1 is equal to (λ_1 -1). β exists only in trended case. The DF test is based on the assumption that the variable follows a simple first order autoregression. However, this is not so for most economic time series because of the problem of serial correlation. Therefore, this problem will be dealt with by modifying the Dickey-Fuller test. Thus, the ADF test, in which one takes account of any serial correlation is present by entering lagged values of the dependent variable in the regression equation (6.3.12) as follows: -

$$\log\Delta Y_t = \lambda o + \beta T + \beta_1 \log Y_{t-1} + \Sigma_{i=1}\, \alpha \Delta Y_{t-i} + v_t \quad (6.3.15)$$

6.3.3. Cointegration model

As it has been presented in the fifth chapter, Engle and Granger (1987) were the first to develop the cointegration technique. Based on the argument that though each time series on its own represents a non-stationary process, various linear combinations between those variables may exist, which result in a new stationary process. If cointegration is discovered, there is one (or several) stationary linear combination of non-stationary economic time series. In this regard, one can call it an empirical equilibrium, where economic variables may drift apart in the short run, but in the long run certain factors will bring them together again. The common t- and F- tests for the coefficient estimators cannot be applied because there exist asymptotically no normal distribution for them.

There is a general distinction between two cointegration techniques, i.e. two-step procedure of Engle (1987) and the maximum-likelihood procedure of Johansen (1988b and 1995).The first step of the Engle and Granger procedure is a static OLS regression in order to determine the empirical long-run relationship between the variables. A variable of the pool of variables is chosen as the dependent variable, in this study the per capita income for the aggregate and disaggregate models, and the catch-up variable for the catch-up model are chosen as the dependent variables. If a vector coefficient can be established so that the regression residuals becomes a stationary process, then the hypothesis of cointegration relationship among the variables in each particular models is accepted. The stationarity of the estimated residuals is basically tested with ADF unit root tests. In a second step the lagged estimated residuals of the cointegration is used to estimate the Error Correction Model, i.e. an equation which unifies the long and short run components of the relationship.

The ECM is often interpreted as implying some type of adjustment to disequilibrium or permitting any type of gradual adjustment towards a new equilibrium (Muscatelli and Hurn, 1992). It also can be taken as a partial adjustment equilibrium (Maddala, 1992). In this approach, examining the stability of deviations from the relationship tests the existence of a long- run relationship between two or more non- stationary time series. It is within this context that an error correction mechanism (ECM) is developed and formulated as the second- stage regression. Therefore, with respect to models (6.3.4, 6.5 and 6.3.8), the error correction is consider as:

ECM Model I

$\Delta logPCI_t = A_0 - b_1 V_{t-1} + \Sigma^d{}_{p=1}\, \alpha_{0i}\Delta logPCI_{t-p} + \Sigma^m{}_{i=1}\, \alpha_{1i}\Delta logX_{t-i} + \Sigma^n{}_{j=1}\, \alpha_{2i}\Delta logH_{t-j} + \Sigma^q{}_{k=1}\, \alpha_{3i}\Delta logK_{t-k} + \Sigma^r{}_{l=1}\, \alpha_{4i}\gamma L_{t-1} + \varepsilon_t$ (6.3.16)

ECM Model II

$\Delta logPCI_t = A_{01} - b_{12}\, v_{t-1} + \Sigma^d{}_{p=1}\, \alpha_{11i}\, \Delta logPCI_{t-p} + \Sigma^m{}_{i=1}\, \alpha_{12i}\, \Delta logXp_{t-i} + \Sigma^s{}_{j=1}\, \alpha_{13i}\, \Delta logXf_{t-j} + \Sigma^u{}_{z=1}\, \Delta logXm_{t-z} + \Sigma^n{}_{j=1}\, \alpha_{15i}\, \Delta logH_{t-j} + \Sigma^q{}_{k=1}\, \alpha_{16i}\, \Delta logK_{t-k} + \Sigma^r{}_{l=1}\, \alpha_{17i}\Delta L_{t-1} + \varepsilon_{1t}$ (6.3.17)

ECM Model III

$\Delta logC_t = A_{02} - b_{22}U_{t-1} + \Sigma^y{}_{w=1}\, \alpha_{21i}\, \Delta logC_{t-w} + \Sigma^m{}_{i=1}\, \alpha_{22i}\, \Delta log(X/Y)_{t-i} + \Sigma^n{}_{j=1}\, \alpha_{22i}\, \Delta logH_{t-j} + \Sigma^q{}_{k=1}\, \alpha_{23i}\, \Delta K_{t-k} + \varepsilon_{2t}$ (6.3.18)

Where the first explanatory variable in each model is the error term generated on OLS levels regression in respective models of 6.3.4, 6.3.5 and 6.3.8 and now act as an independent variables in their lagged form. ε_t, ε_{1t} and ε_{2t} are the error terms established for the new equations.

Furthermore, the following is the formulation of the Johansen approach for the empirical model is as follows:

The method begins by expressing the data generation process of a vectors of n variables Y_t, G_t and Z_t as an unrestricted vector autoregressive in the level variables:

$Y_t' = (y_{1t}\ y_{2t}\ y_{3t}\ y_{4t}\ y_{5t}) = (logPCI_t\ logX_t\ logH_t\ logK_t\ logL_t)$ (6.3.19)

$G_t' = (x_{1t}\ x_{2t}\ x_{3t}\ x_{4t}\ x_{5t}\ x_{6t}\ x_{7t}) = (logPCI_t\ logXp_t\ logXf_t\ logXm_t\ logH_t\ logK_t\ LogL_t)$ (6.3.20)

$Z_t' = (z_{1t}\ z_{2t}\ z_{3t}\ z_{4t}) = (logC_t\ logX/Y_t\ logH_t\ logK_t\ logL_t)$ (6.3.21)

$L_{jt} = \Pi_1 L_{jt-1} + ... + \Pi_k L_{jt-k} + \varepsilon_{3jt}$ (6.3.22)

Where j=1, 2 and 3, L_1, L_2 and L_3 represent Y_t, G_t and Z_t respectively.

Where each Πi is an (nXn) matrix of parameter.

The system of equations (6.3.22) are reparameterised in the ECM form:

$\Delta L_{jt} = \Gamma_{j1}\, \Delta L_{jt-1} + \Gamma_{j2}\Delta L_{jt-2} + ... + \Gamma_{jk+1}\Delta L_{jt-k+1} + \Gamma_{jk}L_{jt-k} + \varepsilon_{jt}$ (6.3.21)

$\Gamma_{ji} = -I_j + \Pi_{j1} + ... + \Pi_{jk},\ i = 1...k$ (6.3.24)

Where the rank of Γ_{jK} is equal to the number of cointegrating vectors,

$\Pi = -\Gamma_{jK} = \alpha_j\beta_j'$ (6.3.25)

Thus, Vectors α_j and β_j now define the short run adjustment and the long run cointegrating coefficients in each models respectively.

As has been discussed in chapter five, the Johansen's approach is a maximum likelihood approach of estimating all of the distinct cointegrating vectors that may exist between a set of variables. It also tests the distinct cointegration vectors are statistically significant based the maximal eignevalue and trace test. It also needs to construct a likelihood ratio test for restrictions on the cointegrating parameters.

The maximum eigenvalue test is similar to the trace test, except that the alternative hypothesis is explicit. The null hypothesis r=0 is tested against the alternative r=1, r=1 against the alternative r=2, etc. Whereas the in trace test the null hypothesis r=0 is tested against the alternative r≤1, r=1 against the alternative r≤2, etc. Enders (1995), Johansen (1995) and Johansen and Juselius (1990) tabulate the critical values for these tests. [1] In the Johanson procedure it is possible to identify the common trends (m). Thus, if r is the number of cointegrating vectors and n is the number of variables in the particular model, m = (n-r), and m is the number of common or shared trends.

The final question is that if one finds that r > 1, the question remains of how this should be interpreted in economic terms. As has been pointed out in the above discussion, the cointegrating vectors can be interpreted as the long-run equilibrium relationship between a set of variables. If r > 1, there is no longer unique equilibrium towards which ECM model is adjusted. This property originates from the fact that growth variables may be tied in the long- run in such a multivariate framework. This sometimes causes difficulty in identifying the single long- run relationship of interest from the available data. According to Muscatelli and Hurn (1992), the usual response by applied researchers who are seeking a single long-run behavioural relationship between the variables included in vector Y_t, G_t and Z_t above when faced with results that r > 1 is to choose to employ only that cointegrating vector which makes 'economic sense'. That is, to choose that vector where the estimated long- run elasticities correspond closely (in both sign and magnitude) to those predicted by economic growth theory. In this work the predictions of new growth and export-led growth models hypotheses are applicable in the sense that the long run elasticities of exports and other variables in this particular modelling are expected to be positive and their magnitude is far from zero when normalised say to per capital income (model 1 and 2) and catching-up (model 3) variables.

This research work is going to apply the ADF test (6.3.15) to make a series test for unit roots. In order to identify whether there is a cointegration relationship and related ECM among the economic variables in the above three models considered, first, the residual based cointegration test (6.3.4, 3.3.5 and 6.3.8) and its ECM estimation (6.3.16-6.3.18) is conducted; second, the Johansen Maximum likelihood approach is applied (6.3.19 -6.3.25).

The ADF test, identification of cointegrating vectors and the respective ECM matrix for short run adjustment and the necessary significance tests are undertaken using a MICROFIT 3.0 software.

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[1]For Practical purpose the ADF, ECM and cointegration applications are fitted to MICROFIT 3.0 software.

6. 4. Data Quality and Coverage

The empirical research is conducted on selected developing economies. In the light of the econometric methodology discussed in the previous chapter, a time series econometric analysis is undertaken for each country under consideration. The International Monetary Fund Financial Statistics year books and monthly reports, the World Bank (World Development Reports and World Tables), Penn World Data (5.6), Mitchell (1995), UNESCO, UN, ILO and OECD publications served as the major sources of data. In order to make the empirical analysis manageable, the number of countries included in the econometric test are limited. In this thesis, a sample of 46 developing economies has been created. The data series are annual based and cover the period from 1950 to 1990 for the aggregate and catching up data and the period 1966-1990 for disaggregated data with possible down or up within this margin based on the availability of data (see appendix 1 to the chapter for the exact data periods).

It also should be noted that the data set used in this study has the same limitations that the IMF, the World Bank, ILO, OECD or UNESCO generally faces as a result of (a) sometimes narrow definitions and possible differences in accounting concepts and methods and (b) inadequate statistical coverage of sub-national governments.[2] The data limitations have been well recognised, documented and discussed particularly by IMF and World Bank in their annual reports and in Mitchell (1995).[3] Despite these limitations, the statistical data from the World Bank, IMF, Penn World Data, UNESCO and Mitchell's world historical statistics are more compatible to each other and represent the best of the available time series statistical data used for economic analysis of the developing economies. Data from these sources are better standardised to facilitate cross-country, international and

[2] For example, the GDP has a great advantage of encompassing all a country's economic activity in a few mutually consistent summary statistics. However, it also has limitations. One difficulty is that poor countries usually have poor statistical services, data from certain sectors of poor countries, such as agriculture are the worst of all. Estimates of GDP of many developing economies are based on fairly reliable statistics on modern industrial and mining enterprises combined with estimates of rural-sector performance based on small samples or outright guesses. In addition to data limitations, there are basic methodological issues that get in the way of reliable estimates (Gillis, 1993, pp. 42).

[3] For more details, see the International Monetary Fund (Various Years) International Financial Statistics Year Book. Washington, D. C.: IMF, Various Years); World Bank (1979-94)World Development Reports. New York: Oxford University Press, and World Tables. New York: Oxford University Press, 1994).

intertemporal comparisons. They are consistent time series, cover longer time periods and have been regularly up dated.

In the literature of development economics, countries of the world are often categorised as developed and developing economies. In this regard, Welsh and Butorin (1990, pp. 309) defined developing country in the dictionary of development as a country in which large segments of the economy are still comparatively underdeveloped and the majority of the population is very poor. Countries of such group are sometimes called as less developed, underdeveloped, backward or third world countries. Although there are wide variations in these countries Gross National Product and per capita income, most developing countries have economies based on export of raw materials, and their infrastructure is inadequate for their needs. The development Assistant committee (DAC) describes developing economies as all countries in Africa except South Africa, in America except the United States and Canada, in Asia except Japan and China, in Oceania except Australia and New Zealand (Welsh and Butorin, 1990, pp. 309-310).

145 member countries of the United Nations (UN) are classified as developing countries (Todaro, 1994, p. 27).

The UN classification system distinguishes among three major groups within developing countries: the 44 poorest countries designated by the UN as 'least developed', the 88 non-oil- exporting 'developing nations', and the 13 Petroleum- rich members of the Organisation of Petroleum Exporting Countries (OPEC) (Todaro, 1994, pp. 27-29).[4]

The classification system established by the Organisation for Economic Co-operation and Development (OECD), in Paris, divides the 'Third World' (including countries which are not in UN system) into low-income countries (LICs) (those with a 1990 per capita income of less than $600, including 29 least developed countries, or LLDCs), 73 middle- income countries (MICs), 11 newly industrialising countries (NICs), and the 13 members of OPEC (Todaro, 1994, p. 28). In this classification, countries such as China, South Africa, Spain, Portugal and Greece which are not classified as developing countries by DAC are described as developing economies (Todaro, 1994).

The World Bank has its own classification. It divides 208 countries (both developing and developed) with populations of more than 30, 000 into four categories according to their 1992 GNP per capita income levels: low-income ($675 or less), lower-middle income ($676-2,695), upper-middle-income ($2,696-8,355), and high-income economies ($8,356 or more). The first, three groups comprise 169 mostly developing countries, while the last group, the high-income economies, consists of 39 countries of 21 of which are typically included in the developed world and the other 18 (Brunei, French Polynesia, Hong Kong, Kuwait, Israel, Singapore, the United Arab Emirates, Andorra, Channel Islands, Cyprus, Faeroe Islands, Greenland, San Marino, Qatar, Taiwan, Bahamas, The Bermuda and Virgin Islands) of which are classified by the United Nations as developing (World Bank, 1994, pp. 251-252). [5]

The Brandt Commission report has adopted a classification system similar to that of the OECD by dividing Third World countries into three groups: low-income countries, newly industrialising countries (NICs), and oil exporters. The NICs include countries like Brazil, Argentina, South Korea, Taiwan, Hong Kong, Mexico, and Singapore, which are rapidly developing a diversified manufacturing and industrial capability (Todaro, 1994, pp. 27-60; Thirlwall, 1994, pp. 38-50). The International Monetary Fund (IMF) and United Nations Centre for Trade and Development (UNCTAD) produce other lists in international use, all differ slightly from each other. The IMF in its 1994 International Financial Statistics YearBook (pp. 14-16) classified countries of the world into industrial and developing economies. The former includes only United States, Canada, Australia, Japan, New Zealand, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and United Kingdom. The transitional economies of the ex-Soviet Union and Eastern Europe are in economic transition and their economic status is uncertain. However, according to the World Bank, in its World

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[4] The least developed countries are sometimes even referred to as the fourth world to underline their situation as the 'poorest of the poor' of the developing economies and their special need for international assistance (Low, et al. 1974, pp. 35-54).

[5] Per capita Gross National Product (GNP) or Gross Domestic Product (GDP) comparisons among countries are sometimes exaggerated by the use of official foreign-exchange rates to convert the developing country national currency figures into U.S. dollars. This conversion does not attempt to measure the relative domestic purchasing power of different currencies. To rectify this, the United Nations has attempted to compare relative GDP by using purchasing power parities (PPPs) instead of exchange rates as conversion factors. PPPs use a common set of international prices for all goods and services produced. Income gaps between rich and poor countries tend to be less when PPPs are used (Summers and Heston, 1991).

Development Report (1994, pp. 158-59) except Tajikistan (classified as a low-income economy) 26 of them are preliminary classified as middle-income economies in which only 4 countries (Belarus, Estonia, Hungary and Slovenia) are upper middle-income economies. The rests are lower-middle income economies. The World Bank in its 1993 extracts of economic trends in developing economies classified the historically planned economies of Eastern Europe and the former Soviet Union as developing economies. The IMF (1994, pp. 28) explicitly classified them as developing economies. Thus, Tables 6.1- 6.6 below give a complete listing of the IMF, OECD and World Bank classifications of 185 developing economies according to their income group and export category. Because of disagreements among different sources in classifying Greece, Spain and Portugal as developing nations they have been excluded from the sample data categorising them as developed economies.

In this empirical analysis, the WB classification is used as a basic source. IMF, OECD, UN and DAC committee sources to distinguish developing economies from developed ones supplement this. With careful considerations and cross checks between these sources, thus, out of 208 countries and territories 185 (excluding 23 developed economies) are categorised as developing economies and considered as a candidate for empirical tests.

Tables 6.1 - 6.6 Classification of Developing Economies by Income and Major Export Category*

Table 6.1. Exporters of Manufactures

Countries By Income Group		
Low-Income	Middle-Income	High-Income
China**	Armenia	Hong Kong
	Belarus	Israel**
	Bulgaria	Singapore**
	Estonia	Taiwan
	Georgia	
	Hungary	
	Korea Dem.	
	Korea, Rep.**	
	Kyrgyz Republic	
	Lebanon	
	Lithuania	
	Macao	
	Moldavia	
	Romania	
	Russia	
	Poland	
	Ukraine	
	Uzbekistan	

Table 6.2. Exporters of Non-fuel Primary Products

Countries by Income Group		
Low-Income	Middle-Income	High-Income
Afghanistan	Albania	Faeroe Islands
Burundi	American Samoa	Greenland
Chad	Argentina**	
Equatorial Guinea	Bolivia**	
Ethiopia**	Botswana	
Ghana**	Chile**	
Guinea	Cote D'Ivoire	
Guinea-Bissau	Cuba	
Guyana**	French Guyana	
Honduras**	Guadeloupe Reunion	
Liberia	Guatemala**	
Madagascar	Mongolia	
Mali	Namibia	
Malawi	Papua New Guinea	
Mauritania	Solomon Islands	
Myanmar**	St. Vincent and the Grenadines	
Nicaragua**	Suriname	
Niger**	Swaziland	
Rwanda	Peru**	
Sao Tome and Principe	Paraguay**	
Somalia		
Sudan		
Tanzania		
Togo		
Uganda		
Viet Nam		
Zaire		
Zambia		
Zimbabwe		

Table 6.3. Exporters of Fuels (Mainly Oil)

Countries by Income Group		
Low-Income	Middle-Income	High-Income
Nigeria**	Algeria**	Brunei
	Angola	Qatar
	Bahrain	United Arab Emirates
	Congo	
	Iran**	
	Iraq**	
	Libya	
	Oman	
	Saudi Arabia**	
	Trinidad and Tobago	
	Turkmenistan	
	Venezuela**	

Table 6.4. Exporters of Services

Countries by Income Group		
Low-Income	Middle-Income	High-Income
Benin	Antigua and Barbuda	Bahamas
Bhutan	Aruba	The Bermuda
Burkina Faso	Barbados	Cyprus
Cambodia	Belize	French Polynesia
Egypt**	Cape Verde	
Haiti	Dominican Republic**	
Djibouti	Lesotho	
Maldives	El Salvador**	
Nepal	Fiji	
Yemen	Grenada	
	Jamaica**	
	Jordan**	
	Panama**	
	Kiribati	
	Malta	
	Martinique	
	Netherlands Antillers	
	Seychelles	
	St. Kitts and Nevis	
	St. Lucia	
	Tonga	
	Vanuatu	
	Western Samoa	

Table 6.5. Diversified Exporters

Countries by Income Group		
Low-Income	Middle-Income	High-Income
Bangladesh	Azerbaijan	Kuwait
Comoros	Brazil**	
Central African Republic	Cameroon	
India**	Colombia	
Indonesia**	Costa Rica**	
Lao PDR	Dominica	
Mozambique	Ecuador**	
Pakistan**	Kazakhstan	
Sierra Leone**	Malaysia**	
Sri Lanka**	Mauritius**	
Tajikistan	Mexico**	
Kenya**	Morocco**	
	Philippines**	
	Senegal	
	South Africa**	
	Syria**	
	Tunisia	
	Turkey	
	Thailand	
	Uruguay**	
	Yugoslavia F. R.	

Table 6.6: - Countries that are not classified by Export Category

Countries by Income Group		
Low-Income	Middle-Income	High-Income
Eritrea	Bosnia and Herzegovina	Andorra
	Croatia	Channel Islands
	Czech Republic	San Marino
	Gibraltar	Virgin Islands
	Guam	
	Isle of Man	
	Macedonian	
	Marshall Islands	
	Mayotte	
	Micronesia	
	New Caledonia	
	N. Mariana IS.	
	Puerto Rico	
	Slovak Republic	
	Slovenia	

* Major exports are those that account for 50 per cent or more of total exports of goods and services from one category, in the period 1987-1991. The categories are: non-fuel primary, fuels, manufactures and services. If no single category accounts for 50 per cent or more of total exports, the economy is classified as diversified.

** Countries, which are included in econometric test (In terms of income category: - 16 are low income, 28 are middle income and 2 are high-income countries. In terms of export category: - 13 countries are non-oil primary commodity exporters, 6 are oil exporters, 6 are services exporters, 4 are manufacturing and the export structure of 17 countries is diversified).

Source: 1. World Bank (1994) World Development Report. Washington, D. C.

2. OECD Classification of Developing Economies in M. P. Todaro (1994).

3. IMF. 1994. International Financial Statistics YearBook.

6.5. Empirical Tests and Results

6.5.1. Unit Roots Test

Before conducting the identification of the existence of long-run equilibrium relationship in the cointegration model set out in section 6.3 above, it is important to identify the time-series properties of the particular data series. Accordingly, this section presents in the tables 6.7-6.11 below summary results of ADF unit roots tests in growth variables at the 5% level of significance for 46 countries. The ADF test is asymptotically valid and widely used method for testing for unit roots.

In practice, the appropriate lag length of the autoregression is rarely known. One approach would be to use a model selection procedure based on some information criterion such as, for instance, Akaike's (1969) information criterion (AIC) or Schwartze's (1978) Bayesian Information Criterion (BIC). The LM test, Box and Pierce Q-statistics and Ljung and Box Q* statistics are widely used in determination of lag structures (Maddala, 1992, pp. 540-541). However, Said and Dickey (1984) showed that the ADF test is valid asymptotically if the order of autoregression is increased with sample size (T) at a controlled rate ($T^{1/3}$).

M. H. Pesaran and B. Pesaran (1991, p. 161) argue that the choice of order of autoregression largely depends on the number of available observations and serial correlation patterns that may be present in the error term. They have further indicated that it is quite reasonable to assume autocorrelated order level equal to 1, 2, 4 and 12 respectively for annual, half-yearly, quarterly and monthly data (M. H. Pesaran and B. Pesaran, pp. 66 and 167).

Thus, in this study, because of annual nature of the samples and their relatively small size it seems reasonable to assume autocorrelation level equal to 1. However, tests have been conducted to identify the lag structure of each variable based on the modified Ljung and Box test (Q*-statistic).Furthermore, the visual autocorrelation structure of the variables is checked. For variables that the Q*-statistic does give the presence of serial correlation at the lag structure more than one, further test conducted based on LM test, AIC and BIC for model selection criteria. Besides, it is to be noted that for an order of zero the ADF reduces to the simple Dickey-Fuller (DF) test. ADF(0), ADF(1) and ADF(2) tests have been calculated both with trend and without trend. The results are reported and interpreted in the tables below based on ADF(1) for both log level variables (basically based on the trended case) as well as their first differences (basically based on non-trended). In the cases that the null hypothesis of non-stationary is not accepted for level variables based on the trended case and is not rejected in the case of first differenced variables in the non-trended case, variable deletion, addition and changing of lag levels have been considered to improve the results.

According to these tests, out of 452 series of level variables (10 series for each countries except for Iraq (7) and Paraguay (9)) 443 are best characterised as non-stationary at levels or I (1), i.e., they are non-deterministically random walk with drift. Only 9 level variables (labour variables for Syria and Uruguay; Human Capital variables for Philippines, Sri Lanka, Syria, Uruguay; Physical Capital variable for Philippines; PCI variable for Myanmar; and manufacturing export variable for Argentina) are Stationary. Out of 443 non-stationary level series, 420 series are I (0), i.e., having a stochastic trend at their levels but stationary at their first difference. The first difference of 23 series (PCI variable for Syria; Gross Export variable for Pakistan and Syria; Fuel export variable for Bolivia, Myanmar, Mexico; Manufactured Export variable for Bolivia, Algeria, Ecuador; Human Capital variable for Chile, Saudi Arabia, Venezuela, El Salvador, Panama, Costa Rica and Malaysia; Physical capital variable for Singapore, El Salvador and Panama; Labour variable for Singapore, Myanmar; Catching up variable for Singapore and Indonesia) are non-stationary.

Therefore, since more than 98 per cent of level time series are non-stationary the above results are consistent with the prevalent view that most macroeconomic time series are characterised by a stochastic trend and I (0) at their first differences (Nelson and Plosser, 1982). Based on this prevalent view, in the few cases that tests in this study are inconclusive it seems reasonable to assume that the series are I(1), which is compatible with the widely held economic view. In other words, as most of the time series variables, it has been considered here that variables in economic growth-export expansion model are non-stationary. Therefore, the reliance on the cointegration methodology for determining the significance of export-led growth in economic growth and catching up process is justified.

Table 6.7- 6.16. Results of ADF Unit root Tests for Levels and First Differenced Variables[xx]

I. Levels Variables

Table 6.7. Exporters of Manufactures

Country	Level Variables									
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
China	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Israel	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Korea Rep.	NS	NS	NS	NS	NS	NS	NS*	NS	NS	NS
Singapore	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[xx](LAG level 1 is considered.
Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

Table 6.8. Exporters of Non-fuel Primary Products

Country	Level Variables									
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
Argentina	NS	NS	NS	NS	NS	S	NS	NS	NS	NS
Ethiopia	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ghana	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Guatemala	NS	NS	N	NS	NS	NS	NS	NS	NS	NS
Bolivia	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Guyana	NS	NS*	NS	NS	NS	NS	NS	NS	NS	NS
Honduras	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Chile	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Myanmar	S	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nicaragua	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Niger	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Peru	NS**	NS	NS	NS	NS**	NS	NS	NS	NS	NS
Paraguay	NS	NS	NS	NS	NA	NS	NS	NS	NS	NS

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

Table 6.9. Exporters of Fuel (Mainly Oil)

Country	Level Variables									
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
Algeria	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nigeria	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S. Arabia	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Iran	NS*	NS	NS	NS	NS*****	NS	NS	NS	NS	NS
Iraq	NS	NS	NS	NA	NA	NA	NS	NS	NS	NS
Venezuela	NS	NS	NS	NS*	NS	NS*	NS	NS	NS	NS

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

Table 6.10. Exporters of Services

Country	Level Variables									
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
Egypt	NS*	NS	NS	NS	NS	NS	NS**	NS	NS *	NS
El Salvador	NS	NS	NS	NS	NS*****	NS	NS	NS	NS	NS
Jordan	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dominica Rep.	NS	NS	NS	NS	NS	NS	NS	N	NS	NS
Jamaica	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Panama	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

Table 6.11. Diversified Exporters

Country	Level Variables								
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
Costa Rica	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Ecuador	NS	NS	NS	NS	NS	NS	NS	NS*	NS*	NS
Indonesia	NS	NS	NS	NS	NS	NS*	NS	NS	NS	NS
Mauritius	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
India	NS	NS	NS*	NS	NS	NS	NS	NS	NS	NS
Kenya	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Malaysia	NS	NS	NS	NS	NS	NS	NS*	NS	NS	NS
Mexico	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Morocco	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Pakistan	NS	NS	NS	NS	NS	NS*	NS	NS	NS	NS
South Africa	NS*	NS	NS	NS	NS	NS	NS*****	NS	NS	NS*****
Sierra Leone	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sri Lanka	NS	NS	NS	NS	NS	NS*	NS	NS	NS	NS
Syria	NS	NS	NS	NS	NS	NS	S	NS	S	NS
Uruguay	NS	NS	NS	NS	NS	NS	S	NS	S	NS
Philippines	NS*****	NS	NS	NS	NS	NS	S	S	NS	NS

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

II. First Differenced Variables

Table 6.12. Exporters of Manufactures

Country try	First Difference Variables									
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
China	S	S	S	S	S	S	S*	S	S	S
Israel	S	S	S	S	S**	S	S	S	S**	S
Korea Rep.	S**	S**	S**	S**	S	S	S	S	S	S**
Singapore	S**	S	S	S	S	S	S**	NS	NS	NS

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

Table 6.13. Exporters of Non-fuel Primary Products

Country	First Difference Variables								
	PCI	X	X/Y	Xp	Xf	X_m	H	K	L	C
Argentina	S	S	S	S	S	S	S	S	S	S
Ethiopia	S	S	S	S	S	S	S	S	S	S
Ghana	S	S	S	S	S	S	S	S	S	S
Guatemala	S	S	S	S	S	S	S	S	S	S
Bolivia	S	S	S	S	NS	NS	S	S	S	S
Guyana	S	S*	S	S	S*	S	S*	S	S	S
Honduras	S	S	S	S	S	S	S	S	S	S
Chile	S	S	S	S	S**	S	NS	S	S	S
Myanmar	S	S	S	S	NS	S	S	S	NS	S
Nicaragua	S	S	S	S**	S**	S**	S**	S	S	S
Niger	S	S	S	S	S	S	S	S	S	S
Peru	S	S	S	S	S	S	S**	S	S	S
Paraguay	S	S	S	S	S	S**	S**	S	S	S

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

Table 6.14. Exporters of Fuel (Mainly Oil)

Country	First Differenced Variables									
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
Algeria	S	S	S	S	S	NS	S	S	S	S
Iraq	S	S	S	NA	NA	NA	S	S	S	S
Nigeria	S	S	S	S	S	S	S	S	S	S
S. Arabia	S	S	S	S	S	S	NS	S**	S	S
Iran	S	S	S	S	S	S***	S	S	S**	S
Venezuela	S	S	S	S	S	S	NS	S	S	S

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

6.15. Exporters of Services

Country	First Differenced Variables									
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
Egypt	S	S	S	S	S	S	S	S	S	S
El Salvador	S	S	S	S	S	S	NS	S	S	S
Jordan	S	S	S	S	S	S	S	S	S	S
Dominica Rep.	S	S	S	S	S	S	S	S	S	S
Jamaica	S	S	S	S	S	S	S	S	S**	S
Panama	S	S	S	S	S**	S	NS	S	S**	S

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

Table 6.16. Diversified Exporters

Country	First Differenced Variables								
	PCI	X	X/Y	Xp	Xf	Xm	H	K	L	C
Brazil	S	S	S	S	S****	S	S	S	S	S
Costa Rica	S	S	S	S**	S	S**	NS	S	S**	S
Ecuador	S**	S	S	S	S*****	NS	S	S	S	S
Indonesia	S**	S	S**	S	S	S	S	S	S	NS
Mauritius	S	S	S	S	S	S	S	S	S	S
India	S	S	S	S**	S	S	S	S	S	S
Kenya	S	S	S	S	S	S	S	S	S	S
Malaysia	S	S	S	S	S	S	NS	S	S	S
Mexico	S	S	S	S	NS	S	S**	S	S	S**
Morocco	S	S	S	S	S	S	S	S	S	S
Pakistan	S	NS	S	S	S	S	S	S	S	S
South Africa	S	S	S	S	S	S	S	S	S	S
Sierra Leone	S	S	S	S	S	S	S	S	S	S
Sri Lanka	S	S	S	S	S	S	S	S	S	S
Syria	NS	NS	S	S	S	S	S	S	S	S
Uruguay	S	S	S	S	S	S	S**	S	S	S
Philippines	S	S	S	S	S	S	S	S	S	S

Note: NS indicates non-stationary, whereas S stands for Stationary at 5% significance level test. NA represents not applicable
* Represents without trend in the case of level variables, but it represents with trend in the case of first difference variables
** ADF(0) or DF
****Stationary with trend
***** ADF(2)

Since stochastic trends have been confirmed for most of the time series of this study's growth variables the study should focus on the time properties of these economic time series. The question is essentially, whether there exists stable and dynamic long run equilibrium relationships between these growth variables as the study has specified in section 3 for each sample economy considered.

