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IS THE EXPORT-LED GROWTH HYPOTHESIS VALID FOR DEVELOPING COUNTRIES? A CASE STUDY OF COSTA RICA

by

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ABSTRACT

The export-led growth hypothesis (ELGH) postulates that export growth is one of the key determinants of economic growth. This study goes beyond the traditional neoclassical theory of production by estimating an augmented Cobb–Douglas production function. The inclusion of exports as a third input provides an alternative procedure to capture total factor productivity (TFP) growth. The study tests the hypothesis by analysing the case of Costa Rica, using annual data for the period 1950–1997. In using several procedures to test for cointegration, it goes beyond the traditional time series studies by examining empirically the short-term as well as the long-run relationship. The study finds that the ELGH is valid in this particular case; however, the empirical results show that physical investment and population mainly drove Costa Rica's overall economic performance from 1950 onwards. From a review of the literature we find that the empirical evidence regarding the relationship between exports and growth is not robust, and although the results of the study suggest that exports have a positive effect on the overall rate of economic growth and could be considered an "engine of growth" as the ELGH advocates, their impact was quantitatively relatively small, in both the short and the long-run. The evidence presented clearly supports the neoclassical theory of production and, to a lesser extent, the so-called new-fashioned economic wisdom. Moreover, it challenges the empirical literature regarding the ELGH and expresses serious doubts with regard to promoting exports as a comprehensive development strategy. The ELGH is probably beneficial only for a limited number of developing countries, and only to a certain extent.

Keywords: export-led growth hypothesis (ELGH); economic growth; neoclassical theory of production; cointegration; Costa Rica

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I. INTRODUCTION

It is widely accepted among economists that economic growth is an extremely complex process, which depends on many variables such as capital accumulation (both physical and human), trade, price fluctuations, political conditions and income distribution, and even more on geographical characteristics.

The export-led growth hypothesis (ELGH) postulates that export expansion is one of the main determinants of growth. It holds that the overall growth of countries can be generated not only by increasing the amounts of labour and capital within the economy, but also by expanding exports. According to its advocates, exports can perform as an "engine of growth".

The association between exports and growth is often attributed to the possible positive externalities for the domestic economy arising from participation in world markets, for instance from the reallocation of existing resources, economies of scale and various labour training effects. However, these mechanisms are frequently invoked without any theoretical support or any empirical proof.

A substantial amount of research concerning the ELGH in developing countries (DCs) has been carried out during the past 30 years. In fact, during the 1990s a new series of empirical studies has been conducted on a number of divergent lines of research, methodologies, time periods and countries.

A key aspect concerning early studies is related to both the methodology and the econometric technique used. The theoretical benchmark can be considered in general weak and based on bivariate and ad hoc production functions, while the empirical results derived from traditional econometrics have been highly criticized for being spurious. Therefore, early studies could have been misleading in that they advocated export expansion in an indiscriminate way. In fact, the evidence available is far from conclusive and this situation explains to some extent why this debate still exists in the economic literature.

Consequently, the purpose of this study is to examine and test the ELGH, using the case of Costa Rica. The study has three distinctive features, in contrast to the hundreds of empirical studies on growth that have been published. First, we have gone beyond the traditional neoclassical theory of production by estimating an augmented Cobb–Douglas functional form, which includes exports, using annual data for the period 1950–1997. The inclusion of exports as a third input of production provides an alternative procedure to capture total factor productivity (TFP) growth. Secondly, the study focuses on a single developing country, examining empirically the relationship between export expansion and economic growth. Thirdly, it has gone beyond the traditional short-term effects, and uses extensively modern time series to examine empirically the long-run relationship, employing several procedures to test for cointegration. Thus, the final aim of this study is to quantify the importance of exports in the economic performance of Costa Rica in the second part of the twentieth century.

II. THEORETICAL REVIEW

A. Trade and growth

Although the theoretical links between trade and economic growth have been discussed for over two centuries, controversy still persists regarding their real effects. The initial wave of favourable arguments with respect to trade can be traced to the classical school of economic thought that started with Adam Smith and which was subsequently enriched by the work of Ricardo, Torrens, James Mill and John Stuart Mill in the first part of the nineteenth century. Since then, the justification for free trade and the various and indisputable benefits that international specialization brings to the productivity of nations have been widely discussed and are well documented in the economic literature (see e.g. Bhagwati, 1978; Krueger, 1978).