6.5.2 Cointegration test

I. Analysis of the Aggregated Exports Data

The above unit roots test results analysis indicates that except for a few series the variables concerned for each economy are non stationary at levels and stationary at first differences. Therefore, in the light of 'new' growth model and the econometric methodology outlined, the thesis now tests for the presence of cointegration relationships among the variables considered in the multivariate context.

Thus, this thesis includes a measure of physical capital (real gross investment as a percentage of real GDP), a measure of human capital (the primary and secondary school enrolment per 1000 population), real per capita GDP (measured in terms of purchasing power parity), real exports in value terms and labour variables. Accordingly, the study is interested to start its analysis by employing the Engle-Granger cointegrating regressions by OLS. Thus, it is formulating the following multivariate relationship:

$PCI = f(X, H, K, L)$

As it is formulated in equation (6.3.4), this relationship expresses long-run relationship as a regression is in natural logarithms:

$\log PCI_t = A_3 + B_1 \log X_t + B_2 \log H_t + B_3 \log K_t + B_4 \log L_t + V_t$

Where A_3 and V_t are intercept term and residuals respectively, for the variables in the above equation to be cointegrated, they need to be stationary as a necessary condition (but not sufficient). A sufficient condition for a joint cointegration among the variables now is that the error term, V_t, should be stationary. Within this context, the study conducts test for the stationarity of the residuals by applying the residual based ADF test. The last columns in Tables 6.17-6.21 and appendix 1 to the chapter report the results of the residual-based ADF test for cointegration. Thus, the study is able to reject the null of no cointegration at 5% significance level, i.e. the variables are said to be cointegrated. The result of Cointegrating Durbin-Watson (CRDW) statistic is also strongly confirms the presence of cointegration for all economies. The graph of residuals and the residual correlogram is supportive to the results obtained. Therefore, the results indicate that EG OLS are robust.

Table 6.17-6.21.: Aggregated Data:- Cointegration Tests and Results

Table 6.17. Aggregated Data: Exporters of Manufactures

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration and ECM		
	Number of Cointegrated Vectors		Exclusion Test for exports variable	Unique or Proxy Unique Cointegrated Vector	Exports Coefficient in the Unique/ Proxy Unique Cointegrated vector			
	Maximal Eigenvalue Test	Trace Test				CRDW	ADF	Sign of ECM term
China	2	3	INS	2nd (proxy)	positive	CI	CI	-ve
Israel	1	4	INS	3rd (proxy)	positive	CI	CI	-ve
Korea Rep	3	5	SI	NA	not applicable	CI	CI	-ve
Singapore	3	3	SI	NA	NA	CI	CI	-ve

Table 6.18. Aggregated Data: Exporters of Non-fuel Primary Products

Country	Johansen Maximum Likelihood Approach					OLS Residual Based Cointegration Test		
	Number of Cointegrating Vectors		Exclusion test for Exports variable	Unique or proxy Unique Cointegrated Vectors	Exports Coefficient in the Unique/ proxy Unique Cointegrated vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
Argentina	2	1	INS	1st (proxy)	positive	CI	CI	-ve
Ethiopia	1	1	INS	1st	positive	CI	CI	-ve
Ghana	1	1	INS	1st	positive	CI	CI	-ve
Guatemala	4	4	INS	3rd (proxy)	positive	CI	CI	-ve
Bolivia	2	2	INS	1st (proxy)	positive	CI	CI	-ve
Guyana	1	2	INS	2nd (proxy)	positive	CI	CI	-ve
Honduras	1	1	INS	1st	positive	CI	CI	-ve
Chile	3	3	INS	1st (proxy)	positive	CI	CI	-ve
Myanmar	2	2	INS	1st (proxy)	positive	CI	CI	-ve
Nicaragua	3	3	INS	2nd (proxy)	Positive	CI	CI	-ve
Niger	1	4	INS	2nd (proxy)	positive	CI	CI	-ve
Paraguay	2	5	INS	1st (proxy)	positive	CI	CI	-ve
Peru	0	2	INS	1st (proxy)	positive	CI	CI	-ve

Table 6.19. Aggregated Data: Exporters of Fuel (Mainly Oil)

Country	Johansen Maximum Likelihood Approach					OLS Residual Based Cointegration Test		
	Number of Cointegrating Vectors		Exclusion test for Exports Variable	Unique or Proxy Unique Cointegrated Vector	Exports Coefficient in the Unique/ proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
Algeria	3	4	INS	1st (proxy)	positive	CI	CI	-ve
Iraq	0	0	SI	not applicable	not applicable			
Nigeria*	0	5	SI	not applicable	not applicable	CI	CI	-ve
Iran	2	2	INS	2nd (proxy)	positive	CI	CI	-ve
S. Arabia	2	5	INS	3rd (proxy)	positive	CI	CI	-ve
Venezuela	0	0	not applicable	not applicable	not applicable	CI	CI	-ve

Table 6.20. Aggregated Data: Exporters of Services

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration test		
	Number of Cointegrating Vectors		Data Generation Process	Unique or Proxy Unique Cointegrated Vector	Exports coefficient in the Unique/ Proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
El Salvador	3	3	INS	3rd (proxy)	positive	CI	CI	-ve
Jordan	1	1	SI	not applicable	not applicable	CI	CI	-ve
Dominica Rep.	1	1	SI	not applicable	not applicable	CI	CI	-ve
Jamaica	2	2	SI	not applicable	not applicable	CI	CI	-ve
Panama	2	2	SI	not applicable	not applicable	CI	CI	-ve
Egypt	1	1	INS	1st	positive	CI	CI	-ve

Table 6.21. Aggregated Data: Diversified Exporters

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration test		
	Number of Cointegrating Vectors		Exclusion test for Exports variable	Unique or Proxy Unique Cointegrated Vector	Exports Coefficient in the Unique / Proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
Brazil	2	2	INS	2nd (proxy)	positive	CI	CI	-ve
Ecuador	1	1	SI	not applicable	not applicable	CI	CI	-ve
Costa Rica	3	3	INS	2nd (proxy)	positive	CI	CI	-ve
Indonesia	3	3	INS	1st (proxy)	positive	CI	CI	-ve
Mauritius*	1	1	SI	not applicable	not applicable	CI	CI	-ve
India	1	1	INS	1st	positive	CI	CI	-ve
Kenya	2	2	INS	2nd (proxy)	positive	CI	CI	-ve
Mexico	2	2	INS	1st	positive	CI	CI	-ve
Malaysia	2	1	INS	1st (proxy)	positive	CI	CI	-ve
Morocco	2	2	INS	1st (proxy)	positive	CI	CI	-ve
Pakistan	2	2	INS	2nd (proxy)	positive	CI	CI	-ve
South Africa	1	1	INS	1st	positive	CI	CI	-ve
Sri Lanka	2	2	INS	1st (proxy)	positive	CI	CI	-ve
Syria	2	2	INS	2nd (proxy)	positive	CI	CI	-ve
Uruguay*	1	1	INS	1st	positive	CI	CI	-ve
Philippines	3	3	SI	not applicable	not applicable	CI	CI	-ve
Sierra Leone	1	2	INS	1st (proxy)	positive	CI	CI	-ve

* The Johansen cointegration is conducted with non-trended case otherwise the DGP is trended

The thesis now further investigates the relationship examining the ECM. Since the EG OLS estimates were shown to be robust, the estimated lagged residuals may still be used in the ECM as the Error correction term. The last columns in Tables 6.17-6.21 shows the evidence that error correction terms for the 46 economies' aggregated data are existing with correct negative sign. Which mean, the sign of the speed of adjustment coefficients are in accordance with convergence toward the long run equilibrium. The t-statistics for error correction term is significant only for Iran, Pakistan, Saudi Arabia, Iraq, Jordan, South Korea, Costa Rica, El Salvador, Mexico, Panama, Chile, Guyana, Peru, Praguay, Uruguay, Venezuela, Algeria, Ethiopia, Morocco, South Africa, Kenya, China and India. Thus, it indicates that for these economies, logX, logH, logK and logL jointly Granger cause logPCI in the long run. However, the OLS based cointegration and the accompanying ECM results are subject to serious limitations:

(1) the number of cointegrating vectors may be more than one, since there are more than two variables involved in each cointegrating regression. Because the EG approach assumes the uniqueness of the cointegrating vector, the study needs to employ system-based Johansen method to check for the number of cointegrating vectors and common trends.

(2) OLS long run estimates may be biased and the parameter estimates are variant to normalisation. Note that, as a rule the higher R^2 statistic in a cointegrating regression, the less biased the estimated static long run estimates are (Ghatak et al., 1997).

(3) resulting t-statistics have only a descriptive role due to nonstationary nature of the variables under search (See Enders, 1995; Ghatak et al. 1997). 3) Long run OLS estimation gives inconsistent estimation of parameters due to simultaneity problems with explanatory variables (Maddala, 1992, p. 383). Thus, the study applied the Johansen system-based approach (Johansen, 1995; Johansen and Juselius, 1990).

The second columns of Tables 6.17- 6.21 set out a summary results of cointegration test conducted based on Johansen Maximum Likelihood approach of VAR formulation equation (6.3.23) for series in equation (6.3.19). A VAR (1) model is chosen due to the relatively small sample size and data frequency.

The maximal eigenvalue (Lambda) test, which is the most powerful, results suggest that the exports variable forms cointegrating vectors with PCI, Human Capital, Physical capital and labour variables for 42 developing economies out of 46 economies considered. The trace test results, which is relatively less powerful, rejects the null of no cointegration for 44 countries.

Out of 4 countries for which the null of no cointegration has not been rejected in Lambda test, 3 are from fuel exporters (Iraq, Nigeria and Venezuela) and 1 is Peru, which is non-fuel primary goods exporter. The trace test rejects cointegration for Iraq and Venezuela but significantly accepts for Nigeria and Peru. The thesis further conducted maximum likelihood restriction test for the export variable, which is the study's particular interest. The result shows that for 34 developing economies the export variable shows statistically insignificant results for super exogenous test. Which mean that the export variable cannot be excluded from the long run cointegration relationship. Accordingly, export expansion plays a significant causal role in these economies' growth. This is a very robust evidence for export-led growth hypothesis. However, for 10 economies (South Korea, Singapore, Nigeria, Ecuador, Mauritius, Philippines, Jordan, Dominica Republic, Jamaica and Panama) the test indicates exports variable is super exogenous that it can be excluded from the long run economic growth model. Thus, it is difficult to see how export expansion has not played a significant causal role in these economies' growth. For economies such as Nigeria, Philippines, Jordan, Dominica Republic and Panama the result is not surprising because such economies have not followed a well articulated export-led growth policies. They have been characterised by microeconomic instabilities, mismanagement and export bias trade regimes (Sachs and Warner, 1995).

In the case of Mauritius, South Korea and Singapore which are relatively export oriented economies, it is very essential to consider the argument that has been forwarded by Rodrik (1995). In the light of his argument the measured increase in the relative profitability of exports during the 1960s is too insignificant to account for the phenomenal export boom that ensued. besides, exports were initially too small to have a significant effect on economic performance. A more plausible argument emphasises on the investment booms that take place in these two economies. In the early 1960s particularly South Korea and Singapore had an extremely well educated labour force relative to their physical capital stock, rendering the latent return to capital quite high. By subsidising and co-ordinating investment decisions, government policy managed to engineer a significant increase in the private return to capital. An exceptional degree of equality in income and wealth helped by rendering government intervention effective and keeping it free of rent seeking. The export-led growth strategy of these economies was the product of the increase in demand for imported capital goods. However, the investment booms which have been taken place in these economies has not been possible in absence of export expansion or in the presence of gross policy biases against exports, but these booms have been compatible with a wide range of export-led growth policy options.

II. Disaggregated Exports Data

The study has now disaggregated the real exports into non-fuel primary, fuels and manufacturing products to examine the separate effects for each of them on real per capita income growth. The data for disaggregated exports are annual and mostly for the period 1966-1990 and are taken from various Yearbooks of World Bank Tables. Unavailability of data prevented the research work from extending the sizes of the observations. Disaggregated data for exports were only available in World Tables. The aggregate data from the IMF and the disaggregated data from the World Bank presumed as compatible.

The methodology applied here has already outlined and the tests for the order of integration for particular series have been reported in the previous section.

Tables 6.22-6.26 below reports the multivariate cointegration test results for the 46 economies.

Table 6.22-6.26. Disaggregated Data

Table 6.22. Disaggregated Data: Exporters of Manufactures

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration and ECM		
	Number of Cointegrated Vectors		Exclusion Test for Xp, Xf and Xm	Unique or Proxy Unique Cointegrated Vector	Export Coefficient in the Unique / Proxy Unique Cointegrated vector			
	Maximal Eigenvalue Test	Trace Test				CRDW	ADF	Sign of ECM term
China	2	4	INS	2nd (proxy)	positive	CI	CI	-ve
Israel	6	6	INS	3rd (proxy)	positive	CI	CI	-ve
Korea Rep	2	3	SI	not applicable	not applicable	CI	CI	-ve
Singapore	2	3	INS	3rd (proxy)	positive	CI	CI	-ve

Table 6.23. Disaggregated Data: Exporters of Non-fuel Primary Products

Country	Johansen Maximum Likelihood Approach					OLS Residual Based Cointegrated Test		
	Number of Cointegrating Vectors		Exclusion test for Exports variable	Unique or Proxy Unique Cointegrated Vectors	Export Coefficient in the Unique / Proxy Unique Cointegrated vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
Argentina	2	3	INS Xf and Xm but SI Xp	1st (proxy)	positive	CI	CI	-ve
Ethiopia	3	2	INS Xm but SI Xp and Xf	2nd (proxy)	positive	CI	CI	-ve
Ghana	4	7	INS	3rd (proxy)	positive	CI	CI	-ve
Guatemala	2	5	INS	2nd (proxy)	positive	CI	CI	-ve
Bolivia	3	3	INS Xp but SI Xf and Xm	3rd (proxy)	positive	CI	CI	-ve
Guyana	2	5	INS	3rd (proxy)	positive	CI	CI	-ve
Honduras	2	2	INS Xp and Xf but SI Xm	1st (proxy)	positive	CI	CI	-ve
Chile	3	4	INS	2nd (proxy)	positive	CI	CI	-ve
Myanmar	6	3	INS	2nd (proxy)	positive	CI	CI	-ve
Nicaragua	2	4	INS	3rd (proxy)	positive	CI	CI	-ve
Niger	4	4	INS	2nd (proxy)	positive	CI	CI	-ve
Paraguay	1	4	INS	1st (proxy)	positive	CI	CI	-ve
Peru	1	1	INS Xp and Xf but SI Xm	1st	positive	CI	CI	-ve

Table 6.24. Disaggregated Data: Exporters of Fuel (Mainly Oil)

Country	Johansen Maximum Likelihood Approach					OLS Residual Based Cointegration Test		
	Number of Cointegrating Vectors		Exclusion test for Exports Variable	Unique or Proxy Unique Cointegrated Vector	Exports Coefficient in the Unique/ proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
Algeria	0	0	not applicable	not applicable	not applicable	CI	CI	-ve
Iraq	not applicable	not applicable	not applicable	not applicable	not applicable	NA	NA	NA
Nigeria	0	1	SI	not applicable	not applicable	CI	CI	-ve
Iran	2	4	INS	4th (proxy)	positive	CI	CI	-ve
S. Arabia	4	4	INS	3rd (proxy)	positive	CI	CI	CI
Venezuela	0	0	not applicable	not applicable	NA	CI	CI	CI

Table 6.25. Disaggregated Data: Exporters of Services

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration test		
	Number of Cointegrating Vectors		Data Generation Process	Unique or Proxy Unique Cointegrated Vector	Export coefficient in the Unique/ proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
El Salvador	3	3	INS	1st (proxy)	positive	CI	CI	-ve
Jordan	3	2	INS Xm but SI Xp	1st (proxy)	positive	CI	CI	-ve
Dominica Rep.	3	2	INS Xp but SI X_m	2nd (proxy)	positive	CI	CI	-ve
Jamaica	3	4	INS	2nd (proxy)	positive	CI	CI	-ve
Panama	3	4	INS	1st (proxy)	positive	CI	CI	-ve
Egypt	0	0	not applicable	not applicable	NA	CI	CI	-ve

Table 6.26. Disaggregated Data: Diversified Exporters

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration test		
	Number of Cointegrating Vectors		Exclusion test for Exports variable	Unique or Proxy Unique Cointegrated Vector	Export Coefficient in the Unique / Proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
Brazil	3	4	INS	3rd (proxy)	positive	CI	CI	-ve
Ecuador	3	4	INS	4th (proxy)	positive	CI	CI	-ve
Costa Rica	4	4	INS Xm but SI Xp and Xf	3rd (proxy)	positive	CI	CI	-ve
Indonesia	2	5	INS	2nd (proxy)	positive	CI	CI	-ve
Mauritius*	3	3	INS Xp and Xm	2nd (proxy)	positive	CI	NA	NA
India	0	1	INS	1st	positive	CI	CI	-ve
Kenya	1	2	INS	1st (proxy)	positive	CI	CI	-ve
Mexico	2	2	INS Xf and Xm but SI Xp	1st (proxy)	positive	CI	CI	-ve
Malaysia	3	3	INS	2nd (proxy)	positive	CI	CI	-ve
Morocco	2	2	INS	2nd (proxy)	positive	CI	CI	-ve
Pakistan	3	3	INS	2nd (proxy)	positive	CI	CI	-ve
South Africa	1	1	INS Xp and Xm but SI Xf	1st	positive	CI	CI	-ve
Sri Lanka	2	2	INS	1st (proxy)	positive	CI	CI	-ve
Syria	2	2	INS	1st (proxy)	positive	CI	CI	-ve
Uruguay*	1	1	INS	1st	positive	CI	CI	-ve
Philippines	0	1	SI	not applicable	not applicable	CI	CI	-ve
Sierra Leone	3	4	INS	3rd (proxy)	positive	CI	CI	NA

* The Johansen system based cointegration is conducted with non-trended case otherwise the DGP is trended.

The residual based ADF and the CRDW tests results appear to support stable, 'genuine' long-run relationships, i.e. cointegration exists among the variables involved. The related ECM is with correct negative sign for all countries. However, as far as the residual based cointegrating regression result is concerned the study still faces the following problems:-

- Though the residual based approach presumes a single and unique cointegrating vector, there may be more than one since there are more than two variables involved in each economies cointegration regression,
- Normalisation of the dependent and independent variables relationship is based on the arbitrary assumption that the former is exogenous,
- OLS long-run estimates may be biased,
- The simultaneity problem results in inconsistent estimators of the parameters of explanatory variables, when structural equations are estimated based on OLS long-run estimation,
- Resulting t-statistics may not be valid due to non-normality of the distribution.
- OLS long-run estimation could not identify the number of common trends in the system.

Thus, study applied the Johansen method, which is appropriate for multivariate cointegration analysis.

The maximal eigenvalue test rejects the null of no cointegration for 39 economies but accepts for 6 economies (Algeria, Nigeria, Venezuela, Egypt, India and Philippines). The unique cointegrating vector is identified only for 5 economies (Paraguay, Peru, Kenya, South Africa and Uruguay). The results for 34 economies show at least two cointegrating vectors. The trace test result shows that the null hypothesis of no cointegration can be accepted for 3 economies (Algeria, Venezuela and Egypt). The unique cointegrating vector is identified for 6 economies (Peru, Nigeria, South Africa, Uruguay, India and Philippines).

Let as now consider an exclusion test for disaggregated exports variables. Accordingly, the Chi-square test shows that Xm is not super exogenous for 36 economies. Xm can be excluded from cointegrating relationship only for 6 economies (South Korea, Bolivia, Honduras, Nigeria, Peru, Dominica Republic and Philippines). Xp has insignificant Chi-square result for 33 economies. However, it is significant for 9 economies (South Korea, Argentina, Ethiopia, Nigeria, Jordan, Costa Rica, Mexico, South Africa and Philippines). The null hypothesis of exclusion for X_f has been rejected for 31 economies but accepted for 7 economies (Ethiopia, Bolivia, Nigeria, Costa Rica, South Africa, South Korea and Philippines).

Consequently, the Johansen Maximum Likelihood based cointegration test results with disaggregated real exports data appears to suggest that for the majority of the countries the three export categories are significantly contributing to their economic growth. The results for manufactured products exports are remarkable and suggest its expansion as a major engine of per capita economic growth whether for a very low per capita income Ethiopia or high per capita income economy of Singapore. Accordingly, it seems reasonable for developing economies to promote the expansion of manufactured goods export along with diversification of other export categories to the degree that necessary to have a significant impact on real economic growth.

III. Catching-up Data Analysis

In the light of the catching-up models specified in equations 6.3.6- 6.3.8, section 6.3 above, this section tests the catching-up hypothesis on a sample of 46 of developing economies in a dynamic context, which is based on time series methods. Accordingly, the study first tests the presence of stochastic trends in each of the 46 developing economies' relative productivity series. Tables 6.7-6.16 in the last columns present the results for ADF tests. None of the 46 economies reject the null hypothesis of a unit root (conditional catching-up) in level productivity level series. In addition, the Johansen cointegration test has been conducted to detect the presence of a stable, long run and common trend relationship between the productivity series of USA and the developing economies. The results are shown in the table 6.27 below.

Table 6.27:- Cointegration Test for Productivity Catching-up

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix***

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
1. Algeria (1960-90)				
r = 0	r = 1	5.1614	14.0690	12.0710
r= 1	r = 2	2.3385	3.7620	2.6870
2. Bolivia (1950-90)				
r = 0	r = 1	3.3889	14.0690	12.0710
r= 1	r = 2	2.0453	3.7620	2.6870
3. Chile (1950-90)				
r = 0	r = 1	6.4243	14.0690	12.0710
r= 1	r = 2	1.4572	3.7620	2.6870
4. Dominica Republic (1950-90)				
r = 0	r = 1	9.7819	14.0690	12.0710
r= 1	r = 2	5.4280	3.7620	2.6870
5. Egypt (1950-90)				
r = 0	r = 1	6.2261	14.0690	12.0710
r= 1	r = 2	0.19739	3.7620	2.6870
6. Ethiopia (1950-86)				
r = 0	r = 1	7.1006	14.0690	12.0710
r= 1	r = 2	3.9436	3.7620	2.6870
7. Guatemala (1950-1990)				
r = 0	r = 1	5.8456	14.0690	12.0710
r= 1	r = 2	0.81325	3.7620	2.6870
8. Honduras (1950-90)				
r = 0	r = 1	4.3677	14.0690	12.0710
r= 1	r = 2	0. 28969	3.7620	2.6870
9. Indonesia (1960-90)				
r = 0	r = 1	10.0900	14.0690	12.0710
r= 1	r = 2	0 .0037737	3.7620	2.6870
10. Mauritius (1951-90)				
r = 0	r = 1	4.9002	14.0690	12.0710
r= 1	r = 2	0.048380	3.7620	2.6870
11. Nicaragua (1950-90)				
r = 0	r = 1	11.9016	14.0690	12.0710
r= 1	r = 2	0.17888	3.7620	2.6870
12. Panama (1950-90)				
r = 0	r = 1	5.7414	14.0690	12.0710
r= 1	r = 2	1.5884	3.7620	2.6870
13. Saudi Arabia (1960-91)				
r = 0	r = 1	11.5665	14.0690	12.0710
r= 1	r = 2	0.80375	3.7620	2.6870
14. Syria (1960-90)				
r = 0	r = 1	21.6912	14.0690*	12.0710**
r= 1	r = 2	2.4397	3.7620	2.6870

* Significant at 5%
** Significant at 10%
*** Lag structure 1 is used in the whole series. Since the Trace test shows similar result we have not reported here.

Continued over

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix***

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
15. Argentina (1950-90)				
r = 0	r = 1	5.3001	14.0690	12.0710
r= 1	r = 2	0.61011	3.7620	2.6870
16. Brazil (1950-90)				
r = 0	r = 1	8.9152	14.0690	12.0710
r= 1	r = 2	1.6933	3.7620	2.6870
17. Costa Rica (1950-90)				
r = 0	r = 1	12.4802	14.0690	12.0710**
r= 1	r = 2	0.18823	3.7620	2.6870
18. Ecuador (1950-90)				
r = 0	r = 1	6.8827	14.0690	12.0710
r= 1	r = 2	1.4086	3.7620	2.6870
19. Elsalvador (1950-90)				
r = 0	r = 1	7.4886	14.0690	12.0710
r= 1	r = 2	0.5821E-4	3.7620	2.6870
20. Ghana (1955-90)				
r = 0	r = 1	6.6756	14.0690	12.0710
r= 1	r = 2	0.036449	3.7620	2.6870
21. Guyana (1950-90)				
r = 0	r = 1	4.5509	14.0690	12.0710
r= 1	r = 2	0.012938	3.7620	2.6870
22. India (1950-90)				
r = 0	r = 1	28.3370	14.0690*	12.0710**
r= 1	r = 2	0.026772	3.7620	2.6870
23. Iran (1955-90)				
r = 0	r = 1	28.8833	14.0690*	12.0710**
r= 1	r = 2	3.8537	3.7620*	2.6870**
24. Kenya (1951-90)				
r = 0	r = 1	7.0879	14.0690	12.0710
r= 1	r = 2	1.4363	3.7620	2.6870
25. Mexico (1951-90)				
r = 0	r = 1	13.7425	14.0690	12.0710**
r= 1	r = 2	5.2628	3.7620*	2.6870**
26. Jamaica (1953-90)				
r = 0	r = 1	15.4177	14.0690*	12.0710**
r= 1	r = 2	0.094418	3.7620	2.6870
27. Paraguay (1950-90)				
r = 0	r = 1	5.8237	14.0690	12.0710
r= 1	r = 2	1.7434	3.7620	2.6870
28. Philippines (1950-90)				
r = 0	r = 1	18.9393	14.0690*	12.0710**
r= 1	r = 2	1.1286	3.7620	2.6870

* Significant at 5%
** Significant at 10%
*** Lag structure 1 is used in the whole series. Since the Trace test shows similar result we have not reported here.

Table 6.27 Continues...

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix***

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
29. Sri Lanka (1950-89)				
r = 0	r = 1	26.7324	14.0690*	12.0710**
r= 1	r = 2	0.015421	3.7620	2.6870
30. Uruguay (1950-91)				
r = 0	r = 1	12.2753	14.0690	12.0710**
r= 1	r = 2	1.0718	3.7620	2.6870
31. Venezuela (1950-90)				
r = 0	r = 1	14.3021	14.0690*	12.0710**
r= 1	r = 2	0.040327	3.7620	2.6870
32. Niger (1960-61)				
r = 0	r = 1	10.8321	14.0690	12.0710
r= 1	r = 2	1.1469	3.7620	2.6870
33. Nigeria (1950-90)				
r = 0	r = 1	4.9582	14.0690	12.0710
r= 1	r = 2	0.52772	3.7620	2.6870
34. Morocco (1950-90)				
r = 0	r = 1	8.0407	14.0690	12.0710
r= 1	r = 2	1.7386	3.7620	2.6870
35. Sierra Leone (1961-90)				
r = 0	r = 1	18.8390	14.0690*	12.0710**
r= 1	r = 2	0 .64687	3.7620	2.6870
36. South Africa (1950-90)				
r = 0	r = 1	8.7693	14.0690	12.0710
r= 1	r = 2	1.0119	3.7620	2.6870
37. Myanmar (1950-89)				
r = 0	r = 1	7.8551	14.0690	12.0710
r= 1	r = 2	1.6475	3.7620	2.6870
38. China (1955-90)				
r = 0	r = 1	28.7165	14.0690*	12.0710**
r= 1	r = 2	3.6109	3.7620	2.6870**
39. Iraq (1953-87)				
r = 0	r = 1	4.1689	14.0690	12.0710
r= 1	r = 2	0.84183	3.7620	2.6870
40. Israel (1953-90)				
r = 0	r = 1	17.3175	14.0690*	12.0710**
r= 1	r = 2	2.8012	3.7620	2.6870**
41. Jordan (1954-90)				
r = 0	r = 1	5.3836	14.0690	12.0710
r= 1	r = 2	2.6286	3.7620	2.6870

* Significant at 5%
** Significant at 10%
*** Lag structure 1 is used in the whole series. Since the Trace test shows similar result we have not reported here.

Table 6.27 Continues...

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix***

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
42. South Korea (1950-90)				
r=0	r=1	30.3710	14.0690*	12.0710**
r=1	r=2	11.4570	3.7620*	2.6870**
43. Singapore (1960-90)				
r=0	r= 1	12.3172	10.7642*	9. 0871**
r =	r= 2	11. 4252	4. 6751*	3.0912**
44. Malaysia (1955-90)				
r=0	r=1	4.6883	14.0690	12.0710
r=1	r=2	0.51332	3.7620	2.6870
45. Pakistan (1950-90)				
r=0	r=1	12.1745	14.0690	12.0710**
r=1	r=2	0.78890	3.7620	2.6870
46. Peru (1950-90)				
r=0	r=1	9.4999	14.0690	12.0710
r=1	r=2	0.043583	3.7620	2.6870

* Significant at 5%
** Significant at 10%
*** Lag structure 1 is used in the whole series. Since the Trace test shows similar result we have not reported here.

In testing for cointegration of each developing economies with that of the USA, among the sample of 46, only 16 developing economies (China, Israel, South Korea, Singapore, Mexico, India, Sierra Leone, Pakistan, Venezuela, Uruguay, Sri Lanka, Philippines, Jamaica, Mexico, Iran, Costa Rica and Syria) have exhibited pairwise cointegration in both the maximum eigenvalue and trace tests. The implication of the cointegration results are that only a few developing economies have revealed the evidence of technological spill-over from the technologically leading developed economy. The majority of developing economies has not shown the tendency of diffusion of world technology into their economy. Unsurprisingly, none of the non-fuel primary product exporters have revealed catching-up to the USA productivity level. Except for Iran and Venezuela (fuel exporters), the 16 economies with significant cointegrating results are manufactured exporters (China, South Korea, Israel and Singapore) and diversified exporters (Pakistan, Sierra Leone, Uruguay, Sri Lanka, Philippines, Jamaica, Mexico, India, Costa Rica and Syria). Thus, the results may provide an evidence for asymmetric international technological spill over.

In order to identify the possible determinants of the catching-up process, the study now conducts further empirical test based on the following functional form:

$C= f(X/Y, H, K)$

Where C, X/Y, H and K represent Catching-up, the share of real exports in real GDP, Human and Physical capital respectively. As it is formulated in equation (6.3.8), the logarithm series of the equation is restated as follows:

$C_t = A_5 + B_5X/Y_t + B_6H_t + B_7K_t + U_t$

The unit root series test in previous report confirms that the variables are I(1). Thus, the study now conducts the multivariate cointegration estimation. The residual based EG and CRDW results confirm that the exports variable together with the Catching-up, Human and Physical Capital can enter the cointegrating relationship. The OLS based modified ECM test shows the presence of error correction term with its negative sign. The summaries of the study's results are reported in the last column of Tables 6.2.28-6.2.32.

III. Catching-up Data: Cointegration Tests and Results

Table 6.28. Catching-up Data: Exporters of Manufactures

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration Test		
	Number of Cointegrated Vectors		Exclusion Test for X/Y	Unique or Proxy Unique Cointegrated Vector	Export Coefficient in the Unique/ Proxy Unique Cointegrated vector			
	Maximal Eigenvalue Test	Trace Test				CRDW	ADF	Sign of ECM term
China	1	1	INS	1st	positive	CI	CI	-ve
Israel	0	0	not applicable	not applicable	not applicable	CI	CI	-ve
Korea Rep	3	3	SI	not applicable	not applicable	CI	CI	-ve
Singapore	3	3	INS	2nd (proxy)	positive	CI	CI	-ve

Table 6.29. Catching-up Data: Exporters of Non-fuel Primary Products

Country	Johansen Maximum Likelihood Approach				OLS Residual Based Cointegration Test		
	Number of Cointegrating Vectors		Unique or Proxy unique Cointegrated Vectors	Export Coefficient in the Unique/ Proxy Unique Cointegrated vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test					
Argentina	0	1	SI	not applicable	CI	CI	-ve
Ethiopia	1	2	1st (proxy)	Positive	CI	CI	-ve
Ghana	1	1	1st	Positive	CI	CI	-ve
Guatemala	2	2	1st (proxy)	Positive	CI	CI	-ve
Bolivia	0	1	not applicable	not applicable	CI	CI	-ve
Guyana	1	0	1st	Positive	CI	CI	-ve
Honduras	0	0	not applicable	not applicable	CI	CI	-ve
Chile	2	2	1st (proxy)	Positive	CI	CI	-ve
Myanmar	4	2	1st (proxy)	Positive	CI	CI	-ve
Nicaragua	2	2	1st (proxy)	Positive	CI	CI	-ve
Niger	2	1	1st (proxy)	Positive	CI	CI	-ve
Paraguay	1	1	1st	Positive	CI	CI	-ve
Peru*	1	1	1st	Positive	CI	CI	-ve

Table 6.30. Catching-up Data: Exporters of Fuel (Mainly Oil)

Country	Johansen Maximum Likelihood Approach					OLS Residual Based Cointegration Test		
	Number of Cointegrating Vectors		Exclusion test for X/Y	Unique or Proxy Unique Cointegrated Vector	Export Coefficient in the Unique/ Proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
Algeria	0	0	not applicable	not applicable	Not applicable	CI	CI	-ve
Iraq	0	0	not applicable	not applicable	Not applicable	CI	CI	-ve
Nigeria*	0	2	INS	2nd (proxy)	Positive	CI	CI	-ve
Iran	4	4	INS	3rd (proxy)	Positive	CI	CI	-ve
S. Arabia	1	1	INS	1st	Positive	CI	CI	-ve
Venezuela	1	1	INS	1st	Positive	CI	CI	-ve

* The Johansen approach is conducted in non-trended case, otherwise, the DGP process is trended

Table 6.31. Catching-up Data: Exporters of Services

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration test		
	Number of Cointegrating Vectors		Exclusion Test for X/Y	Unique or Proxy Unique Cointegrated Vector	Export coefficient in the Unique/ Proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
El Salvador	0	1	INS	1st	Negative	CI	CI	-ve
Jordan*	1	1	INS	1st	Positive	CI	CI	-ve
Dominica Rep.	0	0	not applicable	not applicable	Not applicable	CI	CI	-ve
Jamaica	4	4	SI	not applicable	Not applicable	CI	CI	-ve
Panama	2	2	INS	2nd (proxy)	Positive	CI	CI	-ve
Egypt	0	0	not applicable	not applicable	Not applicable	NA	NA	NA

*The Johansen approach is conducted in non-trended case, otherwise, the DGP is trended

Table 6.32. Catching-up Data: Diversified Exporters

Country	Johansen Maximum Likelihood Approach					OLS Residual based Cointegration test		
	Number of Cointegrating Vectors		Exclusion test for Exports variable	Unique or Proxy Unique Cointegrated Vector	Export Coefficient in the Unique/ Proxy Unique Cointegrated Vector	CRDW	ADF	Sign of ECM term
	Maximal Eigenvalue Test	Trace Test						
Brazil	1	1	INS	1st	Positive	CI	CI	-ve
Ecuador	0	0	not applicable	not applicable	not applicable	CI	CI	-ve
Costa Rica	2	2	INS	2nd (proxy)	Positive	CI	CI	-ve
Indonesia	2	2	INS	1st (proxy)	Positive	CI	CI	-ve
Mauritius	0	0	not applicable	not applicable	not applicable	CI	CI	-ve
India	2	2	INS	2nd (proxy)	Positive	CI	CI	-ve
Kenya	1	1	INS	1st	Positive	CI	CI	-ve
Mexico	2	2	INS	1st (proxy)	Positive	NA	NA	NA
Malaysia*	1	2	INS	1st (proxy)	Positive	CI	CI	-ve
Morocco	1	1	SI	not applicable	not applicable	CI	CI	-ve
Pakistan	1	1	SI	not applicable	not applicable	CI	CI	-ve
South Africa	1	1	INS	not applicable	not applicable	CI	CI	-ve
Sri Lanka	1	1	SI	not applicable	not applicable	CI	CI	-ve
Syria	0	0	not applicable	not applicable	not applicable	CI	CI	-ve
Uruguay*	1	1	SI	not applicable	not applicable	CI	CI	-ve
Philippines	2	2	SI	not applicable	not applicable	CI	CI	-ve
Sierra Leone	0	2	INS	2nd (proxy)	Positive	CI	CI	-ve

* The Johansen approach is conducted in the non-trended case, otherwise, the DGP is trended

These empirical results suggest that by building developing economy's social capability, export expansion together with human capital and physical capital accumulation facilitates the opportunity to catch-up with the developed economies' higher productivity levels. Accordingly, economies which promote export-led growth, higher saving rates and a better educational base can catch up the higher productivity level enjoyed by developed economies, and can eventually enter the 'convergence club'. Economies that do not direct their policies in these directions not only lag behind the achievers but also diverge even further. Consequently, the expansion of exports is leading to convergence. However, if its expansion and diversification is thwarted, it is a recipe for productivity divergence. Nevertheless, as has been cited in the previous discussions, because of the limitation that the residual based cointegration tests suffer, the study's interpretation of the evidence should not be taken as conclusive. Thus, the thesis is conducting the system based Johansen cointegration test and present the results.

As is reported in the Tables 6.28-6.32 above, the maximal eigenvalue test shows that out of 46 economies in the sample it confirms the presence of stable and 'latent' long run relationship among catching-up variable, exports, human and physical capital variables for 32 economies that include both diverging and catching-up economy groups. It accepts the null hypothesis of no cointegration for 14 countries (Israel, Argentina, Bolivia, Honduras, Algeria, Iraq, Nigeria, El Salvador, Dominica Republic, Egypt, Ecuador, Mauritius, Syria and Sierra Leone). The trace test does not reject the null of no cointegration for 10 economies (Israel, Guyana, Honduras, Algeria, Iraq, Dominica Republic, Egypt, Ecuador, Mauritius and Syria). The exclusion test on exports variable is conducted for economies with at least one cointegrating vector in either the maximal eigenvalue test or the trace test. The result shows that the exports variable can be excluded from the cointegrating relationship for 8 economies (South Korea, Argentina, Bolivia, Jamaica, Morocco, Pakistan, Uruguay and Philippines).

Although the Johansen approach shows less conclusive results on the significance of export expansion in catching-up hypothesis, for the majority of the developing economies the hypothesis is well established. For 28 developing economies exports variable derives productivity convergence/ divergence. Accordingly, export expansion and the accompanying open economy forces increase the availability of intermediate products, which may promote domestic technological progress and lead to higher productivity growth. Besides, the importance of benevolent institution for economic growth is more likely to be phased out in the export-led growth economies. Therefore, the study establishes that for these economies the export variable interacts with the catching-up variable. The results for the 28 economies strongly suggest that the catching-up process is export driven. Thus, the catching-up process is faster the more liberalised and export-oriented the economies are (Jordan, Indonesia, Chile, Malaysia and Singapore).

Therefore, in the highly interdependent, skill and technology oriented world, the less the developing countries are open, the more they refrain from external competition and the more biased to exports, the less technological diffusion from outside world and the more rent seeking in the economy that divergence is an inevitable result.

Export-led economies such as the Asian NICs among others exhibits a higher growth rate of income and international technological spill over and moving towards catching-up the higher productivity levels of the developed economies, whereas the protectionist and distorted economies of Sub-Saharan African economies do not reveal such tendencies. However, in addition to export-led growth, structural features of such economies can influence how much the economies can benefit from the international linkages. If a country has natural trade barriers, such as high transportation costs, it is likely to trade less. The technological benefits of export-led growth may be insignificant for poor economies that are specialised in goods that have exhausted their potential to exhibit learning by doing, so that the impact of such line of exports on catching-up process can be insignificant in poor economies (Findlay, 1984). The 16 developing economies that have revealed bilateral productivity series catching-up with the USA have significantly diversified their exports and manufacturing exports has important share in their exports.

The more economies are diverging means the less and less productivity growth in developing economies. Thus, they are going to sustain lower productivity and wage level. This is particularly true for poor performing African economies.

The results in the three models assert that despite the empirical fact that exports, PCI, human capital, physical capital, labour and catching-up variables individually exhibit non-stationarity, there exists a linear combination of these non-stationary series that is stationary for most of the countries, thus, valid inference is still possible and the cointegrating variables can be regarded as defining long-run equilibrium subspace. As postulated in the basic model, which is based on export-led hypothesis, the five variables in the aggregated data, the seven variables in the disaggregated data and the four variables in catching-up data respectively comprising the cointegration vector move closely together in the long-run. Since they are cointegrated the respective level equations the study has formulated are valid. Therefore, these cointegration test results offer valid econometric empirical evidence, which supports the significance of export-led growth for the majority of the economies in the sample. The super exogenous test for the cointegration results, which is a restriction test on the long run direction of causality, reveals that for at least 28 economies the ratio of exports to GDP is an important economic variable which not only cointegrates with the catching-up process, but also drives it. In line with the theoretical argument this suggests that rapid export growth and their accompanying open economy forces have significant and dynamic causal impacts on catching up trends of developing economies.

Based on the maximal eigenvalue test, the study has identified a single and unique cointegrated vector:

1) In aggregated data for 14 countries (Israel, Ethiopia, Ghana, Guyana, Honduras, Niger, Jordan, Dominica Republic, Egypt, Ecuador, Mauritius, India, South Africa and Sierra Leone),

2) In disaggregated data for 5 countries (Paraguay, Peru, Kenya, South Africa and Uruguay),

3) In catching-up data for 17 countries (China, Ethiopia, Ghana, Guyana, Paraguay, Peru, Saudi Arabia, Venezuela, Jordan, Panama, Brazil, Kenya, Malaysia, Morocco, Pakistan, south Africa and Uruguay). Multivariate cointegration vectors are reported for the remaining economies in respective three models.

The existence of 1 cointegrating vector implies that there is a single unique long-run equilibrium relationship in the growth series of the developing economies. The presence of 2 and above cointegrating vectors mean that there are respective 2 and above long-run equilibrium relationship among the series of the respective countries. In this regard, the larger the number of cointegrating vectors implies greater stability of the system. The existence of 1 cointegrating vector implies that the system is stable in one out of 5, 7 and 4 dimensions in aggregated, disaggregated and catch up models respectively, and there are four, six and three stochastic or common trends which drives the system in that order. Considering full rank long run matrix (where r, the number of cointegrating vectors, is equal to n, the number of economic variables included in the system) rather than reduced rank matrix (where r is n-1), series for which there are five, seven and four cointegrating vectors in respective models proves that the systems are stable in five out of five, in seven out of seven and four out of four dimensions and there are no stochastic trends in the respective systems. An economic system that is characterised by such stability is conducive to economic analysis, and although the coefficients in each cointegrating vector on their own have some incorrect signs, their linear combinations could yield a plausible cointegrating vector with correct signs and magnitudes.

Moreover, the respective coefficients of cointegrating vectors (β) of each country series and the corresponding adjustment (ECM) alpha matrix (α) have been estimated. The Johansen procedure has normalised the β vectors for PCI in the aggregated and disaggregated models and for relative productivity series (C) in the catching-up model, for all countries so that the coefficients for PCI and C variables of each country series are one. In this context, the cointegrating relation of economies for which maximal eigenvalue test gives at least 1 cointegrating vector is identified since the numbers of cointegrating relations for each country is equal to the number of cointegrating vectors. These cointegrating relations capture the dynamic behaviour of the equilibrium relation in economic growth-export expansion and productivity convergence-export expansion relationship in their respective models. In this work, for those country series that there is a single cointegrating vector means there is a single and a unique dynamic equilibrium equation. For countries which are characterised by multicointegrating vectors there is no such a single and a unique behavioural equation. Hence, it is not straightforward to establish such a single and a unique behavioural equation. Based on the study's theoretical economic argument about economic growth and export expansion relationship, the thesis has selected the cointegrating vectors that are the most obvious in corresponding to the economic argument both in magnitude and sign. Thus, tables 6.17 - 6.32 (excluding table 6. 27) in columns 5 reports the unique (for series with single cointegrating vector) or proxy unique (for series with more than one cointegrating vector) cointegrating vector from which a single dynamic behaviour equation can be established for each country series.

In the Johansen maximum likelihood approach the economic series have entered the cointegration system in multivariate equation forms. Besides, all the variables are considered as endogenous to the system. Therefore, this has helped to avoid the arbitrary normalisation of behavioural relationship, which is a serious problem in conventional regression, and Engle and Granger residual based cointegration models. In this regard, the results from the Johansen approach indicates the cointegrating vectors are explicitly normalised to logPCI in first two model and to logC in the third model for all economies without any arbitrary imposition. Therefore, from tables 6.17-6.26 and 6.28 - 6.32 Columns 5 above except for El Salvador (catching-up model) the study has identified for all countries with significant cointegration test that the productivity impact of exports is positive in the dynamic behavioural equilibrium equation. However, one must be cautious in interpreting the economic significance of finding cointegration and a single cointegrating vector. As Dickey et al. (1991) point out, the cointegrating vectors are obtained from the reduced form of a system of variables where all variables are assumed jointly endogenous they can thus not be interpreted as representing structural equations, since there is no general method to go from the reduced form back to the structural form. The cointegrating vectors can, however, be thought of as arising from a constraint imposed by an economic structure on the long-run relationship among the variables in the system. Thus, by finding at least one cointegrating vector the system is quite constrained. Real PCI growth, real export expansion, real physical capital variable, human capital and labour input are closely tied together for those economies with cointegrating relationship, as posited by new growth theory.

The existence of cointegrating vectors for these developing economies implies that there is indeed a long-run equilibrium relationship and common (shared) trends among the macroeconomic production function variables included in the three models and therefore supports the hypothesis of export-led growth. If there is one cointegrating vector, there must be 5, 7 and 4 minus 1 common (shared) trends in respective aggregated, disaggregated and catch up models. This implies that there are 4, 6 and 3 primary factors that influence economic growth-export expansion processes in respective models for developing economies under consideration. In the case of the catching-up model, the presence of at least one cointegrating vector suggests the existence of n-1 shared trends (see table 6.27) which means that there is a long run productivity convergence for the given economies. The identification of these factors is an important topic that should be considered in future research.

6.6. Conclusions

This chapter has conducted tests for cointegration and identified the existence of cointegrating vector(s) and common trends among a set of (growth) series that includes export expansion as one of its argument in developing economies, within a framework of a new growth theory. The tests started by analysing the statistical properties of the growth series of the sample economies and found that almost all series are non-stationary integrated series, I (1). The study has tested for cointegration using two methods. The first has tested the residuals of cointegrating regression for stationarity and the second utilised the Johansen procedure. Using time series data relating to a sample of 46 developing economies, the study tested the hypothesis of export-led growth and productivity catching-up models, accordingly the growth illuminating effects of exports and the tendency to catch-up the higher productivity level of developed economies (represented by USA's productivity level) are stronger in economies which promote manufacturing and diversified export structure.

In the Johansen approach, each of the individual cointegrating vectors can be viewed as a behavioural or reduced form equation resulting from a structural model. Given this econometric interpretation, structural identification is not necessary to specify the set of endogenous versus exogenous variables. Imposing export-led growth theory on the cointegrating vectors can facilitate exact identification of behavioural equations.

The thesis has illustrated the procedure using the set of variables suggested in macroeconomic production function series. Data for the majority of developing economies has revealed the existence of at least one cointegrating vector among the real PCI, export, physical capital, human capital and labour variables. In the Johansen approach, thus, study has found that the hypothesised structural relationships for export expansion-growth model exist as long-run stable equilibrium relationships.

Therefore, the empirical results provide robust evidence for the existence of stable and dynamic equilibrium relationship and shared trends among real PCI, physical capital, human capital, labour and export variables in the majority of developing economies. Besides, it suggests that export expansion and its accompanying open economy forces are an important economic factors that should be considered in the drive to achieve sustained and accelerated economic growth in the majority of developing economies and to catch-up the productivity level of leading developing or developed economies, as it is suggested in neo-growth theory model.

Export-led growth is based on the principle of comparative advantage. In this regard, it is most efficient for a country to export those products that it is relatively best at producing. The Ricardian version of comparative advantage attributed this mainly to a country's natural resource endowment or labour productivity. The neo-classical trade theory bases comparative advantage on the given endowments of factors of production, such as labour and capital. In this argument it would be most efficient for labour abundant developing economies to focus on production and export of labour intensive products. The new trade theory, however, argues that comparative advantage can be mutable through learning by doing and engaging in the competitive world market. Thus, producing and exporting products that are based on technological efficiencies rather than natural resource or cheap labour endowments can help to prosper developing economies. Therefore, the empirical findings support the new trade theory argument because economies that have shown a tendency to catch-up the high productivity performance of USA are not those in Ricardian type export category, rather they are those which have promoted manufacturing or diversified exports with relatively higher technical progress. In addition, the remarkable performance of economies such as South Korea and Singapore may not be exclusively credited to export-led growth, but also to sound economic management of the overall economy and the strength of developmental state.

The existence of less than five, seven and four cointegrating vectors in the respective first, second and third models (Tables 6.17-6.32, see also the appendixes to the chapter) means that there is at least one common trend that affects achievement of stable and dynamic long-run equilibrium relationship in the growth series considered. The identification of these shared factors also is crucial in designing effective growth policy in developing economies. The rejection of cointegrating relationship among export expansion and other variables in growth series of a few economies in the joint maximal eigenvalue and trace tests indicates that the growth process of these countries has no shared trends but stochastic trends. The existence of at least one common trend indicates partial convergence (weak convergence in the context of catching-up model) of the observed series of productivity, exports, labour, physical capital and human capital. These common trends may be microeconomic policies, exchange rate movements, monetary stability, governance, inflationary variables, etc. Explicit identification of these shared trends should be considered in the further research since its is beyond the scope of this topic to deal with.

Finally, from the analysis and results of common trends and cointegration tests of export-led growth model, this study indicates that future research on growth process of developing economies should take in an international approach (the significance of open economy forces) rather than exclusively adopt a closed economy and domestic variables focus.

Chapter 6 Appendix 1: - Residual Based Cointegration tests

Aggregated Data (Model I)				
Economy	**Adjusted R^2**	**CRDW**	**Estimated ADF for Residuals**	**Data Period**
Myanmar	.90	1.79	3.63(2.95)	1950-89
China	.57	2.05	4.55(2.94)	1960-92
Indonesia	.18	1.99	6.23(3.00)	1960-90
India	.21	1.93	6.19(2.94)	1950-90
Syria	.35	1.75	5.60(2.97)	1960-90
Sri Lanka	.34	1.89	4.65(2.97)	1950-89
Iran	.26	1.74	6.17(2.96)	1955-88
Pakistan	.16	1.96	4.89(2.94)	1950-90
Philippines	.21	1.98	4.65(2.94)	1950-90
Singapore	.20	1.92	3.65(2.97)	1960-90
S. Arabia	.39	2.17	4.79(2.98)	1960-89
Iraq	.27	1.77	4.66(2.96)	1953-87
Israel	.24	1.82	4.51(2.95)	1953-90
Jordan	.14	1.60	3.55(2.95)	1950-90
S. Korea	.27	2.20	5.43(2.95)	1950-90
Malaysia	.11	2.10	5.38(2.95)	1955-90
Argentina	.27	1.99	5.06(2.95)	1950-90
Bolivia	.23	1.97	4.39(2.94)	1950-90
Brazil	.24	1.96	5.80(2.94)	1950-90
Costa Rica	.41	2.22	5.00(2.94)	1950-90
Elsalvador	.20	1.91	5.36(1.94)	1950-90
Honduras	.16	1.83	5.78(2.94)	1950-91
Jamaica	.35	2.03	5.23(2.94)	1954-91
Nicaragua	.51	1.94	4.84(2.94)	1950-91
Dominica Rep.	.26	1.92	5.54(2.94)	1950-91
Guatemala	.47	1.98	7.45(2.94)	1950-91
Mexico	.26	1.93	6.26(2.94)	1950-91

...Continued...Aggregated Data (Model I)

Economy	Adjusted R^2	CRDW	Estimated ADF for Residuals	Data Period
Panama	.19	1.35	3.48(2.94)	1950-90
Chile	.27	2.02	5.57(2.94)	1950-90
Ecuador	.13	1.97	5.17(2.94)	1950-90
Guyana	.34	1.87	6.75(2.94)	1950-90
Paraguay.	16	1.99	5.27(2.94)	1950-90
Peru	.21	2.14	5.20(2.94)	1950-91
Uruguay	.22	1.77	3.83(2.94)	1950-90
Venezuela	.24	2.08	4.31(2.94)	1950-90
Algeria	.35	2.12	7.02(2.98)	1960-88
Egypt	.23	2.04	4.71(2.94)	1950-88
Ethiopia	.10	1.97	5.31(2.95)	1950-86
Morocco	.34	1.92	3.49(2.94)	1950-91
Nigeria	.32	2.01	5.86(2.94)	1950-90
Niger	.21	1.89	4.07(2.98)	1960-90
Sierra Leone	.26	1.68	4.79(2.98)	1950-90
Ghana	.38	1.75	5.14(2.96)	1950-90
Mauritius	.49	1.93	4.35(2.97)	1960-90
S. Africa	.33	2.07	5.86(2.94)	1950-90
Kenya	.39	1.91	8.25(2.94)	1960-90

Chapter 6 Appendix 1: - Residual Based Cointegration tests

Disaggregated Data (Model II)				
Economy	**Adjusted R^2**	**CRDW**	**Estimated ADF for Residuals**	**Data Period**
Myanmar	.26	1.70	3.38(3.01)	1966-91
China	.57	1.82	4.26(3.00)	1966-91
Indonesia	.21	1.85	4.03(2.07)	1966-90
India	.47	2.02	4.85(3.00)	1966-90
Sri Lanka	.44	1.51	4.77(3.00)	1966-89
Syria	.34	1.65	5.60(2.97)	1966-90
Pakistan	.39	1.89	5.39(3.00)	1966-90
Philippines	.16	2.12	4.80(3.00)	1966-90
Singapore	.29	2.07	3.58(3.00)	1966-90
S. Arabia	.22	2.00	3.76(3.01)	1966-89
Iran	.29	1.92	3.68(3.08)	1972-88
Israel	.35	1.88	3.29(3.07)	1972-90
Jordan	.25	2.35	4.10(3.00)	1966-90
S. Korea	.06	2.09	3.03(3.00)	1966-90
Malaysia	.46	1.99	5.56(3.00)	1966-90
Argentina	.37	1.99	4.30(3.00)	1966-90
Bolivia	.08	.27	4.60(3.00)	1966-90
Brazil	.42	1.82	5.50(3.01)	1966-90
Costa Rica	.14	1.89	5.42(3.02)	1968-90
Elsalvador	.47	1.84	7.15(2.94)	1966-90
Honduras	.35	1.92	5.01(3.00)	1966-91
Jamaica	.33	1.96	5.58(2.95)	1966-91
Nicaragua	.37	1.63	5.87(3.00)	1966-91
Dominican Rep.	.52	1.92	5.59(3.00)	1966-91
Guatemala	.44	2.076	4.67(3.00)	1966-91
Mexico	.43	1.78	6.22(3.00)	1966-91

Chapter 6 Appendix 1: - Residual Based Cointegration tests

...Continued...Disaggregated Data (Model II)

Economy	Adjusted R^2	CRDW	Estimated ADF for Residuals	Data Period
Panama	.033	1.20	3.90(3.00)	1966-90
Chile	.37	1.92	4.77(3.01)	1966-90
Ecuador	.22	1.93	3.67(3.00)	1966-90
Guyana	.51	2.27	4.70(3.01)	1966-90
Paraguay	.58	2.03	5.91(3.00)	1966-90
Peru	.25	2.06	3.50(3.00)	1966-91
Uruguay	.51	1.83	3.94(3.00)	1966-90
Venezuela	.31	1.88	3.15(3.00)	1966-90
Algeria	.21	1.78	5.68(3.02)	1966-89
Egypt	.24	1.54	3.24(3.00)	1966-89
Ethiopia	.41	2.04	3.16(3.05)	1966-86
Morocco	.48	1.94	4.50(3.00)	1966-91
Nigeria	.27	1.87	5.16(3.00)	1966-90
Niger	.45	1.96	4.54(3.01)	1966-90
Sierra Leone	.28	2.24	2.96(3.00)*	1966-90
Mauritius	.32	2.05	2.96(3.00)*	1966-90
S. Africa	.05	3.03	4.26(3.00)	1966-90
Kenya	.38	2.14	4.49(3.00)	1966-90

Chapter 6 Appendix 1: - Residual Based Cointegration tests

Catching-up Data (Model III)

Economy	Adjusted R^2	CRDW	Estimated ADF for Residuals	Data Period
Myanmar	.12	1.69	3.74(2.94)	1950-89
China	.39	2.04	6.01(3.00)	1955-90
India	.44	2.01	6.96(2.94)	1950-90
Indonesia	.27	2.96	3.42(2.97)	1960-90
Syria	.56	1.95	7.73(2.97)	1960-90
Sri Lanka	.45	2.03	5.02(2.96)	1950-89
Iran	.41	1.96	6.05(1.96)	1955-90
Pakistan	.17	2.01	5.07(1.96)	1950-90
Philippines	.17	1.99	5.30(2.94)	1950-90
Singapore	.12	1.94	4.12(2.98)	1960-90
Iraq	.04	1.71	5.15(2.96)	1953-87
Israel	.34	1.83	5.24(2.96)	1953-90
Jordan	.12	1.90	3.09(3.00)	1954-90
S. Korea	.17	1.93	5.67(2.95)	1950-90
Malaysia	.38	1.97	6.84(2.95)	1955-90
Argentina	.15	1.92	5.80(2.94)	1950-90
Bolivia	.80	2.00	3.57(2.94)	1950-90
Brazil	.22	2.00	5.01(2.94)	1950-90
Costa Rica	.49	1.93	4.90(2.94)	1950-90
Elsavador	.12	1.90	6.83(2.94)	1950-90
Honduras	.041	1.87	4.37(2.94)	1950-90
Jamaica	.76	2.06	6.51(3.01)	1953-90
Nicaragua	.01	1.95	5.12(2.94)	1950-90
Dominica Rep.	.17	1.89	5.20(2.94)	1950-90
Guatemala	.09	1.97	4.34(2.94)	1950-90
Mexico	.15	1.18	1.40(1.12)	1951-90

Chapter 6 Appendix 1: - Residual Based Cointegration tests

... Continued... Catching-up Data (Model III)

Economy	Adjusted R^2	CRDW	Estimated ADF for Residuals	Data Period
Panama	.076	1.61	3.04(2.94)	1950-90
Chile	.25	2.14	4.56(2.94)	1950-90
Ecuador	.13	2.01	4.09(2.94)	1950-90
Guyana	.18	1.92	5.65(2.94)	1950-90
Paraguay	.14	2.00	5.07(2.94)	1950-90
Peru	.05	1.90	4.66(2.94)	1950-90
Uruguay	.054	1.87	4.56(2.94)	1950-90
Venezuela	.20	2.00	3.96(2.94)	1950-90
Algeria	.25	2.05	4.67(2.94)	1960-90
Egypt	.23	2.04	4.71(2.94)	1950-90
Ethiopia	.10	1.97	5.31(2.95)	1950-86
Morocco	.34	1.92	3.49(2.94)	1950-90
Nigeria	.45	2.06	5.86(2.94)	1950-90
Niger	.34	2.02	4.07(2.98)	1960-90
Sierra Leone	.42	1.87	4.79(2.98)	1961-90
Ghana	.23	2.23	5.14(2.96)	1955-90
Mauritius	.35	1.54	4.35(2.97)	1951-90
S. Africa	.33	2.07	5.86(2.94)	1950-90
Kenya	.39	1.91	8.25(2.94)	1951-90

CHAPTER SEVEN

CONCLUSION

The purpose of this study is to bring out the dynamic long run relationship between export expansion and economic growth in developing economies. To do this it is necessary both to provide an analysis of the theoretical issues and their interactions and also to undertake empirical investigation using the time series data to ascertain for or against export-led growth hypothesis. The study finds that conventional methods of detecting export-led growth may give misleading results if unit roots, cointegration and common trends tests are not conducted in dynamic system being analysed.

An investigation of the link between exports and economic growth is generally constrained by lack of data. A sufficient data on exports and other growth variables are not available for many developing countries for a long period of time. Such data have become available for a larger number of economies for three or four decades of the post II World War period. Figures on growth variables reported in particular countries statistical publications differ from those reported by international organisations such as the World Bank and IMF. Moreover, the definition of what constitutes a given variable might differ from country to country. Every effort has been made to verify the available data on candidate growth variables, which are clearly problematic. These and other data problems are well documented by concerned international organisations such as IMF, World Bank, UNESCO, UNCTAD and ILO in their various reports and are candidly acknowledged here.

It is the implicit assumption of the extant empirical works on export-led growth that these data shortcomings are not serious enough to undermine all efforts at empirical study. The issue of data quality is important and accordingly, the results, which follow, need to be interpreted with an appropriate degree of caution.

Accordingly, in this view of the statistical evidence, the study has concentrated on the period since 1950. However, despite data limitations, the analysis is successful in identifying many aspects of the exports-growth relationship.

The literature on export-led growth has documented among other things that the incentives associated with export orientation is likely to lead an economy to a higher factor productivity level because of the exploitation of economies of scale, better capacity utilisation and lower capital output ratios. Moreover, it is documented that exports are likely to alleviate serious foreign exchange constraints and can therefore provide greater access to international markets. Besides, exports are likely to result in a higher rate of technological innovation and dynamic learning from abroad. Knowledge accumulation and dissemination provide the synergism of growth. Exports facilitate the diffusion of knowledge. The theoretical framework presented in chapter two predicts that economies with similar technological parameters will exhibit similar per capita income and productivity growth in the long run. These steady state growth rates depend upon the rates of growth of labour and knowledge accumulation. Knowledge accumulation, in turn, is a function of existing knowledge world-wide. Each developing economy accesses foreign knowledge by conducting competitive and diversified exporting trade based on its natural and created comparative advantage as theorised by orthodox and new trade theory respectively. Therefore, the extent and the nature of this trade dictate the extent of knowledge spill over that will ensue, hence, the rate of their economic growth.

Developing economies with similar export structure and trade regime will also converge to the same steady state growth path and to a similar productivity and per capita outputs in the long run.

Chapter three of this thesis has focused on the trade regime-growth nexus. Trade liberalisation and the accompanying open economy forces, by increasing export growth and the access to world market, information and stock of knowledge will have a positive casual impact on the long run growth and productivity catching-up trends.

Most of the past empirical works that have been reviewed in chapter four and the present empirical investigation in chapter six, however, have focused on the relation between exports and economic growth since exports is considered to be the principal conduit through which export-led growth strategy influences growth.

The conclusion emanates from most of the past cross section studies is that there exists a positive and significant relationship between export performance and economic growth mainly in middle income developing economies. The time series studies yield mixed results.

These findings, however, do not bear directly on the dynamic casual interactions that may exist among exports, productivity catch-up and economic growth. The cross section studies are purely conducted in static settings and identified exports-growth correlation, which is not necessarily causation. Moreover, based on commonality assumption they have pooled countries with diverse geographical environment, resource endowment, export structure, social capability and economic policies, etc., which is unwarranted to clearly identify the response of particular economy to export expansion. Most of the time series studies have been conducted without properly checking the stochastic properties of export-led growth series. Besides, they have not conducted the empirical test in the light of dynamic and multivariate cointegration and common trends econometric method developed recently. Chapter five of this thesis has reviewed these current developments in time series econometrics. Johansen (1995, p.3) has eloquently suggested "By carefully constructing a statistical model where the economic concepts can be defined precisely, and that the analysis of the model would lead to relevant methods that have better properties." Accordingly, the past cointegration tests though they have theorised they dynamic links of exports and economic growth, they have not constructed an appropriate statistical model that can define export-led growth hypothesis. Because studies such as that conducted by Bahmani-Oskooee and Alse (1993) only considered exports and GDP variables in their model. Therefore, in the context of new growth theory the importance of physical and human capital variables is ignored here. The cointegration and bi-directional causality tests conducted in above and similar works have not considered the dynamics of other variables in their analysis. However, the importance of Ghatak et al. (1995 and 1997) paper is particularly significant in capturing this difficulty and has influenced the empirical modelling of this study.

Thus, within the context of new growth model, in chapter six, the study has formulated multivariate export-led growth models that take into account the dynamics of aggregated and disaggregated export variables, physical capital, human capital, labour input, productivity catching-up and per capita income. The thesis has tested the models considering compatible time series data and econometric method using multivariate residual and system based cointegration and common trends approach. The study has included 46 developing economies in the empirical test. The samples have included all the diversities of developing economies. It is also fairly large in the light of past time series studies and complexity of cointegration and common trends method.

For the majority of sample developing economies, the empirical results corroborate the export-led growth predictions. Given the limited sample period under investigation, combined with the diverse nature of the developing economies (e.g., different initial condition of the economies such as size of the export sector, level of development, resources base) and the wide range of policies followed across countries and through time such as exchange rate policies and domestic financial policies it is perhaps surprising that a clearly identifiable and systematic long run link between export and growth are not observed in Johansen cointegration in only few economies. Accordingly, from the empirical result it can be deduced that to the extent that it is promoted, exports will contribute to economic growth and productivity catching-up. In contrary, its retardation will thwart economic growth and productivity catching-up. The increasing tendencies towards competitive export expansion and trade liberalisation in the developing economies of Asian NICs such as South Korea and Singapore during the post-war period has led to a significant economic growth, technological spill over and productivity catching-up. Initially poorer Asian NICs have benefited from export-led faster growth. Generated by technological spill over from the developed economies with greatest stock of technology and knowledge.

IPS based developing economies that have diversified their exports base with significant manufacturing components such India, China, Pakistan and Sri Lanka have benefited to some extent from world technological spill over, however, this is not an apt characterisation of mostly single product non-fuel primary goods exporters. These countries tend to surround themselves with greater walls of protection and/or uncompetitive and less skill content export base, which also, in the context of export-led growth model presented in the thesis, act as a buffer that limits knowledge spill over to them. Hence, the income and productivity gap between such economies and the developed economies or high performing developing economies continues to exist, until they start to bring down the barriers by effectively liberalising their trade and establish competitive and diversified export structures. At the same time, economies with changing and competitive comparative advantage are likely to benefit from international exposure. Exports of advanced products with better market prospects in terms of higher income elasticity of demand and more favourable terms of trade movements likely to have greater potential income generation, scale economies and technological advance. Thus, more advanced developed economies have a greater capacity to realise these potential gains, and raising their own income levels and productivity and providing the basis for sustained export expansion.

By and large, the policy implication of the empirical result should be interpreted in the line of supporting export-led growth hypothesis that exports are potent causal factors in promoting long run growth in developing economies. The exploitation of these potentials, but demands a conducive trade regime in place. In other words, the study considers the centrality of trade policy in relative growth rate differences amongst developing economies. Accordingly, the developing economies policy maker should seriously weight the efficiency effect of export-led growth strategy on the scale of extensive and detailed analysis of the IPS induced inefficiencies. The inefficiencies which such trade strategy imposes on the economy run to a long slate; its ponderous reliance on tariffs and quotas, as the principal instruments of the strategy, introduces widespread distortions in factor and product markets; it encourages the adoption of techniques of production widely at variance with the factor endowments of the economy. In addition, it provides widespread incentives for rent seeking activities and directly unproductive profit seeking economy (DUPSE) (Bhagwati, 1994); it contributes to growth of income disparities; and it is not only promotes misallocation of resources but also encourages X-inefficiency (Bhagwati, 1978). The immiserisation of growth that might occur as a consequence of protection induced inflows of productive resources into an import competing industry has also been extensively discussed (Bhagwati, 1973).

The principal virtue of the export-led growth strategy, with its emphasis on neutrality of policy as between the import and export sectors of the economy, is that it allows for a free play of market forces and the allocation of resources on the basis of comparative and competitive advantage. Furthermore, because of the neutrality of its policy orientation it offers none of the incentives for rent seeking and DUPSE, which the IPS strategy provides. The competition it allows for from both international trade and domestic resources encourages R & D and investment in human capital. Allocation of resources on the basis of competitive advantage and market forces also promotes specialisation and scale economies. Moreover, many of the growth promoting factories identified by new growth theory such as human capital accumulation, externalities and scale economies can be identified and nurtured to promote growth through export-led growth.

Because of the information age information, knowledge and technology now diffuses with greater ease and rapidity to developing economies. Thus, polity and social structure stand as less of a block in such era of global transformation. In present world, differences in social structure, such as domestic saving and consumption behaviour are seemingly less consequential. In open economy system and politically stable social environment, local capital accumulation through local savings is less germane to economic success in a period when capital is colossally mobile. Strong export-led economies can borrow the capital they need without generating it internally just as capital and information flow freely to such economies.

Natural possession of raw materials, which was critical once, no longer sounds fundamental for economic growth. In effect we are returning to the recommendations of the pioneers i.e., Smith and Ricardo. Their ideas are universal that work equally in multi culture of developed and developing economies. Accordingly, the developing economies must concentrate to win production gains by productivity increase. They must maximise production by encouraging specialisation in producing what they can produce best. And, they must encourage the global exchange of their surplus through the most efficient mechanism, the price mechanism freed from the narrow national interest represent by the government of particular economies. However, as the new trade theory suggests, the ability to produce best in this sense is not merely a derivative of innate ability because traditional possession of certain resources in abundance but can be acquired, created and transformed. Moreover, the line of product specialisation is static neither. Thus, it can be transformed through acquisition, accumulation and application of knowledge, better production practice and application of new technology.

However, as the recent experiences of East European countries suggest, a successful shift through open economy forces is not without difficulty. The transitional period policies should be carefully designed considering the stability of macroeconomic environment. Timing and sequencing are vital to achieve credible and successful trade policy, but protectionism would be less compelling and onerous than problems of any variant in the transitional stage. Protectionism would reduce resource accumulation through inefficiencies attendant on attempts to national self-sufficiency. Apart from the above arguments, inward looking behaviour at country or regional level would reduce the chance of resolving pressing common issues such as a environmental problems. A given economy or a group of economies may produce more but pollute the environment. Therefore, transitional production, a global consensus, rules and standards about production system, pollution, resource depletion, and consumption would prevent the more expensive of such mistakes and slow their onset.

Finally, for methodological reasons, and in view of data problems that has been addressed, however, the conclusion should not be taken as decisive confirmation of the export-led growth or rejection of the alternatives. Besides, export-led growth hypothesis is formulated for rather abstract economic concepts, whereas, when it comes to the empirical observations, the study has to employ actual data series that are not observations of the abstract economic concepts but selected proxies. Therefore, the quality of the proxies may affect the results. It must also be emphasised that a cointegration analysis cannot be the final aim of an econometric investigation of export-led growth hypothesis. The presence of multiple cointegrating vectors along with common trends needs further investigations to determine their coherence, correlation and the relative weights of the observed multidimensional relationships. In addition to the cointegration analysis, further economic and empirical analysis is needed to identify the properties and economic implications of common trends. However, the impression is that as an intermediate step a cointegration analysis is a useful and powerful econometric tool in the process of gaining understanding of the relation between export-led growth theory and data. Given time and resources constrains and econometric software to its access, this study cannot extend its investigation beyond this level. Therefore, the study proposes such issue for further research.

Moreover, the thesis has analysed export-led growth hypothesis within the context of the new growth model, but future research on the topic has to develop rival and more disaggregated trade models and has to determine and compare the cointegrating relations and common trends with alternative models.

The conviction is that studies of the growth of developing economies exporting firms would illuminate many unanswered questions in this topic. The nature of their establishment and growth should get closer to the questions of the role of protection in establishing exporters and of the determinants of productivity catching-up by these firms. The nature of their entry into world competitive markets should illuminate the role of demand and supply factors, the nature of price and non-price competition pursued and the degree to which their entry into world market depends on the nature of their particular industry. Though developing economies' export firms may appear to be important for the success of an export-led strategy and the transformation of economies to higher levels of development, but relatively little is known about their operation in micro-level.

Besides, whatever the methodology, crude econometrics may not exactly explain the hidden link between exports and growth. Therefore, future research should not declare the end of history remaining as simple invocations of either exports as the engine of growth hypothesis claiming that particular trade regime is the primary determinant of the nature of exports itself.

Because such approach diverts rather than focus research on the precise interactions between exports and growth in developing economies. Each particular period finds itself in peculiar economic circumstances that it is not sufficiently identical for us to say that what was effectively worked yesterday will also be best in unpredictable but dynamic tomorrow world. Therefore, the dynamics of trade and economic growth interaction still highly demands innovative research, which can fit to the circumstances. Accordingly, though a general principle is helpful, it should be eschewed and refined to be adopted to the becoming process. The study also makes an appeal for investment in collection and publication of reliable and compatible time series data for developing economies by the concerned international and national organisations.

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APPENDIX: ECONOMETRIC RESULTS FOR SELECTED ECONOMIES

Paraguay

Unit Root Tests

Unit root tests for variable $\log K_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-2.4683(-2.9320)	-3.3813(-3.5189)
ADF(1)	1952 1992	41	-1.8038(-2.9339)	-3.4625(-3.5217)
ADF(2)	1953 1992	40	-1.3997(-2.9358)	-2.0579(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\log X_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-.088618(-2.9320)	-2.5944(-3.5189)
ADF(1)	1952 1992	41	-.18755(-2.9339)	-2.9858(-3.5217)
ADF(2)	1953 1992	40	-.23537(-2.9358)	-2.9202(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\log PCI_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-.37562(-2.9320)	-2.0197(-3.5189)
ADF(1)	1952 1992	41	-.66657(-2.9339)	-2.0645(-3.5217)
ADF(2)	1953 1992	40	-.61733(-2.9358)	-1.8482(-3.5247)

95% critical values in brackets.

Unit root tests for variable $logXp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.1039(-2.9798)	-1.8930(-3.5943)
ADF(1)	1968 1992	25	-1.3919(-2.9850)	-2.6173(-3.6027)
ADF(2)	1969 1992	24	-1.4674(-2.9907)	-2.5597(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXm_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-.49048(-2.9798)	-1.3922(-3.5943)
ADF(1)	1968 1992	25	-1.2429(-2.9850)	-1.9639(-3.6027)
ADF(2)	1969 1992	24	-1.5956(-2.9907)	-2.6595(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logH_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	10.0185(-2.9358)	-1.9468(-3.5247)
ADF(1)	1952 1990	39	.38246(-2.9378)	-3.1236(-3.5279)
ADF(2)	1953 1990	38	.23692(-2.9400)	-2.5867(-3.5313)

95% critical values in brackets.

Unit root tests for variable $logL_t$

statistic	sample	observations	without trend	with trend
DF	1951 1991	41	-4.6686(-2.9339)	-3.5927(-3.5217)
ADF(1)	1952 1991	40	-1.7356(-2.9358)	-1.4071(-3.5247)
ADF(2)	1953 1991	39	-2.0388(-2.9378)	-1.9864(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\log C_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-1.3112(-2.9358)	-1.9085(-3.5247)
ADF(1)	1952 1990	39	-1.4673(-2.9378)	-1.9110(-3.5279)
ADF(2)	1953 1990	38	-1.4629(-2.9400)	-1.9703(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-.66385(-2.9320)	-2.6726(-3.5189)
ADF(1)	1952 1992	41	-.92512(-2.9339)	-3.2474(-3.5217)
ADF(2)	1953 1992	40	-.96242(-2.9358)	-3.3717(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta \log K_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.7385(-2.9339)	-5.7527(-3.5217)
ADF(1)	1953 1992	40	-6.5415(-2.9358)	-6.5522(-3.5247)
ADF(2)	1954 1992	39	-5.7205(-2.9378)	-5.6378(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta \log X_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.3318(-2.9339)	-5.3255(-3.5217)
ADF(1)	1953 1992	40	-4.0057(-2.9358)	-3.9508(-3.5247)
ADF(2)	1954 1992	39	-4.2331(-2.9378)	-4.1432(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.4763(-2.9339)	-5.4022(-3.5217)
ADF(1)	1953 1992	40	-4.5381(-2.9358)	-4.4696(-3.5247)
ADF(2)	1954 1992	39	-3.1827(-2.9378)	-3.1217(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logXp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-3.8683(-2.9850)	-3.8500(-3.6027)
ADF(1)	1969 1992	24	-3.2470(-2.9907)	-3.2148(-3.6119)
ADF(2)	1970 1992	23	-3.8687(-2.9970)	-3.7775(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXm_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-4.0295(-2.9850)	-3.9442(-3.6027)
ADF(1)	1969 1992	24	-2.5179(-2.9907)	-2.4668(-3.6119)
ADF(2)	1970 1992	23	-1.9174(-2.9970)	-1.8762(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logH_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-1.0490(-2.9378)	-1.4141(-3.5279)
ADF(1)	1953 1990	38	-1.3220(-2.9400)	-1.2709(-3.5313)
ADF(2)	1954 1990	37	-1.2649(-2.9422)	-1.1681(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta \log L_t$

statistic	sample	observations	without trend	with trend
DF	1952 1991	40	-6.9575(-2.9358)	-6.7063(-3.5247)
ADF(1)	1953 1991	39	-3.3276(-2.9378)	-3.3405(-3.5279)
ADF(2)	1954 1991	38	-2.2408(-2.9400)	-2.0397(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\Delta \log C_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-5.3398(-2.9378)	-5.2683(-3.5279)
ADF(1)	1953 1990	38	-3.9247(-2.9400)	-3.8703(-3.5313)
ADF(2)	1954 1990	37	-3.1791(-2.9422)	-3.1225(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta \log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.4459(-2.9339)	-5.4313(-3.5217)
ADF(1)	1953 1992	40	-4.0066(-2.9358)	-3.9531(-3.5247)
ADF(2)	1954 1992	39	-4.7219(-2.9378)	-4.7263(-3.5279)

95% critical values in brackets.

Model I

EG Cointegration Test:- Unit root tests for variable V_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-5.7484(-2.9378)	-5.6903(-3.5279)
ADF(1)	1953 1990	38	-5.2716(-2.9400)	-5.2530(-3.5313)
ADF(2)	1954 1990	37	-4.3862(-2.9422)	-4.4455(-3.5348)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is $logPCI_t$
40 observations used for estimation from 1952 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	-.055518	.043272	-1.2830[.208]
V_{t-1}	-.35976	.12241	-2.9390[.006]
$\Delta logPCI_{t-1}$	.18701	.15169	1.2328[.226]
$\Delta logX_{t-1}$	-.026713	.048211	-.55410[.583]
$\Delta logH_{t-1}$	2.5237	1.6285	1.5497[.131]
$\Delta logL_{t-1}$	.063783	.45325	.14072[.889]
$\Delta logK_{t-1}$	.047088	.055118	.85432[.399]

R-Squared	.31659	F-statistic F(6, 33)	2.5478[.039]
R-Bar-Squared	.19233	S.E. of Regression	.050112
Residual Sum of Squares	.082869	Mean of Dependent Variable	.014532
S.D. of Dependent Variable	.055760	Maximum of Log-likelihood	66.8298
DW-statistic	1.9269	Durbin's h-statistic	.36508[.715]

LM: χ^2(1)= .033034[.856], RESET: χ^2(1)= 3.5078[.061],
Norm: χ^2(2)= 59.4605[.000], HD: χ^2(1)= .49390[.482]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1968 1990	23	-7.8464(-2.9970)	-7.6677(-3.6219)
ADF(1)	1969 1990	22	-5.9146(-3.0039)	-5.8109(-3.6331)
ADF(2)	1970 1990	21	-4.1576(-3.0115)	-4.1087(-3.6454)

95% critical values in brackets.

CM Model II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
24 observations used for estimation from 1968 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{01}	-.081840	.11209	-.73011[.476]
v_{t-1}	-1.0993	.42232	-2.6029[.019]
$\Delta logPCI_{t-1}$	.40122	.26742	1.5003[.153]
$\Delta logXp_{t-1}$	.062754	.065523	.95773[.352]
$\Delta logmf_{t-1}$	-.0068755	.063952	-.10751[.916]
$\Delta logH_{t-1}$	2.8982	3.7004	.78321[.445]
$\Delta logL_{t-1}$	-.49116	1.1223	-.43766[.667]
$\Delta logK_{t-1}$	-.043928	.21932	-.20029[.844]

R-Squared	.53076	F-statistic F(7, 16)	2.5854[.055]
R-Bar-Squared	.32546	S.E. of Regression	.055293
Residual Sum of Squares	.048917	Mean of Dependent Variable	.020280
S.D. of Dependent Variable	.067323	Maximum of Log-likelihood	40.2938
DW-statistic	1.6448		

LM: χ^2(1)= 2.8121[.094], RESET: χ^2(1)= .18957[.663], Norm: χ^2(2)= .78263[.676], HD: χ^2(1)= 7.5931[.006]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-6.1040(-2.9378)	-6.0212(-3.5279)
ADF(1)	1953 1990	38	-5.0748(-2.9400)	-5.0282(-3.5313)
ADF(2)	1954 1990	37	-4.4389(-2.9422)	-4.4984(-3.5348)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is ΔC_t
39 observations used for estimation from 1952 to 1990

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	-.0031621	.010670	-.29635[.769]
U_{t-1}	-.16974	.10481	-1.6194[.115]
$\Delta logC_{t-1}$	.19098	.15279	1.2500[.220]
$\Delta log(X/Y)_{t-1}$	.019356	.051175	.37822[.708]
$\Delta logL_{t-1}$	-.19508	.49618	-.39317[.697]
$\Delta logK_{t-1}$	.13041	.066359	1.9651[.058]

R-Squared	.27471	F-statistic F(5, 33)	2.4998[.050]
R-Bar-Squared	.16482	S.E. of Regression	.058596
Residual Sum of Squares	.11331	Mean of Dependent Variable	.0022731
S.D. of Dependent Variable	.064118	Maximum of Log-likelihood	58.5653
DW-statistic	1.9354		

LM: χ^2(1)= .24039[.624], RESET: χ^2(1)= .41080[.522],
Norm: χ^2(2)= 122.2263[.000], HD: χ^2 (1)= .014049[.906]

Model I

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.90394 .46870 .27690 .23433 .086470

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	93.7115	33.4610	30.9000
r<= 1	r = 2**	25.2973	27.0670	24.7340
r<= 2	r = 3	12.9685	20.9670	18.5980
r<= 3	r = 4*	10.6803	14.0690	12.0710
r<= 4	r = 5**	3.6176	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95 % critical value
** significant at 90 % critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.90394 .46870 .27690 .23433 .086470

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	146.2752	68.5240	64.8430
r<= 1	r>= 2*	52.5637	47.2100	43.9490
r<= 2	r>= 3**	27.2664	29.6800	26.7850
r<= 3	r>= 4**	14.2979	15.4100	13.3250
r<= 4	r = 5**	3.6176	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95 % critical value
** significant at 90 % critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logX_t$	.067308	.023595	1.0581	-.079045
$logH_t$	.21103	-.18373	-2.8128	2.2926
$logL_t$	-1.7013	-.15197	2.9050	6.1159
$logK_t$	-.51493	.56188	-.30518	-1.5330

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	-1.0000
$logX_t$	.14222
$logH_t$	.63708
$logL_t$	-1.6614
$logK_t$	.086013

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-.012151	.22998	.059116	.0059390
$logX_t$	-.077647	.28182	-.19293	.11614
$logH_t$	-.010911	-.0050154	.0017656	.1945E-3
$logL_t$	.020640	-.022358	-.5354E-3	-.013483
$logK_t$	.098412	-.48112	.17816	.10196

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	.053215
$logX_t$	.33740
$logH_t$	.0032899
$logL_t$	.028322
$logK_t$	.074745

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$\log PCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$\log X_t$	0.00	0.00	0.00	0.00
$\log H_t$	.40504	-.12989	1.9433	1.1900
$\log L_t$	-2.0018	-.20446	5.9766	-2.3163
$\log K_t$	-.56127	.58253	-1.4627	.13002

LR Test of Restrictions $\chi^2(4)=$ 9.0254[.060]

Model II

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logpCI_t$ $logXp_t$ $logXf_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.88339 .69219 .56642 .53380 .22828 .16849

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	51.5746	39.3720	36.7620
r<= 1	r = 2 **	28.2786	33.4610	30.9000
r<= 2	r = 3	20.0565	27.0670	24.7340
r<= 3	r = 4	18.3152	20.9670	18.5980
r<= 4	r = 5	6.2193	14.0690	12.0710
r<= 5	r = 6*	4.4283	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90 % critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logH_t$ $logL_t$
$logK_t$
List of eigenvalues in descending order:
.88339 .69219 .56642 .53380 .22828 .16849

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	128.8725	94.1550	89.4830
r<= 1	r>= 2 *	77.2980	68.5240	64.8430
r<= 2	r>= 3*	49.0194	47.2100	43.9490
r<= 3	r>= 4**	28.9629	29.6800	26.7850
r<= 4	r>= 5	10.6476	15.4100	13.3250
r<= 5	r = 6 **	4.4283	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95 % degree of significance
** significant at 90 % degree of significance

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	-.14903	-.25583	.45211	10.8544
$logXf_t$	-.014661	.090194	-.50272	8.8303
$logH_t$	.83565	.82023	-.42686	-90.5359
$logL_t$	1.8211	2.9509	2.7241	-262.8566
$logK_t$	.36156	.75623	1.1462	-.88949

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	.22150	.41465	.12518	.0037358
$logXp_t$	.71602	1.4754	-1.0688	-.0020812
$logXf_t$	1.3201	.92859	-.63071	-.0053882
$logH_t$	-.029265	.021792	-.0012424	-.3424E-4
$logL_t$	.026734	-.019928	-.012294	.7506E-3
$logK_t$	.13809	-.13302	-.32368	.0030997

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	0.00	0.00	0.00	0.00
$logXf_t$	-.11416	-.091531	-1.5247	.38961
$logH_t$	.57680	.31204	5.7522	1.2363
$logL_t$	1.4274	2.5474	22.7279	6.7005
$logK_t$	.31133	.82817	1.6259	-.98584

LR Test of Restrictions $\chi^2(4)$= 18.3346[.001]

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.52877 .27035 .21709 .8645E-3

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	30.0966	27.0670	24.7340
r<= 1	r = 2	12.6075	20.9670	18.5980
r<= 2	r = 3	9.7895	14.0690	12.0710
r<= 3	r = 4	.034594	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95 % critical value

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.52877 .27035 .21709 .8645E-3

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	52.5282	47.2100	43.9490
r<= 1	r>= 2	22.4316	29.6800	26.7850
r<= 2	r>= 3	9.8241	15.4100	13.3250
r<= 3	r = 4	.034594	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95 % critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	.73206
$\log H_t$	1.2501
$\log K_t$	1.5512

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log C_t$	.029177
$\log(X/Y)_t$	.086261
$\log H_t$	-.017681
$\log K_t$	-.12650

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	0.00
$\log H_t$	2.7343
$\log K_t$	.49665

LR Test of Restrictions $\chi^2(1)=$ 4.2046[.040]

Peru

Unit Root Tests

Unit root tests for variable $\log K_t$

statistic	sample	observations	without trend	with trend
DF	1951 1991	41	-3.0321(-2.9339)	-3.2964(-3.5217)
ADF(1)	1952 1991	40	-4.4366(-2.9358)	-4.7289(-3.5247)
ADF(2)	1953 1991	39	-3.8405(-2.9378)	-4.1335(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\log X_t$

statistic	sample	observations	without trend	with trend
DF	1951 1993	43	-1.2030(-2.9303)	-1.9433(-3.5162)
ADF(1)	1952 1993	42	-.91455(-2.9320)	-1.9008(-3.5189)
ADF(2)	1953 1993	41	-1.1157(-2.9339)	-1.5974(-3.5217)

95% critical values in brackets.

Unit root tests for variable $\log PCI_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-2.1982(-2.9320)	-.28565(-3.5189)
ADF(1)	1952 1992	41	-1.8053(-2.9339)	-.68248(-3.5217)
ADF(2)	1953 1992	40	-2.0781(-2.9358)	.28202(-3.5247)

95% critical values in brackets.

Unit root tests for variable $logXp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.3540(-2.9798)	-3.0355(-3.5943)
ADF(1)	1968 1992	25	-1.2232(-2.9850)	-2.7253(-3.6027)
ADF(2)	1969 1992	24	-.82959(-2.9907)	-2.1364(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXf_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.1799(-2.9798)	-.70053(-3.5943)
ADF(1)	1968 1992	25	-1.2469(-2.9850)	-1.0964(-3.6027)
ADF(2)	1969 1992	24	-1.3433(-2.9907)	-1.5584(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXm_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.4532(-2.9798)	-1.1917(-3.5943)
ADF(1)	1968 1992	25	-1.8065(-2.9850)	-1.7513(-3.6027)
ADF(2)	1969 1992	24	-1.6358(-2.9907)	-1.3143(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logH_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	2.4741(-2.9358)	-1.4102(-3.5247)
ADF(1)	1952 1990	39	1.6788(-2.9378)	-1.5855(-3.5279)
ADF(2)	1953 1990	38	1.2642(-2.9400)	-1.7332(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log L_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-1.3514(-2.9358)	-.65800(-3.5247)
ADF(1)	1952 1990	39	-1.7019(-2.9378)	-.20285(-3.5279)
ADF(2)	1953 1990	38	-1.8577(-2.9400)	-.91743(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log C_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-.84381(-2.9358)	-.20122(-3.5247)
ADF(1)	1952 1990	39	-1.5126(-2.9378)	-.85268(-3.5279)
ADF(2)	1953 1990	38	-1.0790(-2.9400)	.0097089(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-.74217(-2.9320)	-2.8837(-3.5189)
ADF(1)	1952 1992	41	-.65207(-2.9339)	-3.4353(-3.5217)
ADF(2)	1953 1992	40	-.54537(-2.9358)	-2.9857(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta \log K_t$

statistic	sample	observations	without trend	with trend
DF	1952 1991	40	-5.2740(-2.9358)	-5.1962(-3.5247)
ADF(1)	1953 1991	39	-5.3595(-2.9378)	-5.2917(-3.5279)
ADF(2)	1954 1991	38	-6.7041(-2.9400)	-6.6464(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\Delta logX_t$

statistic	sample	observations	without trend	with trend
DF	1952 1993	42	-6.7299(-2.9320)	-6.6851(-3.5189)
ADF(1)	1953 1993	41	-5.0663(-2.9339)	-5.1035(-3.5217)
ADF(2)	1954 1993	40	-4.3653(-2.9358)	-4.6076(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-4.3971(-2.9339)	-4.8809(-3.5217)
ADF(1)	1953 1992	40	-4.7591(-2.9358)	-6.1253(-3.5247)
ADF(2)	1954 1992	39	-3.6803(-2.9378)	-5.5169(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logXp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-6.0911(-2.9850)	-5.9560(-3.6027)
ADF(1)	1969 1992	24	-4.8064(-2.9907)	-4.6910(-3.6119)
ADF(2)	1970 1992	23	-3.5355(-2.9970)	-3.4412(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXf_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-3.7268(-2.9850)	-3.7681(-3.6027)
ADF(1)	1969 1992	24	-2.1894(-2.9907)	-2.2337(-3.6119)
ADF(2)	1970 1992	23	-2.0808(-2.9970)	-2.3772(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXm_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-3.9130(-2.9850)	-4.1234(-3.6027)
ADF(1)	1969 1992	24	-3.5377(-2.9907)	-3.7712(-3.6119)
ADF(2)	1970 1992	23	-2.5646(-2.9970)	-2.6955(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logH_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-4.3333(-2.9378)	-4.9213(-3.5279)
ADF(1)	1953 1990	38	-2.8422(-2.9400)	-3.3121(-3.5313)
ADF(2)	1954 1990	37	-2.2313(-2.9422)	-2.6391(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logL_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-7.4564(-2.9378)	-7.8365(-3.5279)
ADF(1)	1953 1990	38	-3.2309(-2.9400)	-3.6713(-3.5313)
ADF(2)	1954 1990	37	-3.0259(-2.9422)	-3.8348(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logC_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-4.5603(-2.9378)	-5.0089(-3.5279)
ADF(1)	1953 1990	38	-5.1034(-2.9400)	-6.0545(-3.5313)
ADF(2)	1954 1990	37	-4.7880(-2.9422)	-6.8504(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta\log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-6.1298(-2.9339)	-6.0840(-3.5217)
ADF(1)	1953 1992	40	-5.1876(-2.9358)	-5.1385(-3.5247)
ADF(2)	1954 1992	39	-4.9986(-2.9378)	-4.8971(-3.5279)

95% critical values in brackets.

Model I

EG Cointegration Test:- Unit root tests for variable V_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-6.0850(-2.9378)	-6.2028(-3.5279)
ADF(1)	1953 1990	38	-3.6441(-2.9400)	-3.7847(-3.5313)
ADF(2)	1954 1990	37	-4.1454(-2.9422)	-4.2417(-3.5348)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is ΔPCI_t
40 observations used for estimation from 1952 to 991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	-.0062843	.026426	-.23339[.817]
V_{t-1}	-.31184	.12992	-1.8352[.075]
$\Delta logPCI_{t-1}$	.65076	.22149	2.9381[.006]
$\Delta logX_{t-1}$	.041102	.058777	.69928[.489]
$\Delta logH_{t-1}$	.43293	1.0042	.43110[.669]
$\Delta logK_{t-1}$	-.26849	.32473	-.82682[.414]
$\Delta logl_{t-1}$	-.098418	.066637	-1.4769[.149]

R-Squared	.23486	F-statistic F(6, 33)	1.6882[.155]
R-Bar-Squared	.095746	S.E. of Regression	.057669
Residual Sum of Squares	.10975	Mean of Dependent Variable	.0071077
S.D. of Dependent Variable	.060645	Maximum of Log-likelihood	61.2114
DW-statistic	1.8939		

LM: χ^2(1)= .14103[.707], RESET: χ^2(1)= 4.5020[.034], Norm: χ^2(2)= 4.1726[.124], HD:χ^2(1)=.79446[.373]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1968 1990	23	-5.4922(-2.9970)	-5.5940(-3.6219)
ADF(1)	1969 1990	22	-3.5038(-3.0039)	-3.6465(-3.6331)
ADF(2)	1970 1990	21	-2.0705(-3.0115)	-2.1592(-3.6454)

95% critical values in brackets.

ECM Mode II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
24 observations used for estimation from 1968 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{01}	-.19422	.084777	-2.2909[.037]
v_{t-1}	-.76632	.23767	-3.2243[.006]
$\Delta logPCI_{t-1}$	.86255	.25968	3.3216[.005]
$\Delta logXp_{t-1}$	.15439	.086184	-1.7914[.093]
$\Delta logXf_{t-1}$	-.015152	.035504	-.42677[.676]
$\Delta logXm_{t-1}$	.11677	.049714	2.3488[.033]
$\Delta logH_{t-1}$	7.2658	3.3186	2.1894[.045]
$\Delta logL_{t-1}$	-1.6916	.82927	-2.0399[.059]
$\Delta logK_{t-1}$	-.21192	.099355	-2.1329[.050]

R-Squared	.59437	F-statistic F(8, 15)	2.7474[.044]
R-Bar-Squared	.37803	S.E. of Regression	.054855
Residual Sum of Squares	.045136	Mean of Dependent Variable	-.0087643
S.D. of Dependent Variable	.069555	Maximum of Log-likelihood	41.2590
DW-statistic	2.1850		

LM: χ^2(1)= 1.0681[.301], RESET: χ^2(1)= 6.4633[.011], Norm: χ^2(2)= .56905[.752], HD: χ^2(1)= .22689[.634]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-7.9781(-2.9378)	-8.2956(-3.5279)
ADF(1)	1953 1990	38	-4.6573(-2.9400)	-5.1066(-3.5313)
ADF(2)	1954 1990	37	-3.4717(-2.9422)	-4.2998(-3.5348)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is $\Delta logC_t$
39 observations used for estimation from 1952 to 1990

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	-.0055766	.013351	-.41770[.679]
U_{t-1}	.058089	.16663	.34861[.730]
$\Delta logC_{t-1}$	.19363	.24708	.78369[.439]
$\Delta log(X/Y)_{t-1}$	.026778	.076592	.34962[.729]
$\Delta logH_{t-1}$	-.015024	.37673	-.039880[.968]
$\Delta logK_{t-1}$	.061122	.079857	.76539[.449]

R-Squared	.10915	F-statistic F(5, 33)	.80867[.552]
R-Bar-Squared	-.025825	S.E. of Regression	.071043
Residual Sum of Squares	.16656	Mean of Dependent Variable	-.0050588
S.D. of Dependent Variable	.070143	Maximum of Log-likelihood	51.0531
DW-statistic	1.7879		

LM: χ^2(1)= 4.7835[.029], RESET: χ^2(1)= 1.3429[.247], Norm: χ^2(2)= 7.3815[.025], HD: χ^2(1)= .21389[.644]

Model I

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.46238 .42020 .20844 .18028 .13307

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	24.8241	33.4610	30.9000
r<= 1	r = 2	21.8031	27.0670	24.7340
r<= 2	r = 3	9.3501	20.9670	18.5980
r<= 3	r = 4	7.9515	14.0690	12.0710
r<= 4	r = 5	5.7117	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.46238 .42020 .20844 .18028 .13307

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	69.6406	68.5240	64.8430
r<= 1	r>= 2**	44.8165	47.2100	43.9490
r<= 2	r>= 3	23.0133	29.6800	26.7850
r<= 3	r>= 4**	13.6632	15.4100	13.3250
r<= 4	r = 5*	5.7117	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95 % critical value
** significant at 90 % critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log PCI_t$	-1.0000	-1.0000
$\log X_t$	1.0611	-.18002
$\log H_t$	1.2855	-.24406
$\log L_t$	4.0496	1.4410
$\log K_t$	1.6264	.15009

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log PCI_t$	-.11965	.20859
$\log X_t$	.024988	.20409
$\log H_t$	.0025900	-.056149
$\log L_t$	-.013788	-.029454
$\log K_t$	-.42005	-.090257

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log PCI_t$	-1.0000	-1.0000
$LOGX_t$	0.00	0.00
$\log H_t$	-.56084	-.50126
$\log L_t$	.83700	1.3767
$\log K_t$	-.25675	.57150

LR Test of Restrictions $\chi^2(2)$= 9.0994[.011]

Model II

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logH_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.93504 .69253 .55997 .41902 .37483 .28678 .070586

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	65.6153	45.2770	42.3170
r<= 1	r = 2	28.3047	39.3720	36.7620
r<= 2	r = 3	19.7020	33.4610	30.9000
r<= 3	r = 4	13.0331	27.0670	24.7340
r<= 4	r = 5	11.2734	20.9670	18.5980
r<= 5	r = 6	8.1111	14.0690	12.0710
r<= 6	r = 7	1.7568	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95 % critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logH_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.93504 .69253 .55997 .41902 .37483 .28678 .070586

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	147.7964	124.2430	118.5000
r<= 1	r>= 2	82.1811	94.1550	89.4830
r<= 2	r>= 3	53.8764	68.5240	64.8430
r<= 3	r>= 4	34.1744	47.2100	43.9490
r<= 4	r>= 5	21.1413	29.6800	26.7850
r<= 5	r>= 6	9.8680	15.4100	13.3250
r<= 6	r = 7	1.7568	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95 % critical value

Estimated Cointegrated Vectors in Johansen Estimation(Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log PCI_t$	-1.0000
$\log Xp_t$	.79657
$\log Xf_t$	.10783
$\log Xm_t$	.14446
$\log H_t$	3.8046
$\log L_t$	-13.1646
$\log K_t$	.21347

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-.012829
$logXp_t$	.0035482
$logXf_t$	-.57742
$logXm_t$	-.60749
$logH_t$	-.013128
$logL_t$	.027178
$logK_t$	-.14706

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log PCI_t$	-1.0000
$\log Xp_t$	0.00
$\log Xf_t$	.32580
$\log Xm_t$	-.33146
$\log H_t$	7.0283
$\log L_t$	-20.1497
$\log K_t$	.42008

LR Test of Restrictions $\chi^2(1)$= 11.4339[.001]

Restricted Cointegrated Vectors in Johansen Estimation(Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000
$logXp_t$	-.78558
$logXf_t$	0.00
$logXm_t$	.26701
$logH_t$	2.3353
$logL_t$	-9.2061
$logK_t$	.22613

LR Test of Restrictions $\chi^2(1)=$ 5.0833[.024]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log PCI_t$	-1.0000
$\log Xp_t$	.68480
$\log Xf_t$	.17654
$\log Xm_t$	0.00
$\log H_t$	4.7252
$\log L_t$	-14.7194
$\log K_t$	.27025

LR Test of Restrictions $\chi^2(1)=$ 1.5688[.210]

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.38171 .19600 .16573 .012192

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	19.2319	27.0670	24.7340
r<= 1	r = 2	8.7264	20.9670	18.5980
r<= 2	r = 3	7.2477	14.0690	12.0710
r<= 3	r = 4	.49066	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.38171 .19600 .16573 .012192

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	35.6967	47.2100	43.9490
r<= 1	r>= 2	16.4648	29.6800	26.7850
r<= 2	r>= 3	7.7384	15.4100	13.3250
r<= 3	r = 4	.49066	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$ Intercept
List of eigenvalues in descending order:
.38271 .32711 .17555 .11605 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	19.2966	28.1380	25.5590
r<= 1	r = 2	15.8472	22.0020	19.7660
r<= 2	r = 3	7.7215	15.6720	13.7520
r<= 3	r = 4	4.9342	9.2430	7.5250

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$ Intercept
List of eigenvalues in descending order:
.38271 .32711 .17555 .11605 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	47.7996	53.1160	49.6480
r<= 1	r>= 2	28.5030	34.9100	32.0030
r<= 2	r>= 3	12.6557	19.9640	17.8520
r<= 3	r = 4	4.9342	9.2430	7.5250

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

39 observations from 1952 to 1990. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$ Intercept
List of eigenvalues in descending order:
.51323 .40290 .19570 .078091 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	28.0789	28.1380	25.5590
r<= 1	r = 2**	20.1113	22.0020	19.7660
r<= 2	r = 3	8.4937	15.6720	13.7520
r<= 3	r = 4	3.1710	9.2430	7.5250

r is the number of cointegrating vectors
* significant at 95 % critical value
** significant at 90 % critical value

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Trace of the Stochastic Matrix

39 observations from 1952 to 1990. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
$logC_t$ $log(X/Y)_t$ $logH_t$ $logH_t$ Intercept
List of eigenvalues in descending order:
.51323 .40290 .19570 .078091 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1 *	59.8549	53.1160	49.6480
r<= 1	r>= 2	31.7760	34.9100	32.0030
r<= 2	r>= 3	11.6647	19.9640	17.8520
r<= 3	r = 4	3.1710	9.2430	7.5250

r is the number of cointegrating vectors
* significant at 95 % critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

39 observations from 1952 to 1990. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
$logC_t$	-1.0000
$log(X/Y)_t$	1.7334
$logH_t$	4.5852
$logK_t$	4.6600
Intercept	-29.1974

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

39 observations from 1952 to 1990. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
$\log C_t$	-.043452
$\log(X/Y)_t$	.048785
$\log H_t$	.015036
$\log K_t$	-.14838

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

39 observations from 1952 to 1990. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	0.00
$\log H_t$	-.017860
$\log K_t$	-1.5902
Intercept	3.0583

LR Test of Restrictions $\chi^2(1)$= 4.2230[.040]

Uruguay

Unit Root Tests

Unit root tests for variable $\log K_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-1.7833(-2.9320)	-1.7898(-3.5189)
ADF(1)	1952 1992	41	-2.2632(-2.9339)	-2.2922(-3.5217)
ADF(2)	1953 1992	40	-2.4577(-2.9358)	-2.5160(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\log X_t$

statistic	sample	observations	without trend	with trend
DF	1951 1993	43	-.67484(-2.9303)	-1.6465(-3.5162)
ADF(1)	1952 1993	42	-.54138(-2.9320)	-1.7639(-3.5189)
ADF(2)	1953 1993	41	-.59056(-2.9339)	-1.9036(-3.5217)

95% critical values in brackets.

Unit root tests for variable $\log PCI_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-1.9080(-2.9320)	-2.6123(-3.5189)
ADF(1)	1952 1992	41	-1.3831(-2.9339)	-2.7464(-3.5217)
ADF(2)	1953 1992	40	-1.7832(-2.9358)	-2.8571(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\log Xp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-.85698(-2.9798)	-2.5996(-3.5943)
ADF(1)	1968 1992	25	-.90597(-2.9850)	-2.6079(-3.6027)
ADF(2)	1969 1992	24	-.99617(-2.9907)	-2.0044(-3.6119)

95% critical values in brackets.

Unit root tests for variable $\log Xm_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.9285(-2.9798)	-1.8205(-3.5943)
ADF(1)	1968 1992	25	-3.4949(-2.9850)	-2.4706(-3.6027)
ADF(2)	1969 1992	24	-1.1999(-2.9907)	-1.0056(-3.6119)

95% critical values in brackets.

Unit root tests for variable $\log H_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-3.8178(-2.9358)	-2.3658(-3.5247)
ADF(1)	1952 1990	39	-3.3908(-2.9378)	-2.4513(-3.5279)
ADF(2)	1953 1990	38	-2.5356(-2.9400)	-2.4210(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log L_t$

statistic	sample	observations	without trend	with trend
DF	1951 1991	41	.68178(-2.9339)	-.51176(-3.5217)
ADF(1)	1952 1991	40	.28674(-2.9358)	-.91413(-3.5247)
ADF(2)	1953 1991	39	.37967(-2.9378)	-1.0798(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\log C_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-1.4488(-2.9358)	-2.0605(-3.5247)
ADF(1)	1952 1990	39	-2.2139(-2.9378)	-2.5466(-3.5279)
ADF(2)	1953 1990	38	-1.4253(-2.9400)	-1.9409(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-.60245(-2.9320)	-1.7172(-3.5189)
ADF(1)	1952 1992	41	-.58138(-2.9339)	-1.6239(-3.5217)
ADF(2)	1953 1992	40	-.58793(-2.9358)	-1.7982(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta\log K_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.1672(-2.9339)	-5.1276(-3.5217)
ADF(1)	1953 1992	40	-3.5902(-2.9358)	-3.5566(-3.5247)
ADF(2)	1954 1992	39	-3.4388(-2.9378)	-3.3817(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta\log X_t$

statistic	sample	observations	without trend	with trend
DF	1952 1993	42	-6.0029(-2.9320)	-5.9311(-3.5189)
ADF(1)	1953 1993	41	-4.0121(-2.9339)	-3.9630(-3.5217)
ADF(2)	1954 1993	40	-2.9548(-2.9358)	-2.9212(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-6.0696(-2.9339)	-6.0101(-3.5217)
ADF(1)	1953 1992	40	-4.2245(-2.9358)	-4.1772(-3.5247)
ADF(2)	1954 1992	39	-3.9094(-2.9378)	-3.8889(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logXp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-5.2584(-2.9850)	-5.1571(-3.6027)
ADF(1)	1969 1992	24	-4.4927(-2.9907)	-4.4147(-3.6119)
ADF(2)	1970 1992	23	-3.0376(-2.9970)	-2.9864(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXm_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-6.2003(-2.9850)	-7.3665(-3.6027)
ADF(1)	1969 1992	24	-3.9836(-2.9907)	-3.8527(-3.6119)
ADF(2)	1970 1992	23	-2.5216(-2.9970)	-2.8032(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logH_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-5.1197(-2.9378)	-6.1250(-3.5279)
ADF(1)	1953 1990	38	-2.8581(-2.9400)	-3.4217(-3.5313)
ADF(2)	1954 1990	37	-2.1726(-2.9422)	-2.5196(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logL_t$

statistic	sample	observations	without trend	with trend
DF	1952 1991	40	-5.5583(-2.9358)	-5.7303(-3.5247)
ADF(1)	1953 1991	39	-4.0492(-2.9378)	-4.2614(-3.5279)
ADF(2)	1954 1991	38	-2.3216(-2.9400)	-2.3692(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\Delta logC_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-5.4891(-2.9378)	-5.4237(-3.5279)
ADF(1)	1953 1990	38	-5.0039(-2.9400)	-4.9254(-3.5313)
ADF(2)	1954 1990	37	-3.6467(-2.9422)	-3.6257(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-6.6203(-2.9339)	-6.5387(-3.5217)
ADF(1)	1953 1992	40	-4.0819(-2.9358)	-4.0370(-3.5247)
ADF(2)	1954 1992	39	-2.9507(-2.9378)	-2.9146(-3.5279)

95% critical values in brackets.

Model I

EG Cointegration Test:- Unit root tests for variable V_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-7.3104(-2.9378)	-7.1775(-3.5279)
ADF(1)	1953 1990	38	-3.8250(-2.9400)	-3.7958(-3.5313)
ADF(2)	1954 1990	37	-4.6219(-2.9422)	-4.5518(-3.5348)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
40 observations used for estimation from 1952 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	.0048593	.013450	.36129[.720]
V_{t-1}	-.48582	.19793	-2.4545[.020]
$\Delta logPCI_{t-1}$	.21275	.18428	1.1545[.257]
$\Delta logX_{t-1}$	.064642	.046432	1.3922[.173]
$\Delta logH_{t-1}$	-.57238	1.4153	-.40443[.689]
$\Delta logL_{t-1}$	-.056107	.10191	-.55054[.586]
$\Delta logK_{t-1}$	.0048491	.069371	.069901[.945]

R-Squared	.23792	F-statistic F(6, 33)	1.7171[.148]
R-Bar-Squared	.099360	S.E. of Regression	.048936
Residual Sum of Squares	.079026	Mean of Dependent Variable	.0040945
S.D. of Dependent Variable	.051565	Maximum of Log-likelihood	67.7797
DW-statistic	1.4603		

LM: χ^2(1)= 5.8892[.015], RESET: χ^2(1)= .38644[.534], Norm: χ^2(2)= 3.3995[.183],
HD: χ^2 (1)= .66887[.413]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1968 1990	23	-3.6687(-2.9970)	-3.5235(-3.6219)
ADF(1)	1969 1990	22	-3.9443(-3.0039)	-3.8751(-3.6331)
ADF(2)	1970 1990	21	-3.6711(-3.0115)	-3.5706(-3.6454)

95% critical values in brackets.

ECM Model II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
24 observations used for estimation from 1968 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{01}	.0023259	.015803	.14718[.885]
v_{t-1}	-.87329	.28026	-3.1160[.007]
$\Delta logPCI_{t-1}$	.91921	.27320	3.3646[.004]
$\Delta logXp_{t-1}$	.026643	.054294	.49072[.630]
$\Delta logXm_{t-1}$	.024648	.037856	.65112[.524]
$\Delta logH_{t-1}$	-1.2366	2.2924	-.53941[.597]
$\Delta logL_{t-1}$	-.011962	.093198	-.12835[.899]
$\Delta logK_{t-1}$	-.041563	.085041	-.48874[.632]

R-Squared	.56832	F-statistic F(7, 16)	3.0093[.032]
R-Bar-Squared	.37947	S.E. of Regression	.041599
Residual Sum of Squares	.027687	Mean of Dependent Variable	.010493
S.D. of Dependent Variable	.052808	Maximum of Log-likelihood	47.1235
DW-statistic	1.8994		

LM: χ^2(1)= .0029473[.957], RESET: χ^2(1)= .13175[.717], Norm: χ^2(2)= .89837[.638], HD: χ^2(1)= 1.1848[.276]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-6.2585(-2.9378)	-6.3582(-3.5279)
ADF(1)	1953 1990	38	-3.9638(-2.9400)	-4.0036(-3.5313)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is ΔC_t
39 observations used for estimation from 1952 to 1990

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	-.016597	.0089945	-1.8452[.074]
U_{t-1}	-.32046	.10813	-2.9637[.006]
$\Delta logC_{t-1}$	.29874	.17637	1.6939[.100]
$\Delta log(X/Y)_{t-1}$	.12053	.047908	2.5158[.017]
$\Delta logH_{t-1}$	.072219	.11295	.63942[.527]
$\Delta logK_{t-1}$	-.037854	.078034	-.48510[.631]

R-Squared	.32954	F-statistic F(5, 33)	3.2439[.017]
R-Bar-Squared	.22795	S.E. of Regression	.051382
Residual Sum of Squares	.087124	Mean of Dependent Variable	-.0089571
S.D. of Dependent Variable	.058477	Maximum of Log-likelihood	63.6892
DW-statistic	1.5661	Durbin's h-statistic	1.8369[.066]

LM: χ^2(1)= 4.7608[.029], χ^2(1)= .48939[.484], Norm: χ^2 (2)= .62691[.731],
HD: χ^2(1)= .029290[.864]

Model I

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.49840 .41951 .19271 .085439 .4903E-3

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	27.5981	33.4610	30.9000
r<= 1	r = 2	21.7554	27.0670	24.7340
r<= 2	r = 3	8.5630	20.9670	18.5980
r<= 3	r = 4	3.5725	14.0690	12.0710
r<= 4	r = 5	.019617	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.49840 .41951 .19271 .085439 .4903E-3

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	61.5086	68.5240	64.8430
r<= 1	r>= 2	33.9105	47.2100	43.9490
r<= 2	r>= 3	12.1550	29.6800	26.7850
r<= 3	r>= 4	3.5921	15.4100	13.3250
r<= 4	r = 5	.019617	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
Intercept
List of eigenvalues in descending order:
.81193 .43557 .21578 .086892 .050041 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	66.8385	34.4000	31.6640
r<= 1	r = 2	22.8773	28.1380	25.5590
r<= 2	r = 3	9.7226	22.0020	19.7660
r<= 3	r = 4	3.6360	15.6720	13.7520
r<= 4	r = 5	2.0535	9.2430	7.5250

r is the number of cointegrating vectors
* significant at 95 % critical value

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
Intercept
List of eigenvalues in descending order:
.81193 .43557 .21578 .086892 .050041 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1 *	105.1280	76.0690	71.8620
r<= 1	r>= 2	38.2895	53.1160	49.6480
r<= 2	r>= 3	15.4121	34.9100	32.0030
r<= 3	r>= 4	5.6895	19.9640	17.8520
r<= 4	r = 5	2.0535	9.2430	7.5250

r is the number of cointegrating vector
* significant at 95 % critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000
$logX_t$	.80023
$logH_t$	12.0936
$logL_t$	.33297
$logK_t$	.96373
Intercept	-79.7188

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-.0055831
$logX_t$	-.048285
$logH_t$	-.0071073
$logL_t$	-.019851
$logK_t$	.017947

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000
$logX_t$	0.00
$logH_t$	1.7255
$logL_t$	-.0010406
$logK_t$	.18187
Intercept	-4.4123

LR Test of Restrictions $\chi^2(1)$= 7.8296[.005]

Model II

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXm_t$ $logH_t$ $logL_t$
$logK_t$
List of eigenvalues in descending order:
.77331 .57591 .47501 .38592 .17912 .3768E-3

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	35.6204	39.3720	36.7620
r<= 1	r = 2	20.5873	33.4610	30.9000
r<= 2	r = 3	15.4652	27.0670	24.7340
r<= 3	r = 4	11.7032	20.9670	18.5980
r<= 4	r = 5	4.7371	14.0690	12.0710
r<= 5	r = 6	.0090450	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXm_t$ $logH_t$ $logL_t$
$logK_t$
List of eigenvalues in descending order:
.77331 .57591 .47501 .38592 .17912 .3768E-3

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	88.1223	94.1550	89.4830
r<= 1	r>= 2	52.5018	68.5240	64.8430
r<= 2	r>= 3	31.9145	47.2100	43.9490
r<= 3	r>= 4	16.4493	29.6800	26.7850
r<= 4	r>= 5	4.7461	15.4100	13.3250
r<= 5	r = 6	.0090450	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXm_t$ $logH_t$ $logL_t$
$logK_t$ Intercept
List of eigenvalues in descending order:
.85570 .67236 .49525 .45995 .31097 .17184 -.0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	46.4602	40.3030	37.4480
r<= 1	r = 2	26.7804	34.4000	31.6640
r<= 2	r = 3	16.4088	28.1380	25.5590
r<= 3	r = 4	14.7863	22.0020	19.7660
r<= 4	r = 5	8.9393	15.6720	13.7520
r<= 5	r = 6	4.5250	9.2430	7.5250

r is the number of cointegrating vectors
* significant at 95 % critical value

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Trace of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXm_t$ $logH_t$ $logL_t$
$logK_t$ Intercept
List of eigenvalues in descending order:
.85570 .67236 .49525 .45995 .31097 .17184 -.0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	117.9000	102.1390	97.1780
r<= 1	r>= 2	71.4398	76.0690	71.8620
r<= 2	r>= 3	44.6594	53.1160	49.6480
r<= 3	r>= 4	28.2507	34.9100	32.0030
r<= 4	r>= 5	13.4643	19.9640	17.8520
r<= 5	r = 6	4.5250	9.2430	7.5250

r is the number of cointegrating vectors
* significant at 95 % critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000
$logXp_t$	.22073
$logXm_t$	.61885
$logH_t$	20.1269
$logL_t$	.0023663
$logK_t$	1.2532
Intercept	-134.8832

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-.055655
$logXP_t$	-.25539
$logXm_t$	-.24249
$logH_t$	-.014955
$logL_t$	-.022509
$logK_t$	-.18922

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000
$logXp_t$	0.00
$logXm_t$	.81978
$logH_t$	31.5922
$logL_t$	-.060619
$logK_t$	1.7585
Intercept	-214.7303

LR Test of Restrictions $\chi^2(1)=$ .38596[.534]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000
$logXp_t$	.87739
$logXm_t$	0.00
$logH_t$	-14.4832
$logL_t$	.12526
$logK_t$	-.39342
Intercept	106.5543

LR Test of Restrictions $\chi^2(1)$= 11.4983[.001]

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.23356 .17943 .10061 .022594

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	10.6399	27.0670	24.7340
r<= 1	r = 2	7.9102	20.9670	18.5980
r<= 2	r = 3	4.2417	14.0690	12.0710
r<= 3	r = 4	.91413	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.23356 .17943 .10061 .022594

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	23.7060	47.2100	43.9490
r<= 1	r>= 2	13.0660	29.6800	26.7850
r<= 2	r>= 3	5.1558	15.4100	13.3250
r<= 3	r = 4	.91413	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log L_t$ Intercept
List of eigenvalues in descending order:
.24790 .23345 .10639 .091008 -.0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	11.3956	28.1380	25.5590
r<= 1	r = 2	10.6343	22.0020	19.7660
r<= 2	r = 3	4.4995	15.6720	13.7520
r<= 3	r = 4	3.8168	9.2430	7.5250

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$ Intercept
List of eigenvalues in descending order:
.24790 .23345 .10639 .091008 -.0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	30.3461	53.1160	49.6480
r<= 1	r>= 2	18.9506	34.9100	32.0030
r<= 2	r>= 3	8.3162	19.9640	17.8520
r<= 3	r = 4	3.8168	9.2430	7.5250

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

39 observations from 1952 to 1990. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$ Intercept
List of eigenvalues in descending order:
.55307 .18013 .13245 .083334 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	31.4086	28.1380	25.5590
r<= 1	r = 2	7.7457	22.0020	19.7660
r<= 2	r = 3	5.5410	15.6720	13.7520
r<= 3	r = 4	3.3935	9.2430	7.5250

r is the number of cointegrating vectors
* significant at 95 % critical value

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Trace of the Stochastic Matrix

39 observations from 1952 to 1990. Maximum lag in VAR = 2.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$ Intercept
List of eigenvalues in descending order:
.55307 .18013 .13245 .083334 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	48.0887	53.1160	49.6480
r<= 1	r>= 2	16.6801	34.9100	32.0030
r<= 2	r>= 3	8.9345	19.9640	17.8520
r<= 3	r = 4	3.3935	9.2430	7.5250

r is the number of cointegrating vectors

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

39 observations from 1952 to 1990. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	.042862
$\log H_t$	-1.2711
$\log K_t$	-.089632
Intercept	-2.5866

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

39 observations from 1952 to 1990. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
$\log C_t$	.54965
$\log(X/Y)_t$	-1.1501
$\log H_t$	-.022524
$\log K_t$	.98254

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

39 observations from 1952 to 1990. Maximum lag in VAR = 2, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	0.00
$\log H_t$	-1.0715
$\log K_t$	-.030313
Intercept	-2.9160

LR Test of Restrictions $\chi^2(1)=$ 2.4223[.120]

Venezuela

Unit Root Tests

Unit root tests for variable $logK_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-2.3786(-2.9320)	-2.6553(-3.5189)
ADF(1)	1952 1992	41	-2.2996(-2.9339)	-2.6174(-3.5217)
ADF(2)	1953 1992	40	-1.8942(-2.9358)	-2.0605(-3.5247)
ADF(3)	1954 1992	39	-1.7206(-2.9378)	-1.8726(-3.5279)

95% critical values in brackets.

Unit root tests for variable $logX_t$

statistic	sample	observations	without trend	with trend
DF	1951 1993	43	-1.3744(-2.9303)	-1.8063(-3.5162)
ADF(1)	1952 1993	42	-1.1806(-2.9320)	-2.0668(-3.5189)
ADF(2)	1953 1993	41	-1.0857(-2.9339)	-1.8101(-3.5217)
ADF(3)	1954 1993	40	-1.0568(-2.9358)	-1.9078(-3.5247)

95% critical values in brackets.

Unit root tests for variable $logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-2.9647(-2.9320)	-2.4444(-3.5189)
ADF(1)	1952 1992	41	-2.6195(-2.9339)	-2.3658(-3.5217)
ADF(2)	1953 1992	40	-2.5045(-2.9358)	-2.3073(-3.5247)
ADF(3)	1954 1992	39	-2.8029(-2.9378)	-2.4907(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\log Xp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.4589(-2.9798)	-4.1266(-3.5943)
ADF(1)	1968 1992	25	-1.4066(-2.9850)	-5.4374(-3.6027)
ADF(2)	1969 1992	24	-1.0105(-2.9907)	-5.2354(-3.6119)

95% critical values in brackets.

Unit root tests for variable $\log Xf_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-5.2431(-2.9798)	-5.0904(-3.5943)
ADF(1)	1968 1992	25	-1.6462(-2.9850)	-1.4240(-3.6027)
ADF(2)	1969 1992	24	-1.9875(-2.9907)	-1.5685(-3.6119)
ADF(3)	1970 1992	23	-1.9024(-2.9970)	-1.3805(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\log Xm_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-.99610(-2.9798)	-4.5241(-3.5943)
ADF(1)	1968 1992	25	-.65751(-2.9850)	-5.9647(-3.6027)
ADF(2)	1969 1992	24	-.45203(-2.9907)	-5.6145(-3.6119)

95% critical values in brackets.

Unit root tests for variable $\log H_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	1.2096(-2.9358)	-1.4896(-3.5247)
ADF(1)	1952 1990	39	-.42256(-2.9378)	-2.9671(-3.5279)
ADF(2)	1953 1990	38	-.43158(-2.9400)	-2.9095(-3.5313)
ADF(3)	1954 1990	37	-.42397(-2.9422)	-2.5611(-3.5348)

95% critical values in brackets.

Unit root tests for variable $logL_t$

statistic	sample	observations	without trend	with trend
DF	1951 1991	41	-1.6606(-2.9339)	-1.6124(-3.5217)
ADF(1)	1952 1991	40	-1.6963(-2.9358)	-2.1867(-3.5247)
ADF(2)	1953 1991	39	-1.7964(-2.9378)	-2.1760(-3.5279)
ADF(3)	1954 1991	38	-2.0100(-2.9400)	-2.3619(-3.5313)

95% critical values in brackets.

Unit root tests for variable $logC_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	1.0504(-2.9358)	-1.5164(-3.5247)
ADF(1)	1952 1990	39	.65490(-2.9378)	-1.5425(-3.5279)
ADF(2)	1953 1990	38	.64337(-2.9400)	-1.3565(-3.5313)
ADF(3)	1954 1990	37	.84826(-2.9422)	-1.6749(-3.5348)

95% critical values in brackets.

Unit root tests for variable $log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-1.3808(-2.9320)	-1.9076(-3.5189)
ADF(1)	1952 1992	41	-1.4792(-2.9339)	-2.2757(-3.5217)
ADF(2)	1953 1992	40	-1.2078(-2.9358)	-1.9794(-3.5247)

95% critical values in brackets.

Unit root tests for variable $log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-1.3808(-2.9320)	-1.9076(-3.5189)
ADF(1)	1952 1992	41	-1.4792(-2.9339)	-2.2757(-3.5217)
ADF(2)	1953 1992	40	-1.2078(-2.9358)	-1.9794(-3.5247)
ADF(3)	1954 1992	39	-1.1139(-2.9378)	-1.9476(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logK_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-6.6231(-2.9339)	-6.5370(-3.5217)
ADF(1)	1953 1992	40	-5.5656(-2.9358)	-5.4263(-3.5247)
ADF(2)	1954 1992	39	-4.3395(-2.9378)	-4.1983(-3.5279)
ADF(3)	1955 1992	38	-3.3959(-2.9400)	-3.2931(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\Delta logX_t$

statistic	sample	observations	without trend	with trend
DF	1952 1993	42	-5.7480(-2.9320)	-5.7098(-3.5189)
ADF(1)	1953 1993	41	-4.7529(-2.9339)	-4.7298(-3.5217)
ADF(2)	1954 1993	40	-3.5417(-2.9358)	-3.5268(-3.5247)
ADF(3)	1955 1993	39	-3.5779(-2.9378)	-3.6023(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-4.9254(-2.9339)	-5.0077(-3.5217)
ADF(1)	1953 1992	40	-3.5348(-2.9358)	-3.5214(-3.5247)
ADF(2)	1954 1992	39	-3.2257(-2.9378)	-3.5035(-3.5279)
ADF(3)	1955 1992	38	-3.1282(-2.9400)	-3.4073(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\Delta logXp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-5.2986(-2.9850)	-5.1759(-3.6027)
ADF(1)	1969 1992	24	-5.1951(-2.9907)	-5.0380(-3.6119)
ADF(2)	1970 1992	23	-6.6440(-2.9970)	-6.4429(-3.6219)
ADF(3)	1971 1992	22	-5.7915(-3.0039)	-5.6119(-3.6331)

95% critical values in brackets.

Unit root tests for variable $\Delta logXf_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-9.1737(-2.9850)	-8.8229(-3.6027)
ADF(1)	1969 1992	24	-4.1091(-2.9907)	-4.2994(-3.6119)
ADF(2)	1970 1992	23	-3.2792(-2.9970)	-3.5312(-3.6219)
ADF(3)	1971 1992	22	-2.7211(-3.0039)	-3.4722(-3.6331)

95% critical values in brackets.

Unit root tests for variable $\Delta logXm_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-5.9309(-2.9850)	-5.7976(-3.6027)
ADF(1)	1969 1992	24	-5.7596(-2.9907)	-5.6139(-3.6119)
ADF(2)	1970 1992	23	-6.4277(-2.9970)	-6.2642(-3.6219)
ADF(3)	1971 1992	22	-6.0759(-3.0039)	-5.9186(-3.6331)

95% critical values in brackets.

Unit root tests for variable $\Delta logH_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-1.5023(-2.9378)	-1.3738(-3.5279)
ADF(1)	1953 1990	38	-1.5622(-2.9400)	-1.3960(-3.5313)
ADF(2)	1954 1990	37	-1.7736(-2.9422)	-1.5538(-3.5348)
ADF(3)	1955 1990	36	-1.8485(-2.9446)	-1.5913(-3.5386)

95% critical values in brackets.

Unit root tests for variable $\Delta logL_t$

statistic	sample	observations	without trend	with trend
DF	1952 1991	40	-4.2350(-2.9358)	-4.2811(-3.5247)
ADF(1)	1953 1991	39	-3.7595(-2.9378)	-3.8461(-3.5279)
ADF(2)	1954 1991	38	-2.8809(-2.9400)	-3.0510(-3.5313)
ADF(3)	1955 1991	37	-2.9892(-2.9422)	-3.3011(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logC_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-5.1266(-2.9378)	-6.3641(-3.5279)
ADF(1)	1953 1990	38	-3.4029(-2.9400)	-4.4937(-3.5313)
ADF(2)	1954 1990	37	-3.0368(-2.9422)	-4.8727(-3.5348)
ADF(3)	1955 1990	36	-2.8981(-2.9446)	-5.0075(-3.5386)

95% critical values in brackets.

Unit root tests for variable $\Delta \log(X\,Y)_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.5632(-2.9339)	-5.4910(-3.5217)
ADF(1)	1953 1992	40	-4.7478(-2.9358)	-4.6770(-3.5247)
ADF(2)	1954 1992	39	-3.8596(-2.9378)	-3.8012(-3.5279)
ADF(3)	1955 1992	38	-3.8816(-2.9400)	-3.8055(-3.5313)

95% critical values in brackets.

Model I

EG Cointegration Test:- Unit root tests for variable V_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-6.1887(-2.9378)	-6.1503(-3.5279)
ADF(1)	1953 1990	38	-4.3095(-2.9400)	-4.3264(-3.5313)
ADF(2)	1954 1990	37	-4.5411(-2.9422)	-4.6045(-3.5348)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
40 observations used for estimation from 1952 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	.030586	.043022	.71094[.482]
V_{t-1}	-.25167	.12868	-1.9558[.059]
$\Delta logPCI_{t-1}$	.34318	.20800	1.6500[.108]
$\Delta logX_{t-1}$	.0085293	.037792	.22569[.823]
$\Delta logH_{t-1}$	-.70946	1.1865	-.59795[.554]
$\Delta logL_{t-1}$	-.086923	.17917	-.48514[.631]
$\Delta logK_{t-1}$	-.036827	.050191	-.73374[.468]

R-Squared	.14837	F-statistic F(6, 33)	.95817[.468]
R-Bar-Squared	-.0064763	S.E. of Regression	.047872
Residual Sum of Squares	.075626	Mean of Dependent Variable	.0065153
S.D. of Dependent Variable	.047717	Maximum of Log-likelihood	68.6592
DW-statistic	2.1420	Durbin's h-statistic	-.77270[.440]

LM: χ^2(1)= 2.9395[.086], RESET: χ^2(1)= .59829[.439], Norm: χ^2(2)= 15.7518[.000],
HD: χ^2 (1)= .10891[.741]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1968 1990	23	-6.9952(-2.9970)	-6.8239(-3.6219)
ADF(1)	1969 1990	22	-3.1537(-3.0039)	-3.0857(-3.6331)
ADF(2)	1970 1990	21	-2.9679(-3.0115)	-2.9463(-3.6454)

95% critical values in brackets.

ECM Model II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
24 observations used for estimation from 1968 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{01}	.0094652	.049882	.18975[.852]
v_{t-1}	-.57394	.2787	-2.0587[.057]
$\Delta logPCI_{t-1}$	.44578	.34115	1.3067[.211]
$\Delta logXp_{t-1}$	.031879	.054791	.58183[.569]
$\Delta logXf_{t-1}$	.030740	.022027	1.3956[.183]
$\Delta logXm_{t-1}$	-.042754	.054852	-.77945[.448]
$\Delta logH_{t-1}$	-.31433	1.2624	-.24900[.807]
$\Delta logL_{t-1}$	.16473	.34442	.47829[.639]
$\Delta logK_{t-1}$	-.019730	.068091	-.28976[.776]

R-Squared .33235 F-statistic F(8, 15) .93334[.518]
R-Bar-Squared -.023735 S.E. of Regression .047911
Residual Sum of Squares .034432 Mean of Dependent Variable -.0045784
S.D. of Dependent Variable .047353 Maximum of Log-likelihood 44.5072
DW-statistic 2.0436
LM: χ^2(1)= .26125[.609], RESET: χ^2(1)= 2.6827[.101], Norm: χ^2(2)= 32.6723[.000],
HD: χ^2(1)= .35904[.549]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-5.5805(-2.9378)	-5.5263(-3.5279)
ADF(1)	1953 1990	38	-4.1622(-2.9400)	-4.1582(-3.5313)
ADF(2)	1954 1990	37	-3.8307(-2.9422)	-3.9455(-3.5348)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is $\Delta \log C_t$
39 observations used for estimation from 1952 to 1990

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	-.010772	.0090940	-1.1846[.245]
U_{t-1}	-.013929	.074876	-.18602[.854]
$\Delta \log C_{t-1}$	.32192	.20421	1.5764[.124]
$\Delta \log(X/Y)_{t-1}$	.053019	.038726	1.3691[.180]
$\Delta \log H_{t-1}$	.046921	.17709	.26495[.793]
$\Delta \log K_{t-1}$	-.038092	.052431	-.72650[.473]

R-Squared	.10488	F-statistic F(5, 33)	.77332[.576]
R-Bar-Squared	-.030744	S.E. of Regression	.050368
Residual Sum of Squares	.083720	Mean of Dependent Variable	-.010696
S.D. of Dependent Variable	.049611	Maximum of Log-likelihood	64.4664
DW-statistic	2.0305	Durbin's h-statistic	-.10790[.914]

LM: χ^2(1)= .43823[.508], RESET: χ^2(1)= .13893[.709], Norm: χ^2(2)= 5.6913[.058], HD: χ^2 (1)= 1.0443[.307]

Model III

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

38 observations from 1953 to 1990. Maximum lag in VAR = 3.
List of variables included in the cointegrating vector:
$logC_t$ $log(X/Y)_t$ $logH_t$ $logK_t$ Intercept
List of eigenvalues in descending order:
.66422 .22390 .21613 .10548 -.0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	41.4689	28.1380	25.5590
r<= 1	r = 2	9.6320	22.0020	19.7660
r<= 2	r = 3	9.2534	15.6720	13.7520
r<= 3	r = 4	4.2356	9.2430	7.5250

r is the number of cointegrating vectors
* significant at 95 % critical value

Johansen Maximum Likelihood Procedure (Non-trended case)
Cointegration LR Test Based on Trace of the Stochastic Matrix

38 observations from 1953 to 1990. Maximum lag in VAR = 3.
List of variables included in the cointegrating vector:
$logC_t$ $log(X/Y)_t$ $logH_t$ $logK_t$ Intercept
List of eigenvalues in descending order:
.66422 .22390 .21613 .10548 -.0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	64.5899	53.1160	49.6480
r<= 1	r>= 2	23.1210	34.9100	32.0030
r<= 2	r>= 3	13.4890	19.9640	17.8520
r<= 3	r = 4	4.2356	9.2430	7.5250

r is the number of cointegrating vectors
* significant at 95 % critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

38 observations from 1953 to 1990. Maximum lag in VAR = 3, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	.64990
$\log H_t$	.90011
$\log K_t$	1.2346
Intercept	-10.1795

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

38 observations from 1953 to 1990. Maximum lag in VAR = 3, chosen r = 1.

	Vector 1
$\log C_t$	-.021440
$\log(X/Y)_t$	.94300
$\log H_t$	-.020475
$\log K_t$	-.15650

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

38 observations from 1953 to 1990. Maximum lag in VAR = 3, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	0.00
$\log H_t$	-1.4431
$\log K_t$	-1.3094
Intercept	1.2945

LR Test of Restrictions $\chi^2(1) = 29.2540[.000]$

India

Unit Root Tests

Unit root tests for variable $\log K_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-2.6350(-2.9320)	-2.9430(-3.5189)
ADF(1)	1952 1992	41	-2.1890(-2.9339)	-2.3139(-3.5217)
ADF(2)	1953 1992	40	-3.4349(-2.9358)	-2.8526(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\log X_t$

statistic	sample	observations	without trend	with trend
DF	1951 1993	43	.51213(-2.9303)	-2.1213(-3.5162)
ADF(1)	1952 1993	42	1.3613(-2.9320)	-2.7063(-3.5189)
ADF(2)	1953 1993	41	.87016(-2.9339)	-2.3903(-3.5217)

95% critical values in brackets.

Unit root tests for variable $\log PCI_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-.036061(-2.9320)	-1.5627(-3.5189)
ADF(1)	1952 1992	41	-.11512(-2.9339)	-1.8647(-3.5217)
ADF(2)	1953 1992	40	.21029(-2.9358)	-1.3516(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\log Xp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-.92249(-2.9798)	-1.3080(-3.5943)
ADF(1)	1968 1992	25	-1.0726(-2.9850)	-1.6460(-3.6027)
ADF(2)	1969 1992	24	-1.1975(-2.9907)	-1.7689(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXf_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.0792(-2.9798)	-2.4210(-3.5943)
ADF(1)	1968 1992	25	-1.1394(-2.9850)	-2.4021(-3.6027)
ADF(2)	1969 1992	24	-1.2619(-2.9907)	-3.0553(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXm_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-.39203(-2.9798)	-2.0902(-3.5943)
ADF(1)	1968 1992	25	-.64720(-2.9850)	-1.9900(-3.6027)
ADF(2)	1969 1992	24	-.68903(-2.9907)	-2.2166(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logH_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-4.7870(-2.9358)	-6.1041(-3.5247)
ADF(1)	1952 1990	39	-2.9959(-2.9378)	-4.2244(-3.5279)
ADF(2)	1953 1990	38	-2.1738(-2.9400)	-3.3795(-3.5313)

95% critical values in brackets.

Unit root tests for variable $logL_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-4.0758(-2.9358)	-5.1715(-3.5247)
ADF(1)	1952 1990	39	-2.7618(-2.9378)	-3.4370(-3.5279)
ADF(2)	1953 1990	38	-2.3179(-2.9400)	-2.7117(-3.5313)

95% critical values in brackets.

Unit root tests for variable $logC_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-5.1776(-2.9358)	-5.8456(-3.5247)
ADF(1)	1952 1990	39	-3.3292(-2.9378)	-3.9305(-3.5279)
ADF(2)	1953 1990	38	-2.5090(-2.9400)	-3.0775(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-3.3422(-2.9320)	-6.4329(-3.5189)
ADF(1)	1952 1992	41	-1.4785(-2.9339)	-4.0834(-3.5217)
ADF(2)	1953 1992	40	-.95505(-2.9358)	-3.5750(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta logK_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-7.7665(-2.9339)	-7.8405(-3.5217)
ADF(1)	1953 1992	40	-6.1471(-2.9358)	-6.6579(-3.5247)
ADF(2)	1954 1992	39	-5.0931(-2.9378)	-5.8782(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logX_t$

statistic	sample	observations	without trend	with trend
DF	1952 1993	42	-8.6657(-2.9320)	-9.3540(-3.5189)
ADF(1)	1953 1993	41	-4.3532(-2.9339)	-4.7183(-3.5217)
ADF(2)	1954 1993	40	-3.5009(-2.9358)	-3.5733(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.5896(-2.9339)	-5.5757(-3.5217)
ADF(1)	1953 1992	40	-5.0523(-2.9358)	-5.0787(-3.5247)
ADF(2)	1954 1992	39	-4.2328(-2.9378)	-4.3526(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logXp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-3.9613(-2.9850)	-3.9316(-3.6027)
ADF(1)	1969 1992	24	-2.8619(-2.9907)	-2.8872(-3.6119)
ADF(2)	1970 1992	23	-2.4286(-2.9970)	-2.6348(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXf_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-5.0759(-2.9850)	-4.9636(-3.6027)
ADF(1)	1969 1992	24	-3.0730(-2.9907)	-2.9984(-3.6119)
ADF(2)	1970 1992	23	-3.2090(-2.9970)	-3.1211(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXm_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-5.2041(-2.9850)	-5.1024(-3.6027)
ADF(1)	1969 1992	24	-3.1731(-2.9907)	-3.1000(-3.6119)
ADF(2)	1970 1992	23	-2.7156(-2.9970)	-2.6473(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logH_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-10.5320(-2.9378)	-10.3955(-3.5279)
ADF(1)	1953 1990	38	-7.2427(-2.9400)	-7.1505(-3.5313)
ADF(2)	1954 1990	37	-5.7332(-2.9422)	-5.6647(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logL_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-10.4087(-2.9378)	-10.2955(-3.5279)
ADF(1)	1953 1990	38	-7.1063(-2.9400)	-7.0557(-3.5313)
ADF(2)	1954 1990	37	-5.6959(-2.9422)	-5.6915(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logC_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-10.5743(-2.9378)	-10.4304(-3.5279)
ADF(1)	1953 1990	38	-7.2304(-2.9400)	-7.1264(-3.5313)
ADF(2)	1954 1990	37	-5.5577(-2.9422)	-5.4729(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-12.4797(-2.9339)	-12.3799(-3.5217)
ADF(1)	1953 1992	40	-7.2991(-2.9358)	-7.2713(-3.5247)
ADF(2)	1954 1992	39	-5.4377(-2.9378)	-5.4100(-3.5279)

95% critical values in brackets.

Model I

EG Cointegration Test:- Unit root tests for variable V_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-7.6869(-2.9378)	-7.6273(-3.5279)
ADF(1)	1953 1990	38	-6.1937(-2.9400)	-6.1313(-3.5313)
ADF(2)	1954 1990	37	-4.6052(-2.9422)	-4.5835(-3.5348)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
40 observations used for estimation from 1952 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	.0016454	.014268	.11532[.909]
V_{t-1}	-.26906	.12834	-2.0965[.044]
$\Delta logPCI_{t-1}$	.28431	.17900	1.5883[.122]
$\Delta logX_{t-1}$	.056588	.047045	1.2029[.238]
$\Delta logH_{t-1}$	.19228	.24185	.79505[.432]
$\chi logL_{t-1}$	.18762	.24150	.77690[.443]
$\chi logK_{t-1}$	-.031534	.072213	-.43668[.665]

R-Squared	.19784	F-statistic F(6, 33)	1.3564[.261]
R-Bar-Squared	.051987	S.E. of Regression	.043745
Residual Sum of Squares	.063149	Mean of Dependent Variable	.018038
S.D. of Dependent Variable	.044928	Maximum of Log-likelihood	72.2652
DW-statistic	1.7715	Durbin's h-statistic	1.2372[.216]

$\chi^2(1)$= 4.5612[.033], RESET: $\chi^2(1)$= 6.5432[.011], Norm: $\chi^2(2)$= 14.8745[.001],
HD: χ^2 (1)= .93142[.334]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1968 1990	23	-6.7706(-2.9970)	-6.6007(-3.6219)
ADF(1)	1969 1990	22	-4.8489(-3.0039)	-4.6886(-3.6331)
ADF(2)	1970 1990	21	-3.4770(-3.0115)	-3.3251(-3.6454)

95% critical values in brackets.

ECM Model II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
24 observations used for estimation from 1968 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{01}	.011245	.019999	.56227[.582]
v_{t-1}	-.66949	.32089	-2.0864[.054]
$\Delta logPCI_{t-1}$	.28297	.27461	1.0304[.319]
$\Delta logXp_{t-1}$	.024559	.064315	.38185[.708]
$\Delta logXf_{t-1}$	.0046683	.0091406	.51072[.617]
$\Delta logXm_{t-1}$	.036572	.070836	.51629[.613]
$\Delta logH_{t-1}$	-.0068193	.31965	-.021334[.983]
$\Delta logL_{t-1}$	-.0097416	.31978	-.030464[.976]
$\Delta logK_{t-1}$	-.018414	.10451	-.17620[.862]

R-Squared	.39229	F-statistic F(8, 15)	1.2104[.357]
R-Bar-Squared	.068177	S.E. of Regression	.030043
Residual Sum of Squares	.013539	Mean of Dependent Variable	.024312
S.D. of Dependent Variable	.031123	Maximum of Log-likelihood	55.7084
DW-statistic	2.1650		

LM: $\chi^2(1)$= 1.4969[.221], RESET: χ^2 (1)= .47419[.491], Norm, χ^2 (2)= 3.2712[.195], DH: $\chi^2(1)$=.23939[.625]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-10.4545(-2.9378)	-10.3145(-3.5279)
ADF(1)	1953 1990	38	-6.9645(-2.9400)	-6.8654(-3.5313)
ADF(2)	1954 1990	37	-5.2676(-2.9422)	-5.1873(-3.5348)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is $\Delta logC_t$
39 observations used for estimation from 1952 to 1990

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	.016903	.064409	.26244[.795]
U_{t-1}	-.82320	.23431	- 3.5133[.001]
$\Delta logC_{t-1}$	-.090452	.17025	-.53130[.599]
$\Delta log(X/Y)_{t-1}$	-.081367	.38813	-.20964[.835]
$\Delta logH_{t-1}$	.044057	.44004	.10012[.921]
$\Delta logK_{t-1}$	-.28698	.60195	-.47675[.637]

R-Squared	.46700	F-statistic F(5, 33)	5.7828[.001]
R-Bar-Squared	.38625	S.E. of Regression	.39640
Residual Sum of Squares	5.1854	Mean of Dependent Variable	.0090610
S.D. of Dependent Variable	.50599	Maximum of Log-likelihood	-15.9933
DW-statistic	2.0770		

LM: $\chi^2(1)$= 2.8053[.094], Norm: $\chi^2(1)$= 2.8308[.092], Norm: $\chi^2(2)$= 1655.5[.000], HD: $\chi^2(1)$=.027629[.868]

Model I

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.69249 .38850 .30067 .13381 .0095088

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	47.1703	33.4610	30.9000
r<= 1	r = 2	19.6736	27.0670	24.7340
r<= 2	r = 3	14.3051	20.9670	8.5980
r<= 3	r = 4	5.7460	14.0690	12.0710
r<= 4	r = 5	.38217	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.69249 .38850 .30067 .13381 .0095088

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	87.2771	68.5240	64.8430
r<= 1	r>= 2	40.1069	47.2100	43.9490
r<= 2	r>= 3	20.4332	29.6800	26.7850
r<= 3	r>= 4	6.1282	15.4100	13.3250
r<= 4	r = 5	.38217	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000)
$logX_t$	.88093
$logH_t$	2.9614
$logL_t$	.70708
$logK_t$	-.24759

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log PCI_t$	-.0088648
$\log X_t$	.015140
$\log H_t$	.50639
$\log L_t$	.51132
$\log K_t$	.8797E-3

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log PCI_t$	-1.0000
$\log X_t$	0.00
$\log H_t$	.64818
$\log L_t$	.035672
$\log K_t$	.011695

LR Test of Restrictions $\chi^2(1)=$ 10.0397[.002]

Model II

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logH_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.71135 .64388 .57323 .53442 .28597 .10613 .049867

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	29.8210	45.2770	42.3170
r<= 1	r = 2	24.7795	39.3720	36.7620
r<= 2	r = 3	20.4360	33.4610	30.9000
r<= 3	r = 4	18.3472	27.0670	24.7340
r<= 4	r = 5	8.0841	20.9670	18.5980
r<= 5	r = 6	2.6927	14.0690	12.0710
r<= 6	r = 7	1.2277	3.7620	2.6870

r is the number of cointegrating vectors

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logXf_t$ $logXm_t$ $logK_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.71135 .64388 .57323 .53442 .28597 .10613 .049867

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	125.3881	124.2430	118.5000
r<= 1	r>= 2	75.5671	94.1550	89.4830
r<= 2	r>= 3	50.7876	68.5240	64.8430
r<= 3	r>= 4	30.3516	47.2100	43.9490
r<= 4	r>= 5	12.0044	29.6800	26.7850
r<= 5	r>= 6	3.9203	15.4100	13.3250
r<= 6	r = 7	1.2277	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log PCI_t$	-1.0000
$\log Xp_t$	.22399
$\log Xf_t$	.0090833
$\log Xm_t$	.14232
$\log H_t$	.76446
$\log L_t$	.66653
$\log K_t$	.0097363

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log PCI_t$	.10203
$\log Xp_t$	.83636
$\log Xf_t$	.76540
$\log Xm_t$	.41441
$\log H_t$	-8.3249
$\log L_t$	8.2819
$\log K_t$	.38156

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log PCI_t$	-1.0000
$\log Xp_t$	0.00
$\log Xf_t$	-.084863
$\log Xm_t$	.26563
$\log H_t$	2.2013
$\log L_t$	2.0017
$\log K_t$	.011145

LR Test of Restrictions $\chi^2(1)= 2.7239[.099]$

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000
$logXp_t$	.24862
$logXf_t$	0.00
$logXm_t$	.17528
$logH_t$	.63870
$logL_t$	.54005
$logK_t$	.051744

LR Test of Restrictions $\chi^2(1)=$ .10972[.740]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$logPCI_t$	-1.0000
$logXp_t$	.15428
$logXf_t$	.031523
$logXm_t$	0.00
$logH_t$	1.2543
$logL_t$	1.1280
$logK_t$	.070843

LR Test of Restrictions $\chi^2(1)=$ .86466[.352]

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.63075 .43283 .20276 .040214

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	39.8514	27.0670	24.7340
r<= 1	r = 2	22.6835	20.9670	18.5980
r<= 2	r = 3	9.0640	14.0690	12.0710
r<= 3	r = 4	1.6418	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logC_t$ $\quad log(X/Y)_t$ $\quad logH_t$ $\quad logK_t$
List of eigenvalues in descending order:
.63075 .43283 .20276 .040214

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	73.2407	47.2100	43.9490
r<= 1	r>= 2*	33.3893	29.6800	26.7850
r<= 2	r>= 3	10.7058	15.4100	13.3250
r<= 3	r = 4	1.6418	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$logC_t$	-1.0000	-1.0000
$log(X/Y)_t$	.71366	.096722
$logH_t$	.90015	.61508
$logK_t$	-1.8094	1.2931

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log C_t$	.27272	.60591
$\log(X/Y)_t$	-.48089	.41297
$\log H_t$	-.47272	.40156
$\log K_t$	.022646	.032832

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log C_t$	-1.0000	-1.0000
$\log(X/Y)_t$	0.00	0.00
$\log H_t$	2.2507	.37821
$\log K_t$	-2.6071	1.1192
LR Test of Restrictions	$\chi^2(2)$= 8.1863[.017]	

Saudi Arabia

Unit Root Tests

Unit root tests for variable $logK_t$

statistic	sample	observations	without trend	with trend
DF	1961 1989	29	-.30040(-2.9665)	-1.8243(-3.5731)
ADF(1)	1962 1989	28	-.75834(-2.9706)	-2.3278(-3.5796)
ADF(2)	1963 1989	27	-.82078(-2.9750)	-2.9796(-3.5867)

95% critical values in brackets.

Unit root tests for variable $logX_t$

statistic	sample	observations	without trend	with trend
DF	1954 1991	38	-.89196(-2.9400)	-1.1339(-3.5313)
ADF(1)	1955 1991	37	-.95053(-2.9422)	-1.4731(-3.5348)
ADF(2)	1956 1991	36	-1.0178(-2.9446)	-1.7838(-3.5386)

95% critical values in brackets.

Unit root tests for variable $logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1961 1989	29	-2.2758(-2.9665)	.12489(-3.5731)
ADF(1)	1962 1989	28	-1.7892(-2.9706)	-.62816(-3.5796)
ADF(2)	1963 1989	27	-2.2132(-2.9750)	-.86872(-3.5867)

95% critical values in brackets.

Unit root tests for variable $logXp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-2.1229(-2.9798)	-2.3414(-3.5943)
ADF(1)	1968 1992	25	-2.1958(-2.9850)	-2.4726(-3.6027)
ADF(2)	1969 1992	24	-2.4882(-2.9907)	-2.3973(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXf_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-2.3137(-2.9798)	-2.4800(-3.5943)
ADF(1)	1968 1992	25	-2.3617(-2.9850)	-2.4584(-3.6027)
ADF(2)	1969 1992	24	-2.3097(-2.9907)	-2.1019(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logH_t$

statistic	sample	observations	without trend	with trend
DF	1961 1989	29	2.4559(-2.9665)	-2.9616(-3.5731)
ADF(1)	1962 1989	28	-2.6858(-2.9706)	-2.5065(-3.5796)
ADF(2)	1963 1989	27	-2.8753(-2.9750)	-2.6839(-3.5867)

95% critical values in brackets.

Unit root tests for variable $logL_t$

statistic	sample	observations	without trend	with trend
DF	1961 1989	29	-2.0753(-2.9665)	-.97482(-3.5731)
ADF(1)	1962 1989	28	-2.1972(-2.9706)	-1.0700(-3.5796)
ADF(2)	1963 1989	27	-2.0006(-2.9750)	-.83859(-3.5867)

95% critical values in brackets.

Unit root tests for variable $logC_t$

statistic	sample	observations	without trend	with trend
DF	1961 1989	29	-1.1661(-2.9665)	.29425(-3.5731)
ADF(1)	1962 1989	28	-1.2940(-2.9706)	-.40331(-3.5796)
ADF(2)	1963 1989	27	-1.9258(-2.9750)	-.90264(-3.5867)

95% critical values in brackets.

Unit root tests for variable $log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1961 1989	29	-1.1338(-2.9665)	-1.1385(-3.5731)
ADF(1)	1962 1989	28	-1.2582(-2.9706)	-1.2847(-3.5796)
ADF(2)	1963 1989	27	-1.3324(-2.9750)	-1.4639(-3.5867)

95% critical values in brackets.

Unit root tests for variable $\Delta logK_t$

statistic	sample	observations	without trend	with trend
DF	1962 1989	28	-3.6421(-2.9706)	-3.5765(-3.5796)
ADF(1)	1963 1989	27	-2.5929(-2.9750)	-2.5531(-3.5867)
ADF(2)	1964 1989	26	-2.7242(-2.9798)	-2.6340(-3.5943)

95% critical values in brackets.

Unit root tests for variable $\Delta logX_t$

statistic	sample	observations	without trend	with trend
DF	1955 1991	37	-4.8605(-2.9422)	-4.8141(-3.5348)
ADF(1)	1956 1991	36	-3.2283(-2.9446)	-3.2021(-3.5386)
ADF(2)	1957 1991	35	-2.4059(-2.9472)	-2.4071(-3.5426)

95% critical values in brackets.

Unit root tests for variable $\Delta logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1962 1989	28	-2.4802(-2.9706)	-3.3760(-3.5796)
ADF(1)	1963 1989	27	-1.8290(-2.9750)	-3.0783(-3.5867)
ADF(2)	1964 1989	26	-1.5911(-2.9798)	-2.5177(-3.5943)

95% critical values in brackets.

Unit root tests for variable $\Delta logXp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-4.9938(-2.9850)	-4.9247(-3.6027)
ADF(1)	1969 1992	24	-4.0863(-2.9907)	-4.1602(-3.6119)
ADF(2)	1970 1992	23	-2.8274(-2.9970)	-2.9968(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXf_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-5.3943(-2.9850)	-5.3761(-3.6027)
ADF(1)	1969 1992	24	-4.4798(-2.9907)	-4.5863(-3.6119)
ADF(2)	1970 1992	23	-3.1449(-2.9970)	-3.3568(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta \log H_t$

statistic	sample	observations	without trend	with trend
DF	1962 1989	28	-.90823(-2.9706)	.70442(-3.5796)
ADF(1)	1963 1989	27	-1.1444(-2.9750)	1.2487(-3.5867)
ADF(2)	1964 1989	26	-1.3440(-2.9798)	.68341(-3.5943)

95% critical values in brackets.

Unit root tests for variable $\Delta \log L_t$

statistic	sample	observations	without trend	with trend
DF	1962 1989	28	-4.7827(-2.9706)	-5.3869(-3.5796)
ADF(1)	1963 1989	27	-3.4191(-2.9750)	-4.0021(-3.5867)
ADF(2)	1964 1989	26	-2.2999(-2.9798)	-2.8363(-3.5943)

95% critical values in brackets.

Unit root tests for variable $\Delta \log C_t$

statistic	sample	observations	without trend	with trend
DF	1962 1989	28	-2.7089(-2.9706)	-3.4712(-3.5796)
ADF(1)	1963 1989	27	-1.7613(-2.9750)	-2.7877(-3.5867)
ADF(2)	1964 1989	26	-1.6520(-2.9798)	-2.5082(-3.5943)

95% critical values in brackets.

Unit root tests for variable $\Delta \log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1962 1989	28	-4.6643(-2.9706)	-4.6479(-3.5796)
ADF(1)	1963 1989	27	-3.0784(-2.9750)	-3.1002(-3.5867)
ADF(2)	1964 1989	26	-2.3157(-2.9798)	-2.3911(-3.5943)

95% critical values in brackets.

Model I

EG Cointegration Test:- Unit root tests for variable V_t

statistic	sample	observations	without trend	with trend
DF	1962 1989	28	-6.2504(-2.9706)	-6.2826(-3.5796)
ADF(1)	1963 1989	27	-4.7864(-2.9750)	-4.9988(-3.5867)
ADF(2)	1964 1989	26	-3.1279(-2.9798)	-3.3060(-3.5943)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
28 observations used for estimation from 1962 to 1989

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	.069879	.067156	1.0406[.310]
V_{t-1}	-.13135	.20437	-.64268[.527]
$\Delta logPCI_{t-1}$	.63841	.24758	2.5786[.018]
$\Delta logX_{t-1}$	-.043988	.055562	-.79170[.437]
$\Delta logH_{t-1}$	-1.6690	1.4522	-1.1493[.263]
$\Delta logL_{t-1}$	.20725	.19417	1.0674[.298]
$\Delta logK_{t-1}$	.025530	.062797	.40655[.688]

R-Squared .52294 F-statistic F(6, 21) 3.8366[.010]
R-Bar-Squared .38664 S.E. of Regression .072079
Residual Sum of Squares .10910 Mean of Dependent Variable .017188
S.D. of Dependent Variable .092035 Maximum of Log-likelihood 37.9369
DW-statistic 2.1727
LM: χ^2 (1)= 10.3746[.001), RESET: χ^2(1)= .035495[.851], Norm: χ^2(2)= 5.7751[.056], HD: χ^2(1)= .39857[.528] .37544[.545]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1968 1989	22	-5.3226(-3.0039)	-5.2825(-3.6331)
ADF(1)	1969 1989	21	-3.7564(-3.0115)	-3.7902(-3.6454)
ADF(2)	1970 1989	20	-3.2008(-3.0199)	-3.2530(-3.6592)

95% critical values in brackets.

ECM Model II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
22 observations used for estimation from 1968 to 1989

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{01}	.052652	.085296	.61728[.547]
v_{t-1}	-.41094	.15482	-2.6543[.019]
$\Delta logPCI_{t-1}$	.71538	.17508	4.0861[.001]
$\Delta logXp_{t-1}$	-.051712	.032616	-1.5855[.135]
$\Delta logXf_{t-1}$	.041129	.031440	1.3082[.212]
$\Delta logH_{t-1}$	-.79686	1.7910	-.44493[.663]
$\Delta logL_{t-1}$	-.093928	.20164	-.46582[.649]
$\Delta logK_{t-1}$	-.048361	.068309	-.70797[.491]

R-Squared	.68337	F-statistic F(7, 14)	4.3165[.010]
R-Bar-Squared	.52505	S.E. of Regression	.066483
Residual Sum of Squares	.061880	Mean of Dependent Variable	.0018253
S.D. of Dependent Variable	.096469	Maximum of Log-likelihood	33.3930
DW-statistic	2.4908	Durbin's h-statistic	-1.6742[.094]

LM: $\chi^2(1)$= 3.1504[.076], RESET:$\chi^2(1)$= 1.1887[.276], Norm: $\chi^2(2)$= 2.1590[.340], HD:χ^2 (1)= .090501[.764]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1962 1989	28	-6.3860(-2.9706)	-6.5869(-3.5796)
ADF(1)	1963 1989	27	-4.4146(-2.9750)	-4.7641(-3.5867)
ADF(2)	1964 1989	26	-3.0048(-2.9798)	-3.4015(-3.5943)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is $\Delta logC_t$
28 observations used for estimation from 1962 to 1989

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	-.020601	.021816	-.94431[.355]
U_{t-1}	.10583	.13043	.81142[.426]
$\Delta logC_{t-1}$	.48839	.21914	2.2286[.036]
$\Delta log(X/Y)_{t-1}$	.019690	.063885	.30821[.761]
$\Delta logH_{t-1}$	.23428	.20322	1.1528[.261]
ΔK_{t-1}	-.0037955	.067927	-.055877[.956]

R-Squared	.38425	F-statistic F(5, 22)	2.7458[.045]
R-Bar-Squared	.24431	S.E. of Regression	.081484
Residual Sum of Squares	.14607	Mean of Dependent Variable	.0010588
S.D. of Dependent Variable	.093735	Maximum of Log-likelihood	33.8517
DW-statistic	2.1866	Durbin's h-statistic	-.68228[.495]

LM: $\chi^2(1)$= .90790[.341], RESET: $\chi^2(1)$= .28643[.593], Norm:$\chi^2(2)$= 31.4261[.000],
HD: χ^2 (1)= .32704[.567]

Model I

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

29 observations from 1961 to 1989. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCi_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.88540 .74587 .36064 .30314 .11907

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	62.8222	33.4610	30.9000
r<= 1	r = 2*	39.7272	27.0670	24.7340
r<= 2	r = 3	12.9713	20.9670	18.5980
r<= 3	r = 4	10.4740	14.0690	12.0710
r<= 4	r = 5**	3.6764	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90 % critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

29 observations from 1961 to 1989. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.88540 .74587 .36064 .30314 .11907

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	129.6710	68.5240	64.8430
r<= 1	r>= 2 *	66.8488	47.2100	43.9490
r<= 2	r>= 3**	27.1217	29.6800	26.7850
r<= 3	r>= 4**	14.1503	15.4100	13.3250
r<= 4	r = 5*	3.6764	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

29 observations from 1961 to 1989. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logX_t$	-.92188	.19174	1.9225	.22458
$logH_t$	4.6802	-1.6939	10.3871	-1.1007
$logL_t$	-2.2842	1.1560	-6.1291	.56674
$logK_t$	.24079	-.21202	-3.3421	.035021

Estimated Adjustment Matrix in Johansen Estimation (Normalised in Brackets)

29 observations from 1961 to 1989. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	.016305	.27507	-.027628	-.10971
$logX_t$	-.0034890	.72298	-.096105	-1.3001
$logH_t$	-.0064192	-.0053573	-.6261E-3	-.012264
$logL_t$	.013161	.065851	.018383	-.33252
$logK_t$	-.069474	.41271	.093908	.34186

Restricted Cointegrated Vectors in Johansen Estimation (Normalised in Brackets)

29 observations from 1961 to 1989. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logX_t$	0.00	0.00	0.00	0.00
$logH_t$	.63910	-3.7787	-2.6250	-.69226
$logL_t$	.26008	2.6727	1.4404	1.2666
$logK_t$	-.12719	-.13961	.49218	-.14036

LR Test of Restrictions $\chi^2(4)$= 14.6299[.006]

Model II

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

23 observations from 1967 to 1989. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logH_t$ $logL_t$
$logK_t$
List of eigenvalues in descending order:
.94624 .90743 .75946 .57556 .27522 .10983

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	67.2330	39.3720	36.7620
r<= 1	r = 2*	54.7362	33.4610	30.9000
r<= 2	r = 3*	32.7718	27.0670	24.7340
r<= 3	r = 4**	19.7105	20.9670	18.5980
r<= 4	r = 5	7.4034	14.0690	12.0710
r<= 5	r = 6**	2.6758	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

23 observations from 1967 to 1989. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logH_t$ $logL_t$
$logK_t$
List of eigenvalues in descending order:
.94624 .90743 .75946 .57556 .27522 .10983

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	184.5308	94.1550	89.4830
r<= 1	r>= 2*	117.2977	68.5240	64.8430
r<= 2	r>= 3*	62.5615	47.2100	43.9490
r<= 3	r>= 4*	29.7897	29.6800	26.7850
r<= 4	r>= 5	10.0793	15.4100	13.3250
r<= 5	r = 6	2.6758	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	-.12595	1.5388	1.1326	-.18751
$logXf_t$	.36314	-1.7024	1.2076	.081647
$logH_t$	-1.3688	7.2789	-1.2687	-2.0844
$logL_t$	2.4437	-6.1140	.78277	.78942
$logK_t$	-.33271	-.45843	.7673	.31205

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	-1.0000
$logXp_t$	.28580
$logXf_t$	-.22623
$logH_t$	-2.3124
$logL_t$	1.4939
$logK_t$	.42089

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	.10441	.0050185	-.069129	.18397
$logXp_t$	-2.6169	.24802	.19514	2.8983
$logXf_t$	-3.1422	.38353	-.21474	1.9090
$logH_t$	-.0087629	-.0071620	-.0043256	-.014997
$logL_t$	.068807	.023018	-.033927	-.079017
$logK_t$	-.033132	-.10075	-.097133	.24221

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	.052205
$logXp_t$	-.93693
$logXf_t$	-.87059
$logH_t$	.0011725
$logL_t$	-.12260
$logK_t$	-.32028

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	0.00	0.00	0.00	0.00
$logXf_t$	.22302	-.13589	-.19206	.021196
$logH_t$	-.8794)	2.8848	-1.8178	-2.3182
$logL_t$	2.0228	-3.1464	.24594	1.4628
$logK_t$	-.36993	.32449	.18963	.39855

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	-1.0000
$logXp_t$	0.00
$logXf_t$	-.080123
$logH_t$	.73227
$logL_t$	1.4714
$logK_t$	-.63757

LR Test of Restrictions	$\chi^2(5)$= 35.1273[.000]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
loPCI_t	-1.0000	-1.0000	-1.0000)	-1.0000
logXp_t	.18673	-.27593	-.13560	.053172
logXf_t	0.00	0.00	0.00	0.00
logH_t	-.078104	4.9754	-2.0132	-2.3007
logL_t	1.2515	-5.8545	.59749	1.6286
logK_t	-.40398	.86710	.29084	.37868

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	-1.0000
$logXp_t$	-.074337
$logXf_t$	0.00
$logH_t$	.90914
$logL_t$	1.6022
$logK_t$	-.72354

LR Test of Restrictions $\chi^2(5)$= 43.0252[.000]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPC_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	.11044	.20710	-29.6030	125.484
$logX_t$	.11899	-.35236	34.1053	-93.6222
$logXH_t$	0.00	0.00	0.00	0.00
$logL_t$	1.4745	-1.1258	17.5193	85.1308
$logK_t$	-.47720	.39052	10.3942	26.5615

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	-1.0000
$logXp_t$	.15475
$logXf_t$	-.19424
$logH_t$	0.00
$logL_t$	1.4531
$logK_t$	-.37575

LR Test of Restrictions	$\chi^2(5)$= 29.7539[.000]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
PCI_t	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	.37596	-.69376	.19942	-212.1957
$logXf_t$	-.22791	.66676	-.36242	182.2531
$logH_t$	1.3455	-.88081	-1.4707	-160.6558
$logL_t$	0.00	0.00	0.00	0.00
$logK_t$	-.45683	.72576	.37077	-26.5033

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	-1.0000
$logXp_t$	.41693
$logXf_t$	-1.3027
$logXm_t$	23.1541
$logL_t$	0.00
$logK_t$	-7.5394

LR Test of Restrictions $\chi^2(5)$= 46.6388[.000]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	-.53120	.11828	.56743	-2.1309
$logXf_t$	.75751	-.067817	-.66646	1.4449
$logH_t$	-3.3944	.074941	-2.3673	-.62534
$logL_t$	3.6401	.090168	1.0601	-1.4918
$logK_t$	0.00	0.00	0.00	0.00

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1967 to 1989. Maximum lag in VAR = 1, chosen r = 5.

	Vector 5
$logPCI_t$	-1.0000
$logXp_t$	.14662
$logXf_t$	-.16063
$logH_t$	-1.0525
$logL_t$	1.3842
$logK_t$	0.00

LR Test of Restrictions $\chi^2(5)$= 27.0962[.000]

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

29 observations from 1961 to 1989. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logC_t$ $log(X/Y)_t$ $logH_t$ $logK_t$
List of eigenvalues in descending order:
.72142 .43075 .24704 .8434E-3

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	37.0637	27.0670	24.7340
r<= 1	r = 2	16.3397	20.9670	18.5980
r<= 2	r = 3	8.2287	14.0690	12.0710
r<= 3	r = 4	.024468	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

29 observations from 1961 to 1989. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.72142 .43075 .24704 .8434E-3

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	61.6566	47.2100	43.9490
r<= 1	r>= 2	24.5928	29.6800	26.7850
r<= 2	r>= 3	8.2532	15.4100	13.3250
r<= 3	r = 4	.024468	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

29 observations from 1961 to 1989. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	.95059
$\log H_t$	.51876
$\log K_t$	-1.4766

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

29 observations from 1961 to 1989. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log C_t$	.071683
$\log(X/Y)_t$	.11843
$\log H_t$	.035920
$\log K_t$	.19448

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

29 observations from 1961 to 1989. Maximum lag in VAR = 1, chosen r = 1.

	Vector 1
$\log C_t$	-1.0000
$\log(X/Y)_t$	0.00
$\log H_t$	-1.3578
$\log K_t$	2.4409

LR Test of Restrictions $\chi^2(1)$= 6.5268[.011]

Singapore

Unit Root Tests

Unit root tests for variable $logK_t$

statistic	sample	observations	without trend	with trend
DF	1961 1992	32	-13.5432(-2.9558)	-14.0116(-3.5562)
ADF(1)	1962 1992	31	-2.8640(-2.9591)	-2.1649(-3.5615)
ADF(2)	1963 1992	30	-2.3199(-2.9627)	-2.0050(-3.5671)

95% critical values in brackets.

Unit root tests for variable $logX_t$

statistic	sample	observations	without trend	with trend
DF	1951 1993	43	.42103(-2.9303)	-2.1244(-3.5162)
ADF(1)	1952 1993	42	1.1136(-2.9320)	-3.3513(-3.5189)
ADF(2)	1953 1993	41	.80783(-2.9339)	-2.3187(-3.5217)

95% critical values in brackets.

Unit root tests for variable $logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1961 1992	32	-.79904(-2.9558)	-.74158(-3.5562)
ADF(1)	1962 1992	31	-.87546(-2.9591)	-1.3366(-3.5615)
ADF(2)	1963 1992	30	-1.1061(-2.9627)	-1.8590(-3.5671)

95% critical values in brackets.

Unit root tests for variable $logXp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.2614(-2.9798)	-1.5944(-3.5943)
ADF(1)	1968 1992	25	-1.4070(-2.9850)	-1.9541(-3.6027)
ADF(2)	1969 1992	24	-1.5522(-2.9907)	-.95486(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXf_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.6195(-2.9798)	-.98204(-3.5943)
ADF(1)	1968 1992	25	-1.5965(-2.9850)	-1.2461(-3.6027)
ADF(2)	1969 1992	24	-1.6002(-2.9907)	-1.0918(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXm_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-.71397(-2.9798)	-1.0867(-3.5943)
ADF(1)	1968 1992	25	-1.4875(-2.9850)	-2.2202(-3.6027)
ADF(2)	1969 1992	24	-1.5498(-2.9907)	-1.6333(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logH_t$

statistic	sample	observations	without trend	with trend
DF	1961 1990	30	-.69043(-2.9627)	-1.1872(-3.5671)
ADF(1)	1962 1990	29	-.51302(-2.9665)	-1.6980(-3.5731)
ADF(2)	1963 1990	28	-.45474(-2.9706)	-2.1062(-3.5796)

95% critical values in brackets.

Unit root tests for variable $logL_t$

statistic	sample	observations	without trend	with trend
DF	1961 1991	31	1.3719(-2.9591)	-2.7691(-3.5615)
ADF(1)	1962 1991	30	.39014(-2.9627)	-2.6027(-3.5671)
ADF(2)	1963 1991	29	.074891(-2.9665)	-2.8059(-3.5731)

95% critical values in brackets.

Unit root tests for variable $\log C_t$

statistic	sample	observations	without trend	with trend
DF	1961 1990	30	-.22554(-2.9627)	-1.3585(-3.5671)
ADF(1)	1962 1990	29	-.39982(-2.9665)	-2.3300(-3.5731)
ADF(2)	1963 1990	28	-.76577(-2.9706)	-2.9913(-3.5796)

95% critical values in brackets.

Unit root tests for variable $\log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1961 1992	32	-3.4514(-2.9558)	-3.2071(-3.5562)
ADF(1)	1962 1992	31	-2.8782(-2.9591)	-2.5120(-3.5615)
ADF(2)	1963 1992	30	-3.0062(-2.9627)	-2.7270(-3.5671)

95% critical values in brackets.

Unit root tests for variable $\Delta\log K_t$

statistic	sample	observations	without trend	with trend
DF	1962 1992	31	-24.6107(-2.9591)	-24.1435(-3.5615)
ADF(1)	1963 1992	30	-4.3648(-2.9627)	-4.4138(-3.5671)
ADF(2)	1964 1992	29	-2.8308(-2.9665)	-2.9434(-3.5731)

95% critical values in brackets.

Unit root tests for variable $\Delta\log X_t$

statistic	sample	observations	without trend	with trend
DF	1952 1993	42	-7.6271(-2.9320)	-8.3309(-3.5189)
ADF(1)	1953 1993	41	-4.8575(-2.9339)	-5.2003(-3.5217)
ADF(2)	1954 1993	40	-4.0736(-2.9358)	-4.2007(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta\log PCI_t$

statistic	sample	observations	without trend	with trend
DF	1962 1992	31	-3.5571(-2.9591)	-3.5675(-3.5615)
ADF(1)	1963 1992	30	-2.2405(-2.9627)	-2.3039(-3.5671)
ADF(2)	1964 1992	29	-2.3283(-2.9665)	-2.4032(-3.5731)

95% critical values in brackets.

Unit root tests for variable $\Delta logXp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-4.3132(-2.9850)	-4.3651(-3.6027)
ADF(1)	1969 1992	24	-5.0686(-2.9907)	-5.3153(-3.6119)
ADF(2)	1970 1992	23	-2.9619(-2.9970)	-3.1039(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXf_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-3.7961(-2.9850)	-3.9940(-3.6027)
ADF(1)	1969 1992	24	-3.0655(-2.9907)	-3.3238(-3.6119)
ADF(2)	1970 1992	23	-2.3122(-2.9970)	-2.6925(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXm_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-3.0665(-2.9850)	-3.1647(-3.6027)
ADF(1)	1969 1992	24	-3.3605(-2.9907)	-3.5779(-3.6119)
ADF(2)	1970 1992	23	-2.6325(-2.9970)	-2.9948(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logH_t$

statistic	sample	observations	without trend	with trend
DF	1962 1990	29	-4.0560(-2.9665)	-3.9967(-3.5731)
ADF(1)	1963 1990	28	-2.7124(-2.9706)	-2.6666(-3.5796)
ADF(2)	1964 1990	27	-2.1851(-2.9750)	-2.1476(-3.5867)

95% critical values in brackets.

Unit root tests for variable $\Delta logL_t$

statistic	sample	observations	without trend	with trend
DF	1962 1991	30	-3.2410(-2.9627)	-4.1990(-3.5671)
ADF(1)	1963 1991	29	-2.2237(-2.9665)	-2.9103(-3.5731)
ADF(2)	1964 1991	28	-2.3010(-2.9706)	-2.7141(-3.5796)

95% critical values in brackets.

Unit root tests for variable $\Delta logC_t$

statistic	sample	observations	without trend	with trend
DF	1962 1990	29	-3.2250(-2.9665)	-3.1667(-3.5731)
ADF(1)	1963 1990	28	-2.2414(-2.9706)	-2.1972(-3.5796)
ADF(2)	1964 1990	27	-3.0055(-2.9750)	-2.9475(-3.5867)

95% critical values in brackets.

Unit root tests for variable $\Delta log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1962 1992	31	-7.5059(-2.9591)	-7.6505(-3.5615)
ADF(1)	1963 1992	30	-4.0758(-2.9627)	-4.2026(-3.5671)
ADF(2)	1964 1992	29	-2.5672(-2.9665)	-2.6157(-3.5731)

95% critical values in brackets.

EG Cointegration Test:- Unit root tests for variable ΔV_t

statistic	sample	observations	without trend	with trend
DF	1962 1990	29	-7.1052(-2.9665)	-7.0032(-3.5731)
ADF(1)	1963 1990	28	-3.6493(-2.9706)	-3.5902(-3.5796)
ADF(2)	1964 1990	27	-2.5813(-2.9750)	-2.5168(-3.5867)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
30 observations used for estimation from 1962 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	.049615	.023773	2.0871[.048]
V_{t-1}	-.099876	.10094	-.98950[.333]
$\Delta logPCI_{t-1}$	.31898	.20713	1.5400[.137]
$\Delta logX_{t-1}$	.059762	.072317	.82638[.417]
$\Delta logH_{t-1}$	-.45130	.55109	-.81893[.421]
$\Delta logL_{t-1}$	-.35265	.38244	-.92210[.366]
$\Delta logK_{t-1}$	.0070972	.019597	.36216[.721]

R-Squared	.26699	F-statistic F(6, 23)	1.3962[.258]
R-Bar-Squared	.075765	S.E. of Regression	.046203
Residual Sum of Squares	.049099	Mean of Dependent Variable	.065003
S.D. of Dependent Variable	.048060	Maximum of Log-likelihood	53.6585
DW-statistic	2.1547	Durbin's h-statistic	-.50853[.611]

LM: $\chi^2(1)$= 1.4440[.229], RESET: $\chi^2(1)$= .68267[.409], Norm: $\chi^2(2)$= 5.6754[.059], HD: $\chi^2(1)$= .066673[.796]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1968 1990	23	-5.6149(-2.9970)	-5.5270(-3.6219)
ADF(1)	1969 1990	22	-3.5757(-3.0039)	-3.4423(-3.6331)
ADF(2)	1970 1990	21	-3.7661(-3.0115)	-3.6352(-3.6454)

95% critical values in brackets.

ECM Model II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
24 observations used for estimation from 1968 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{01}	.030182	.028913	1.0439[.313]
v_{t-1}	-.053198	.20769	-.25614[.801]
$\Delta logPCI_{t-1}$	.34219	.28939	1.1825[.255]
$\Delta logXp_{t-1}$	-.096324	.072151	-1.3350[.202]
$\Delta logXf_{t-1}$	-.030664	.048499	-.63226[.537]
$\Delta logXm_{t-1}$	.090636	.083139	1.0902[.293]
$\Delta logH_{t-1}$	.30793	.68432	.44998[.659]
$\Delta logL_{t-1}$	.047970	.61196	.078388[.939]
$\Delta logK_{t-1}$	.20649	.095820	2.1550[.048]

R-Squared	.41253	F-statistic F(8, 15)	1.3167[.307]
R-Bar-Squared	.099213	S.E. of Regression	.043322
Residual Sum of Squares	.028151	Mean of Dependent Variable	.071589
S.D. of Dependent Variable	.045645	Maximum of Log-likelihood	46.9240
DW-statistic	1.9214		

LM: $\chi^2(1)$= .28129[.596], RESET: $\chi^2(1)$= 3.9608[.047], Norm: $\chi^2(2)$= 1.0389[.595], HD: $\chi^2(1)$= .15369[.695]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1962 1990	29	-7.7019(-2.9665)	-7.4745(-3.5731)
ADF(1)	1963 1990	28	-4.7618(-2.9706)	-4.7622(-3.5796)
ADF(2)	1964 1990	27	-2.6592(-2.9750)	-2.7926(-3.5867)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is $\Delta \log C_t$
29 observations used for estimation from 1962 to 1990

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	.013219	.011434	1.1561[.260]
U_{t-1}	-.11709	.061686	-1.8982[.070]
$\Delta \log C_{t-1}$	.65287	.18345	3.5588[.002]
$\Delta \log(X/Y)_{t-1}$	.16122	.061315	2.6294[.015]
$\Delta \log H_{t-1}$	-.51164	.31383	-1.6303[.117]
ΔK_{t-1}	-.010850	.017860	-.60749[.549]

R-Squared	.44924	F-statistic F(5, 23)	3.7521[.012]
R-Bar-Squared	.32951	S.E. of Regression	.042925
Residual Sum of Squares	.042379	Mean of Dependent Variable	.039000
S.D. of Dependent Variable	.052422	Maximum of Log-likelihood	53.5124
DW-statistic	2.2655	Durbin's h-statistic	-.75779[.449]

LM: $\chi^2(1)$= 1.3198[.251], RESET: (1)= .81026[.368], Norm: $\chi^2(2)$= 4.4555[.108], HD: $\chi^2(1)$= .34717[.556]

Model I

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

30 observations from 1961 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.97151 .68505 .53641 .23802 .10737

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	106.7479	33.4610	30.9000
r<= 1	r = 2 *	34.6600	27.0670	24.7340
r<= 2	r = 3*	23.0630	20.9670	18.5980
r<= 3	r = 4	8.1551	14.0690	12.0710
r<= 4	r = 5**	3.4076	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

30 observations from 1961 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.97151 .68505 .53641 .23802 .10737

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	176.0335	68.5240	64.8430
r<= 1	r>= 2*	69.2856	47.2100	43.9490
r<= 2	r>= 3*	34.6256	29.6800	26.7850
r<= 3	r>= 4	11.5627	15.4100	13.3250
r<= 4	r = 5 **	3.4076	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

30 observations from 1961 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logX_t$	-6.4452	.90126	2.0129
$logH_t$	-2.5910	-5.6327	1.0448
$logL_t$	-35.5458	-6.8109	5.0212
$logK_t$	11.5282	.97303	.064734

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

30 observations from 1961 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	.6738E-3	-.2562E-3	.050618
$logX_t$	.0039464	-.053755	-.088412
$logH_t$	-.8242E-3	-.0013190	.016106
$logL_t$	-.9148E-3	.030051	-.020514
$logK_t$	-.082801	.030237	-.16574

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

30 observations from 1961 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logX_t$	0.00	0.00	0.00
$logH_t$	-.78069	-15.3471	1.8817
$logL_t$	-4.5107	-23.8705	-2.2337
$logK_t$	1.8999	2.7072	.062447

LR Test of Restrictions $\chi^2(3)$= 17.3775[.001]

Model II

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logH_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.95367 .90507 .71316 .56631 .43686 .31075 .0023367

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	73.7295	45.2770	42.3170
r<= 1	r = 2*	56.5106	39.3720	36.7620
r<= 2	r = 3	29.9716	33.4610	30.9000
r<= 3	r = 4	20.0502	27.0670	24.7340
r<= 4	r = 5	13.7813	20.9670	18.5980
r<= 5	r = 6	8.9316	14.0690	12.0710
r<= 6	r = 7	.056146	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logH_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.95367 .90507 .71316 .56631 .43686 .31075 .0023367

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1**	203.0309	124.2430	118.5000
r<= 1	r>= 2*	129.3014	94.1550	89.4830
r<= 2	r>= 3*	72.7908	68.5240	64.8430
r<= 3	r>= 4	42.8192	47.2100	43.9490
r<= 4	r>= 5	22.7690	29.6800	26.7850
r<= 5	r>= 6	8.9877	15.4100	13.3250
r<= 6	r = 7	.056146	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logXp_t$	-.46423	.24857	-.46866
$logXf_t$	.40150	-.16922	.52440
$logXm_t$	-.19697	.56630	.36820
$logH_t$	-.86174	-4.5815	.52249
$logL_t$	-6.3781	-4.0297	1.3142
$logK_t$	1.1946	.76376	-.56050

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	.053843	.16046	-.064647
$logXp_t$	-.29598	-.20016	.073862
$logXf_t$	-.72553	.48581	-.37292
$logXm_t$	-.25321	-.058387	-.48843
$logH_t$	-.065769	-.012563	.058537
$logL_t$	.074975	.069338	-.054308
$logK_t$	.033710	.16206	-.053405

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logXp_t$	0.00	0.00	0.00
$logXf_t$	.13036	-.12635	.78274
$logXm_t$	-.021725	.82628	-.091150
$logH_t$	-2.3829	-4.6768	1.2725
$logL_t$	-6.2277	-2.4030	3.7033
$logK_t$	1.1718	.45554	-1.5788

LR Test of Restrictions $\chi^2(3)$= 15.4843[.001]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$\log PCI_t$	-1.0000	-1.0000	-1.0000
$\log Xp_t$	-.0065577	.15874	-1.7481
$\log Xf_t$	0.00	0.00	0.00
$\log Xm_t$	.16480	.84804	1.7774
$\log H_t$	-2.7131	-5.4388	-11.9505
$\log L_t$	-5.7156	-1.4809	-12.8287
$\log K_t$	1.1586	.056968	5.6089

LR Test of Restrictions $\chi^2(3)$= 26.0113[.000]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logXp_t$	-.33718	-5.4774	.056679
$logXf_t$	.27783	2.7513	.97095
$logXm_t$	0.00	0.00	0.00
$logH_t$	-1.5442	23.4744	-1.1999
$logL_t$	-5.5061	21.4567	3.0752
$logK_t$	1.0494	-2.8999	-2.1234

LR Test of Restrictions $\chi^2(3)$= 17.6479[.001]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logXp_t$	-.33712	-5.4774	.056679
$logXf_t$	.27783	2.7513	.97095
$logXm_t$	0.00	0.00	0.00
$logH_t$	-1.5442	23.4744	-1.1999
$logL_t$	-5.5061	21.4567	3.0752
$logK_t$	1.0494	-2.8999	-2.1234

LR Test of Restrictions $\chi^2(3)$= 17.6479[.001]

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

30 observations from 1961 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logC_t$ $log(X/Y)_t$ $logH_t$ $logK_t$
List of eigenvalues in descending order:
.95572 .52150 .35329 .038330

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	93.5189	27.0670	24.7340
r<= 1	r = 2**	22.1129	20.9670	18.5980
r<= 2	r = 3	13.0756	14.0690	12.0710
r<= 3	r = 4	1.1725	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

30 observations from 1961 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logC_t$ $log(X/Y)_t$ $logH_t$ $logK_t$
List of eigenvalues in descending order:
.95572 .52150 .35329 .038330

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	129.8799	47.2100	43.9490
r<= 1	r>= 2*	36.3611	29.6800	26.7850
r<= 2	r>= 3**	14.2482	15.4100	13.3250
r<= 3	r = 4	1.1725	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

30 observations from 1961 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$\log C_t$	-1.0000	-1.0000	-1.0000
$\log(X/Y)_t$	-.053362	.57727	-2.1643
$\log H_t$	-1.7579	1.6093	-2.576
$\log K_t$	1.1380	.28576	-.069459

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

30 observations from 1961 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$\log C_t$	.0077034	.0010756	-.037921
$\log(X/Y)_t$	.029043	-.14434	.23890
$\log H_t$	-.010836	.076833	.013300
$\log K_t$	-.77021	.10190	.010704

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

30 observations from 1961 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$\log C_t$	-1.0000	-1.0000	-1.0000
$\log(X/Y)_t$	0.00	0.00	0.00
$\log H_t$	-1.7461	-1.7747	-7.1760
$\log K_t$	1.1551	.20995	.29910

LR Test of Restrictions $\chi^2(3)$= 12.3688[.006]

Panama

Unit Root Tests

Unit root tests for variable $logK_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-2.7733(-2.9320)	-2.7455(-3.5189)
ADF(1)	1952 1992	41	-2.6969(-2.9339)	-2.6929(-3.5217)
ADF(2)	1953 1992	40	-2.2533(-2.9358)	-2.2954(-3.5247)

95% critical values in brackets.

Unit root tests for variable $logX_t$

statistic	sample	observations	without trend	with trend
DF	1951 1993	43	-1.0634(-2.9303)	-1.4615(-3.5162)
ADF(1)	1952 1993	42	-.96323(-2.9320)	-1.5831(-3.5189)
ADF(2)	1953 1993	41	-1.2153(-2.9339)	-1.3575(-3.5217)

95% critical values in brackets.

Unit root tests for variable $logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-1.2935(-2.9320)	-.83372(-3.5189)
ADF(1)	1952 1992	41	-1.7024(-2.9339)	-1.3009(-3.5217)
ADF(2)	1953 1992	40	-1.3067(-2.9358)	-1.5511(-3.5247)

95% critical values in brackets.

Unit root tests for variable $logXp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-2.7640(-2.9798)	-3.8552(-3.5943)
ADF(1)	1968 1992	25	-2.0369(-2.9850)	-2.6590(-3.6027)
ADF(2)	1969 1992	24	-1.7474(-2.9907)	-2.1099(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXf_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.2527(-2.9798)	-1.8036(-3.5943)
ADF(1)	1968 1992	25	-1.1112(-2.9850)	-1.7172(-3.6027)
ADF(2)	1969 1992	24	-1.3140(-2.9907)	-1.9936(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXm_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-1.8616(-2.9798)	-1.8289(-3.5943)
ADF(1)	1968 1992	25	-2.4301(-2.9850)	-2.4280(-3.6027)
ADF(2)	1969 1992	24	-1.9943(-2.9907)	-1.8955(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logH_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	1.9786(-2.9358)	-2.1400(-3.5247)
ADF(1)	1952 1990	39	.35086(-2.9378)	-2.7233(-3.5279)
ADF(2)	1953 1990	38	.33843(-2.9400)	-3.3959(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log L_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-2.2698(-2.9358)	.20821(-3.5247)
ADF(1)	1952 1990	39	-1.7538(-2.9378)	-.99326(-3.5279)
ADF(2)	1953 1990	38	-1.7391(-2.9400)	-.78486(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log C_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-1.3418(-2.9358)	-.21357(-3.5247)
ADF(1)	1952 1990	39	-1.8333(-2.9378)	-.35690(-3.5279)
ADF(2)	1953 1990	38	-1.5364(-2.9400)	-.52834(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-1.1291(-2.9320)	-2.3387(-3.5189)
ADF(1)	1952 1992	41	-.90304(-2.9339)	-2.4138(-3.5217)
ADF(2)	1953 1992	40	-1.0864(-2.9358)	-2.1578(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta\log K_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-7.0219(-2.9339)	-6.9400(-3.5217)
ADF(1)	1953 1992	40	-5.9562(-2.9358)	-5.9089(-3.5247)
ADF(2)	1954 1992	39	-3.8340(-2.9378)	-3.7624(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta \log X_t$

statistic	sample	observations	without trend	with trend
DF	1952 1993	42	-5.9267(-2.9320)	-5.9032(-3.5189)
ADF(1)	1953 1993	41	-4.6737(-2.9339)	-4.7456(-3.5217)
ADF(2)	1954 1993	40	-3.8351(-2.9358)	-3.9248(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta \log PCI_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.1930(-2.9339)	-5.4018(-3.5217)
ADF(1)	1953 1992	40	-3.4187(-2.9358)	-3.4785(-3.5247)
ADF(2)	1954 1992	39	-3.5923(-2.9378)	-3.9128(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta \log Xp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-7.7627(-2.9850)	-7.6262(-3.6027)
ADF(1)	1969 1992	24	-5.1963(-2.9907)	-5.1218(-3.6119)
ADF(2)	1970 1992	23	-3.7571(-2.9970)	-3.7174(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta \log PCI_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-5.1930(-2.9339)	-5.4018(-3.5217)
ADF(1)	1953 1992	40	-3.4187(-2.9358)	-3.4785(-3.5247)
ADF(2)	1954 1992	39	-3.5923(-2.9378)	-3.9128(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta \log Xf_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-5.1851(-2.9850)	-5.0670(-3.6027)
ADF(1)	1969 1992	24	-2.8537(-2.9907)	-2.7469(-3.6119)
ADF(2)	1970 1992	23	-2.2640(-2.9970)	-2.0986(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXm_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-4.6113(-2.9850)	-5.0491(-3.6027)
ADF(1)	1969 1992	24	-3.6525(-2.9907)	-3.9241(-3.6119)
ADF(2)	1970 1992	23	-3.2563(-2.9970)	-3.5997(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logH_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-2.6313(-2.9378)	-2.6079(-3.5279)
ADF(1)	1953 1990	38	-2.1287(-2.9400)	-2.1335(-3.5313)
ADF(2)	1954 1990	37	-2.2466(-2.9422)	-2.1767(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logL_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-3.1069(-2.9378)	-3.4587(-3.5279)
ADF(1)	1953 1990	38	-2.8770(-2.9400)	-3.3067(-3.5313)
ADF(2)	1954 1990	37	-2.7802(-2.9422)	-3.3104(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logC_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-5.5290(-2.9378)	-5.9960(-3.5279)
ADF(1)	1953 1990	38	-3.7350(-2.9400)	-4.0511(-3.5313)
ADF(2)	1954 1990	37	-3.3914(-2.9422)	-3.8708(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta \log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-6.2729(-2.9339)	-6.1615(-3.5217)
ADF(1)	1953 1992	40	-4.9342(-2.9358)	-4.8861(-3.5247)
ADF(2)	1954 1992	39	-4.0525(-2.9378)	-3.9937(-3.5279)

95% critical values in brackets.

Model I

EG Cointegration Test:- Unit root tests for variable V_τ

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-7.7143(-2.9378)	-7.6425(-3.5279)
ADF(1)	1953 1990	38	-3.4787(-2.9400)	-3.4686(-3.5313)
ADF(2)	1954 1990	37	-2.4339(-2.9422)	-2.3968(-3.5348)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
40 observations used for estimation from 1952 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	.0024408	.069413	.035163[.972]
V_{t-1}	-.40733	.23959	-1.7001[.099]
$\Delta logPCI_{t-1}$	.39172	.24458	1.6016[.119]
$\Delta logX_{t-1}$	-.025312	.060789	-.41639[.680]
$\Delta logH_{t-1}$	.45126	2.6089	.17297[.864]
$\Delta logL_{t-1}$	.23543	.28439	.82785[.414]
$\Delta logK_{t-1}$	-.038674	.044958	-.86024[.396]

R-Squared	.13419	F-statistic F(6, 33)	.85241[.539]
R-Bar-Squared	-.023233	S.E. of Regression	.052106
Residual Sum of Squares	.089595	Mean of Dependent Variable	.022992
S.D. of Dependent Variable	.051511	Maximum of Log-likelihood	65.2693
DW-statistic	2.0040		

LM: χ^2(1)= .29788[.585], RESET: χ^2(1)= .031452[.859], Norm: χ^2(2)= 291.3358[.000], HD: χ^2:(1)= 1.2972[.255]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1968 1990	23	-3.8961(-2.9970)	-4.2756(-3.6219)
ADF(1)	1969 1990	22	-1.3963(-3.0039)	-1.6968(-3.6331)
ADF(2)	1970 1990	21	.39987(-3.0115)	.21687(-3.6454)

95% critical values in brackets.

ECM Model II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
24 observations used for estimation from 1968 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	-.14848	.15429	-.96236[.351]
v_{t-1}	-1.1294	.39159	-2.8840[.011]
$\Delta logPCI_{t-1}$	.99245	.37559	2.6424[.018]
$\Delta logXp_{t-1}$	-.028270	.019224	-1.4706[.162]
$\Delta logXf_{t-1}$	-.021031	.014681	-1.4325[.173]
$\Delta logXm_{t-1}$	.013565	.046172	.29379[.773]
$\Delta logH_{t-1}$	5.3833	5.6160	.95856[.353]
$\Delta logL_{t-1}$	.018878	.36275	.052042[.959]
$\Delta logK_{t-1}$	-.17176	.075875	2.2637[.039]

R-Squared	.44260	F-statistic F(8, 15)	1.4888[.241]
R-Bar-Squared	.14532	S.E. of Regression	.057374
Residual Sum of Squares	.049377	Mean of Dependent Variable	.013709
S.D. of Dependent Variable	.062060	Maximum of Log-likelihood	40.1815
DW-statistic	1.9231		

LM: χ^2(1)= .026146[.872], RESET: χ^2(1)= 7.0675[.008], Norm: χ^2(2)= 38.6965[.000], HD: χ^2(1)= 2.6509[.103]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-7.3148(-2.9378)	-7.3079(-3.5279)
ADF(1)	1953 1990	38	-3.0432(-2.9400)	-3.0561(-3.5313)
ADF(2)	1954 1990	37	-2.5508(-2.9422)	-2.5534(-3.5348)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is $\Delta logC_t$
39 observations used for estimation from 1952 to 1990

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	.010883	.011405	.95424[.347]
U_{t-1}	-.32873	.13203	-2.4898[.018]
$\Delta logC_{t-1}$	.17877	.19410	.92104[.364]
$\Delta log(X/Y)_{t-1}$	-.023962	.069525	-.34465[.733]
$\Delta logH_{t-1}$	-.15198	.34293	-.44319[.661]
$\Delta logK_{t-1}$	.023933	.060502	.39558[.695]

R-Squared	.18298	F-statistic F(5, 33)	1.4782[.223]
R-Bar-Squared	.059194	S.E. of Regression	.061371
Residual Sum of Squares	.12429	Mean of Dependent Variable	.0070828
S.D. of Dependent Variable	.063272	Maximum of Log-likelihood	56.7608
DW-statistic	1.8961	Durbin's h-statistic	.57318[.567]

LM: χ^2(1)= .21633[.642], RESET: χ^2(1)= .0043201[.948], Norm: χ_2(1, 32)= .0035451[.953], HD: χ^2(1)= .23550[.627]

Model I

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.58330 .56303 .35091 .12770 .016257

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	35.0156	33.4610	30.9000
r<= 1	r = 2*	33.1155	27.0670	24.7340
r<= 2	r = 3	17.2872	20.9670	18.5980
r<= 3	r = 4	5.4648	14.0690	12.0710
r<= 4	r = 5	.65562	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.58330 .56303 .35091 .12770 .016257

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	91.5387	68.5240	64.8430
r<= 1	r>= 2*	56.5230	47.2100	43.9490
r<= 2	r>= 3	23.4076	29.6800	26.7850
r<= 3	r>= 4	6.1204	15.4100	13.3250
r<= 4	r = 5	.65562	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$logPCI_t$	-1.0000	-1.0000
$logX_t$	.2834	-.10712
$logH_t$	2.3548	1.6593
$logL_t$	-3.2422	-.56067
$logK_t$	.76584	.62882

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$logPCI_t$	-.085128	.011650
$logX_t$	-.24924	.19188
$logH_t$	.0072255	.1642E-3
$logL_t$	-.017588	.10086
$logK_t$	-.45127	-1.4260

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log PCI_t$	-1.0000	-1.0000
$\log X_t$	0.00	0.00
$\log H_t$	2.8264	.94246
$\log L_t$	-2.6126	-.069728
$\log K_t$	.91662	.43220

LR Test of Restrictions $\chi^2(2)=$ 1.5067[.471]

Model II

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logH_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.94289 .87403 .64215 .56111 .44504 .38517 .018030

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	68.7046	45.2770	42.3170
r<= 1	r = 2*	49.7214	39.3720	36.7620
r<= 2	r = 3	24.6634	33.4610	30.9000
r<= 3	r = 4	19.7643	27.0670	24.7340
r<= 4	r = 5	14.1326	20.9670	18.5980
r<= 5	r = 6	11.6739	14.0690	12.0710
r<= 6	r = 7	.43667	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)

Cointegration LR Test Based on Trace of the Stochastic Matrix

24 observations from 1967 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logH_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.94289 .87403 .64215 .56111 .44504 .38517 .018030

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	189.0969	124.2430	118.5000
r<= 1	r>= 2*	120.3923	94.1550	89.4830
r<= 2	r>= 3*	70.6709	68.5240	64.8430
r<= 3	r>= 4**	46.0075	47.2100	43.9490
r<= 4	r>= 5	26.2432	29.6800	26.7850
r<= 5	r>= 6	12.1106	15.4100	13.3250
r<= 6	r = 7	.43667	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	.043495	.030906	9.3962	-.32897
$logXf_t$	.0085298	.023325	7.0443	-.086963
$logXm_t$	.036165	-.083828	-63.7024	.10273
$logH_t$	1.2218	2.1632	298.3263	.68248
$logL_t$	.45606	-.56020	154.3190	.89628
$logK_t$	.27023	.43282	-9.8213	.54886

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-.076814	-.58148	.7952E-3	-.052476
$logXp_t$	-1.9236	-5.2704	-.0024454	1.4207
$logXf_t$	2.1992	-9.8779	.8272E-3	1.2035
$logXm_t$	.55970	.41568	.0059266	.027328
$logH_t$	-.036115	.018339	.8021E-5	.3259E-4
$logL_t$	-.15677	.018057	.5957E-3	.041606
$logK_t$	-1.6123	-5.4656	.0023197	-.59625

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$\log PCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$\log Xp_t$	0.00	0.00	0.00	0.00
$\log Xf_t$	-.016068	.018168	.094281	.10589
$\log Xm_t$	.061166	-.057397	-.86328	-.12995
$\log H_t$	-.26560	1.9034	5.6097	2.7040
$\log L_t$	2.1489	-.25421	2.2393	-.44387
$\log K_t$	.015888	.39294	.25857	.18388

LR Test of Restrictions $\chi^2(4)$= 20.1807[.000]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	.050868	.047424	-.27677	-.19714
$logXf_t$	0.00	0.00	0.00	0.00
$logXm_t$	-.015915	-.046344	1.6601	.024562
$logH_t$	.88816	1.8777	-5.2523	1.4663
$logL_t$	.75669	-.62580	-4.9992	.27718
$logK_t$	.23503	.51271	.086241	.35349

LR Test of Restrictions $\chi^2(4)$= 11.0696[.026]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

24 observations from 1967 to 1990. Maximum lag in VAR = 1, chosen r = 4.

	Vector 1	Vector 2	Vector 3	Vector 4
$logPCI_t$	-1.0000	-1.0000	-1.0000	-1.0000
$logXp_t$	.048804	.033123	-.28987	-.28136
$logXf_t$	.6529E-3	.011046	-.13998	-.018159
$logXm_t$	0.00	0.00	0.00	0.00
$logH_t$	.77903	1.6193	-.25385	2.1978
$logL_t$	.73923	-.73445	1.1754	.86114
$logK_t$	.22448	.45640	.81809	.32553

LR Test of Restrictions $\chi^2(4) = 15.0855[.005]$

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.49393 .30471 .13573 .078417

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	27.2432	27.0670	24.7340
r<= 1	r = 2	14.5368	20.9670	18.5980
r<= 2	r = 3	5.8346	14.0690	12.0710
r<= 3	r = 4**	3.2665	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$\log C_t$ $\log(X/Y)_t$ $\log H_t$ $\log K_t$
List of eigenvalues in descending order:
.49393 .30471 .13573 .078417

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	50.8811	47.2100	43.9490
r<= 1	r>= 2	23.6380	29.6800	26.7850
r<= 2	r>= 3	9.1011	15.4100	13.3250
r<= 3	r = 4**	3.2665	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log C_t$	-1.0000	-1.0000
$\log(X/Y)_t$	-1.0109	2.1623
$\log H_t$	.91424	-4.9242
$\log K_t$	1.8701	1.0209

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log C_t$	.018222	-.0015968
$\log(X/Y)_t$	.040094	-.16890
$\log H_t$	.016094	-.0032479
$\log K_t$	-.099306	-.19452

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log C_t$	-1.0000	-1.0000
$\log(X/Y)_t$	0.00	0.00
$\log H_t$	-.63210	.94526
$\log K_t$	1.3000	.022560

LR Test of Restrictions $\chi^2(2)=$ 8.7188[.013]

Chile

Unit Root Tests

Unit root tests for variable $\Delta logPCI_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-4.9196(-2.9339)	-4.8701(-3.5217)
ADF(1)	1953 1992	40	-4.3246(-2.9358)	-4.2837(-3.5247)
ADF(2)	1954 1992	39	-3.6329(-2.9378)	-3.6251(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta logXp_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-5.3830(-2.9850)	-5.2680(-3.6027)
ADF(1)	1969 1992	24	-4.9035(-2.9907)	-4.7887(-3.6119)
ADF(2)	1970 1992	23	-3.8722(-2.9970)	-3.7900(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logXf_t$

statistic	sample	observations	without trend	with trend
DF	1969 1992	24	-4.5811(-2.9907)	-4.5768(-3.6119)
ADF(1)	1970 1992	23	-2.8761(-2.9970)	-2.9678(-3.6219)
ADF(2)	1971 1992	22	-2.3140(-3.0039)	-2.6050(-3.6331)

95% critical values in brackets.

Unit root tests for variable $\Delta logXm_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-3.8789(-2.9850)	-3.7559(-3.6027)
ADF(1)	1969 1992	24	-3.8701(-2.9907)	-3.7469(-3.6119)
ADF(2)	1970 1992	23	-3.0316(-2.9970)	-2.9534(-3.6219)

95% critical values in brackets.

Unit root tests for variable $\Delta logH_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-1.9168(-2.9378)	-2.7838(-3.5279)
ADF(1)	1953 1990	38	-1.8160(-2.9400)	-2.7322(-3.5313)
ADF(2)	1954 1990	37	-1.8123(-2.9422)	-2.6858(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta logL_t$

statistic	sample	observations	without trend	with trend
DF	1952 1991	40	-2.9274(-2.9358)	-4.8824(-3.5247)
ADF(1)	1953 1991	39	-1.9190(-2.9378)	-3.2535(-3.5279)
ADF(2)	1954 1991	38	-1.3310(-2.9400)	-2.2450(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\Delta logC_t$

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-5.5303(-2.9378)	-5.4718(-3.5279)
ADF(1)	1953 1990	38	-4.7319(-2.9400)	-4.6679(-3.5313)
ADF(2)	1954 1990	37	-3.6185(-2.9422)	-3.5404(-3.5348)

95% critical values in brackets.

Unit root tests for variable $\Delta log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-6.9344(-2.9339)	-6.9355(-3.5217)
ADF(1)	1953 1992	40	-6.8815(-2.9358)	-7.0730(-3.5247)
ADF(2)	1954 1992	39	-4.6190(-2.9378)	-4.7937(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\log K_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-3.5209(-2.9320)	-3.6100(-3.5189)
ADF(1)	1952 1992	41	-1.9131(-2.9339)	-2.0198(-3.5217)
ADF(2)	1953 1992	40	-1.2685(-2.9358)	-1.3411(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\log X_t$

statistic	sample	observations	without trend	with trend
DF	1951 1993	43	-.35502(-2.9303)	-2.9102(-3.5162)
ADF(1)	1952 1993	42	-.010604(-2.9320)	-2.9827(-3.5189)
ADF(2)	1953 1993	41	.57708(-2.9339)	-2.5194(-3.5217)

95% critical values in brackets.

Unit root tests for variable $\log PCI_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-.69331(-2.9320)	-1.9946(-3.5189)
ADF(1)	1952 1992	41	-.96068(-2.9339)	-2.7328(-3.5217)
ADF(2)	1953 1992	40	-.71729(-2.9358)	-2.4786(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\log Xp_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-.67310(-2.9798)	-3.2791(-3.5943)
ADF(1)	1968 1992	25	-.63384(-2.9850)	-3.5034(-3.6027)
ADF(2)	1969 1992	24	-.39676(-2.9907)	-2.7419(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logXf_t$

statistic	sample	observations	without trend	with trend
DF	1968 1992	25	-1.5071(-2.9850)	-1.4499(-3.6027)
ADF(1)	1969 1992	24	-1.7438(-2.9907)	-1.5612(-3.6119)
ADF(2)	1970 1992	23	-2.1736(-2.9970)	-1.9092(-3.6219)

95% critical values in brackets.

Unit root tests for variable $logXm_t$

statistic	sample	observations	without trend	with trend
DF	1967 1992	26	-.016376(-2.9798)	-1.9143(-3.5943)
ADF(1)	1968 1992	25	-.75226(-2.9850)	-2.4848(-3.6027)
ADF(2)	1969 1992	24	-.79169(-2.9907)	-2.0457(-3.6119)

95% critical values in brackets.

Unit root tests for variable $logH_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	7.3599(-2.9358)	-1.2221(-3.5247)
ADF(1)	1952 1990	39	1.6585(-2.9378)	-1.6042(-3.5279)
ADF(2)	1953 1990	38	1.6824(-2.9400)	-1.5464(-3.5313)

95% critical values in brackets.

Unit root tests for variable $logL_t$

statistic	sample	observations	without trend	with trend
DF	1951 1991	41	-2.9161(-2.9339)	.67012(-3.5217)
ADF(1)	1952 1991	40	-2.6198(-2.9358)	-.35794(-3.5247)
ADF(2)	1953 1991	39	-2.0228(-2.9378)	-.47848(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\log C_t$

statistic	sample	observations	without trend	with trend
DF	1951 1990	40	-2.0708(-2.9358)	-2.5744(-3.5247)
ADF(1)	1952 1990	39	-2.4098(-2.9378)	-3.1435(-3.5279)
ADF(2)	1953 1990	38	-2.0699(-2.9400)	-2.7651(-3.5313)

95% critical values in brackets.

Unit root tests for variable $\log(X/Y)_t$

statistic	sample	observations	without trend	with trend
DF	1951 1992	42	-.50952(-2.9320)	-2.4367(-3.5189)
ADF(1)	1952 1992	41	-.22069(-2.9339)	-2.5359(-3.5217)
ADF(2)	1953 1992	40	.46219(-2.9358)	-2.1209(-3.5247)

95% critical values in brackets.

Unit root tests for variable $\Delta \log K_t$

statistic	sample	observations	without trend	with trend
DF	1952 1992	41	-10.7663(-2.9339)	-10.7411(-3.5217)
ADF(1)	1953 1992	40	-6.9744(-2.9358)	-7.0009(-3.5247)
ADF(2)	1954 1992	39	-4.8533(-2.9378)	-5.0071(-3.5279)

95% critical values in brackets.

Unit root tests for variable $\Delta \log X_t$

statistic	sample	observations	without trend	with trend
DF	1952 1993	42	-7.1160(-2.9320)	-7.0802(-3.5189)
ADF(1)	1953 1993	41	-6.7111(-2.9339)	-6.8087(-3.5217)
ADF(2)	1954 1993	40	-4.7355(-2.9358)	-4.8509(-3.5247)

95% critical values in brackets.

Model I

EG Cointegration Test:- Unit root tests for variable V_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-6.6186(-2.9378)	-6.5419(-3.5279)
ADF(1)	1953 1990	38	-5.5693(-2.9400)	-5.5084(-3.5313)
ADF(2)	1954 1990	37	-4.2131(-2.9422)	-4.1732(-3.5348)

95% critical values in brackets.

ECM Model I

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
40 observations used for estimation from 1952 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_0	.037268	.044856	.83083[.412]
V_{t-1}	-.52081	.13124	-3.9685[.000]
$\Delta logPCI_{t-1}$	.50312	.16297	3.0872[.004]
$\Delta logX_{t-1}$	.030303	.045750	.66237[.512]
$\Delta logH_{t-1}$	-1.7219	2.0556	-.83768[.408]
$\Delta logL_{t-1}$	.18980	.37872	.50115[.620]
$\Delta logK_{t-1}$	.010521	.047814	.22005[.827]

R-Squared	.39586	F-statistic F(6, 33)	3.6039[.007]
R-Bar-Squared	.28602	S.E. of Regression	.050327
Residual Sum of Squares	.083584	Mean of Dependent Variable	.014583
S.D. of Dependent Variable	.059561	Maximum of Log-likelihood	66.6582
DW-statistic	2.1731	Durbin's h-statistic	-.98124[.326]

LM: χ^2(1)= 3.6597[.056], RESET: χ^2(1)= 1.4926[.222], Norm: χ^2(2)= 23.7782[.000], HD:χ^2 (1)= .010529[.918]

Model II

EG Cointegration Test:- Unit root tests for variable v_t

statistic	sample	observations	without trend	with trend
DF	1969 1990	22	-4.3836(-3.0039)	-4.3063(-3.6331)
ADF(1)	1970 1990	21	-4.7738(-3.0115)	-4.6750(-3.6454)
ADF(2)	1971 1990	20	-2.5797(-3.0199)	-2.5087(-3.6592)

95% critical values in brackets.

ECM Model II

Ordinary Least Squares Estimation

Dependent variable is $\Delta logPCI_t$
23 observations used for estimation from 1969 to 1991

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{01}	.057756	.10858	.53192[.603]
v_{t-1}	-.53078	.27842	-1.9064[.077]
$\Delta logPCI_{t-1}$	.61127	.27024	2.2620[.040]
$\Delta logXp_{t-1}$	-.032001	.081258	-.39383[.700]
$\Delta logXf_{t-1}$	-.010409	.025357	-.41048[.688]
$\Delta logXm_{t-1}$	-.0038247	.083360	-.045881[.964]
$\Delta logH_{t-1}$	-2.1341	4.5177	-.47240[.644]
$\Delta logL_{t-1}$	.056883	.65634	.086667[.932]
$\Delta logK_{t-1}$	.053250	.086192	.61781[.547]

R-Squared	.44970	F-statistic F(8, 14)	1.4301[.267]
R-Bar-Squared	.13524	S.E. of Regression	.068212
Residual Sum of Squares	.065141	Mean of Dependent Variable	.010733
S.D. of Dependent Variable	.073353	Maximum of Log-likelihood	34.8314
DW-statistic	2.0007		

LM: χ^2(1)= .63298[.426], RESET: χ^2(1)= .070744[.790], Norm: χ^2 (2)= 4.1365[.126], HD: χ^2 (1)= .045731[.831]

Model III

EG Cointegration Test:- Unit root tests for variable U_t

statistic	sample	observations	without trend	with trend
DF	1952 1990	39	-6.2941(-2.9378)	-6.2141(-3.5279)
ADF(1)	1953 1990	38	-4.5570(-2.9400)	-4.5056(-3.5313)
ADF(2)	1954 1990	37	-3.8054(-2.9422)	-3.7601(-3.5348)

95% critical values in brackets.

ECM Model III

Ordinary Least Squares Estimation

Dependent variable is $\Delta logC_t$
39 observations used for estimation from 1952 to 1990

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
A_{02}	-.013932	.0093028	-1.4976[.144]
U_{t-1}	-.55248	.14732	-3.7502[.001]
ΔC_{t-1}	.53963	.17077	3.1600[.003]
$\Delta log(X/Y)_{t-1}$	.12912	.044648	2.8920[.007]
$\Delta logH_{t-1}$	.57289	.31353	1.8272[.077]
$\Delta logK_{t-1}$	.085204	.046558	1.8301[.076]

R-Squared .40826 F-statistic F(5, 33) 4.5536[.003]
R-Bar-Squared .31861 S.E. of Regression .050616
Residual Sum of Squares .084544 Mean of Dependent Variable -.7094E-3
S.D. of Dependent Variable .061318 Maximum of Log-likelihood 64.2753
DW-statistic 2.2655 Durbin's h-statistic -2.1155[.034]
LM: χ^2(1)= 2.3386[.126], RESET: χ^2(1)= 1.0849[.298], Norm: χ^2(2)= 27.2599[.000], HD: χ^2 (1)= .0036163[.952]

Model I

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.83105 .49116 .38228 .19057 .4914E-5

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	71.1251	33.4610	30.9000
r<= 1	r = 2**	27.0250	27.0670	24.7340
r<= 2	r = 3**	19.2691	20.9670	18.5980
r<= 3	r = 4	8.4568	14.0690	12.0710
r<= 4	r = 5	.1965E-3	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logX_t$ $logH_t$ $logL_t$ $logK_t$
List of eigenvalues in descending order:
.83105 .49116 .38228 .19057 .4914E-5

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	125.8763	68.5240	64.8430
r<= 1	r>= 2*	54.7511	47.2100	43.9490
r<= 2	r>= 3**	27.7261	29.6800	26.7850
r<= 3	r>= 4	8.4570	15.4100	13.3250
r<= 4	r = 5	.1965E-3	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logX_t$	-.29977	.21372	1.1674
$logH_t$	8.2417	-.68856	-4.1532
$logL_t$	-.69372	.76882	-.46634
$logK_t$	-3.8629	.69910	.19789

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-.0029753	.18909	.028885
$logX_t$	.0019368	.23615	-.29413
$logH_t$	.0024115	.0093317	-.0023519
$logL_t$	-.013679	-.0087019	-.012239
$logK_t$	.040150	-1.0915	.088273

Restricted Cointegrated Vectors in Johansen Estimation (Normalisd)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logX_t$	0.00	0.00	0.00
$logH_t$	5.5409	.15517	.73866
$logL_t$	-.39390	.89091	-.41730
$logK_t$	-2.8688	.73178	.033344

LR Test of Restrictions $\chi^2(3)=$ 8.8752[.031]

Model II

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

23 observations from 1968 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logH_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.96600 .88559 .78805 .49323 .46151 .32521 .0018681

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	77.7734	45.2770	42.3170
r<= 1	r = 2*	49.8626	39.3720	36.7620
r<= 2	r = 3*	35.6818	33.4610	30.9000
r<= 3	r = 4	15.6331	27.0670	24.7340
r<= 4	r = 5	14.2367	20.9670	18.5980
r<= 5	r = 6	9.0470	14.0690	12.0710
r<= 6	r = 7	.043006	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

23 observations from 1968 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logPCI_t$ $logXp_t$ $logXf_t$ $logXm_t$ $logK_t$
$logL_t$ $logK_t$
List of eigenvalues in descending order:
.96600 .88559 .78805 .49323 .46151 .32521 .0018681

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	202.2776	124.2430	118.5000
r<= 1	r>= 2*	124.5042	94.1550	89.4830
r<= 2	r>= 3*	74.6416	68.5240	64.8430
r<= 3	r>= 4	38.9598	47.2100	43.9490
r<= 4	r>= 5	23.3267	29.6800	26.7850
r<= 5	r>= 6	9.0900	15.4100	13.3250
r<= 6	r = 7	.043006	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1968 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logXp_t$	2.2879	.82032	.55628
$logXf_t$	.19632	.8959E-3	-.19040
$logXm_t$	-1.9533	-.46253	.20529
$logH_t$	27.5024	.27659	-1.6537
$logL_t$	32.4570	3.1783	.12883
$logK_t$	-2.1708	.86708	-.45287

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

23 observations from 1968 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$\log PCI_t$	-.0030308	-.032407	.15004
$\log XP_t$	.0027683	.14961	-.56195
$\log Xf_t$	.0045109	1.6886	1.0375
$\log Xm_t$	.015254	.81041	.078136
$\log H_t$	.8782E-3	.0025836	-.0018892
$\log L_t$	-.0071774	.016700	-.0020455
$\log K_t$	.012148	-.72747	.33243

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1968 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logXp_t$	0.00	0.00	0.00
$logXf_t$	-.15595	-.70446	-.37239
$logXm_t$	.54508	2.0537	.67436
$logH_t$	-15.7204	-8.4298	.016533
$logL_t$	-14.5727	-10.8293	5.1143
$logK_t$	2.0236	-4.5863	.36909

LR Test of Restrictions $\chi^2(3) = 24.2472[.000]$

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1968 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logXp_t$	1.4690	.81900	.79384
$logXf_t$	0.00	0.00	0.00
$logXm_t$	-.95161	-.45964	-.20040
$logH_t$	14.8012	.27014	-1.8134
$logL_t$	18.3434	3.1675	-.86889
$logK_t$	-1.4863	.86146	-.072522

LR Test of Restrictions $\chi^2(3)=$ 16.6683[.001]

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

23 observations from 1968 to 1990. Maximum lag in VAR = 1, chosen r = 3.

	Vector 1	Vector 2	Vector 3
$logPCI_t$	-1.0000	-1.0000	-1.0000
$logXp_t$	.16218	.62773	.80840
$logXf_t$	-.016831	-.12580	-.21560
$logXm_t$	0.00	0.00	0.00
$logH_t$	-14.6147	-.91074	-2.7780
$logL_t$	-13.7732	1.7414	-8.2109
$logK_t$	2.8223	.14685	-3.0283

LR Test of Restrictions $\chi^2(3) = 20.9072[.000]$

Model III

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logC_t$ $log(X/Y)_t$ $logH_t$ $logK_t$
List of eigenvalues in descending order:
.69200 .38963 .11176 .072187

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1*	47.1068	27.0670	24.7340
r<= 1	r = 2**	19.7473	20.9670	18.5980
r<= 2	r = 3	4.7404	14.0690	12.0710
r<= 3	r = 4	2.9970	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Johansen Maximum Likelihood Procedure (Trended case, with trend in DGP)
Cointegration LR Test Based on Trace of the Stochastic Matrix

40 observations from 1951 to 1990. Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
$logC_t$ $log(X/Y)_t$ $logH_t$ $logK_t$
List of eigenvalues in descending order:
.69200 .38963 .11176 .072187

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1*	74.5915	47.2100	43.9490
r<= 1	r>= 2**	27.4847	29.6800	26.7850
r<= 2	r>= 3	7.7374	15.4100	13.3250
r<= 3	r = 4**	2.9970	3.7620	2.6870

r is the number of cointegrating vectors
* significant at 95% critical value
** significant at 90% critical value

Estimated Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log C_t$	-1.0000	-1.0000
$\log(X/Y)_t$	3.5836	-.082081
$\log H_t$	2.8653	.28531
$\log K_t$	6.1873	.30093

Estimated Adjustment Matrix in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log C_t$	.1646E-3	.21565
$\log(X/Y)_t$	.012927	.76900
$\log H_t$	.0084393	-.064090
$\log K_t$	-.032696	-1.1109

Restricted Cointegrated Vectors in Johansen Estimation (Normalised)

40 observations from 1951 to 1990. Maximum lag in VAR = 1, chosen r = 2.

	Vector 1	Vector 2
$\log C_t$	-1.0000	-1.0000
$\log(X/Y)_t$	0.00	0.00
$\log H_t$	.20313	.44642
$\log K_t$	-.12943	2.1441

LR Test of Restrictions $\chi^2(2)$= 23.1860[.000]