However, in the last decade there has been a surprising and impressive resumption of activity in the economic growth literature triggered by the endogenous growth theory, which has led to an extensive inventory of models that stress the importance of trade in achieving a sustainable rate of economic growth. These models have focused on different variables, such as degree of openness, real exchange rate, tariffs, terms of trade and export performance, to verify the hypothesis that open economies grow more rapidly than those that are closed (see e.g. Edwards, 1998).

Although most models emphasized the nexus between trade and growth, they stressed that trade is only one of the variables that enter the growth equation. However, the advocates of the ELGH have stated that trade was in fact the main engine of growth in South-East Asia. They argue that, for instance, Hong Kong (China), Taiwan Province of China, Singapore and the Republic of Korea, the so-called Four Tigers, have been successful in achieving high and sustained rates of economic growth since the early 1960s because of their free-market, outward-oriented economies (see e.g. World Bank, 1993).

The extensive literature concerning the relationship between trade and growth is also the consequence of the many changes that have taken place in the fields of development economics and international trade policy in the last two decades. An example of these changes is the tremendous modification from inward-oriented policies to export promotion (EP) strategy.[1]

By the early 1980s export-led orientation and export promotion had already secured a wide consensus among researchers and policy makers, to such an extent that they had become "conventional wisdom" among most economists in the developing world (see e.g. Tyler, 1981; Balassa, 1985). This is still the case in some international organizations, the international bank community and multilateral lenders such as the World Bank and the International Monetary Fund (IMF), and among the mainstream policy makers.

The advocates of the export-led strategy and free trade point out that most developing countries that followed inward-oriented policies under the import substitution strategy (ISS), mostly in Latin America, had poor economic achievements (Balassa, 1980). Some of them showed on average a complete lack of growth, while real income declined

[1] According to Heitger (1987, p. 249), the ELGH was suggested initially by Kindelberger in 1962.

between 1960 and 1990 (see e.g. Barro and Sala-i-Martin, 1995).

These facts were partly responsible for the substantial change that occurred in the trade literature in the 1980s. For example, Bruton (1989) states that as the first stage of import substitution came to an end, those countries that continued with this strategy, particularly in Latin America, or that were unable to shift to a more outward approach became increasingly vulnerable to external events. Most of them became increasingly dependent on short-run capital inflows, in particular from private banks, in order to maintain their levels of imports and thus of consumption. This was particularly the case of most Latin American countries that were greatly affected by the debt crisis of the early 1980s.

Thereafter, many DCs were forced to stimulate their export-led orientation even more because most of them had to rely on multilateral organizations to implement adjustment and stabilization programmes to correct imbalances in their basic macroeconomic indicators. The strategy was to encourage a free market through policies that relied heavily on the export promotion approach as one of the most suitable and trustworthy mechanisms. Promoting exports would enable DCs to correct imbalances in the external sector and at the same time assist them in ensuring that their domestic economies made a full recovery.

As part of an outward strategy, a new set of policies rapidly became a key component for policy makers in DCs involved in adjustment and stabilization programmes. In this atmosphere, numerous Governments started at this time to stimulate exports using diverse mechanisms and instruments, such as subsidies and tax exemptions.[2]

Consequently, by the mid-1980s, the economic literature concerning development economics, economic growth, adjustment and stabilization programmes had quickly rejected the *inward-oriented approach* and was suddenly placing great emphasis on *export-led strategy*. Most macroeconomic theorists and policy makers in DCs rapidly embraced the new wisdom, in the belief that by following this scheme their countries would achieve or regain the high rates of growth of the past.

Each strategy has been subject of an extensive theoretical survey and that the literature examining the relationship between trade and growth has increased substantially in the last decade with the impetus provided by the endogenous growth theory. However, it is not the intention of the present study to participate in or contribute to the discussion concerning the advantages and disadvantages of both economic strategies, which recently gained a new impetus (see e.g. Bruton, 1998; Edwards, 1998; Frankel and Romer, 1999; Rodrik, 1999).[3]

In addition, although the theoretical literature has frequently focused on the relationship between trade and economic growth (see e.g. Adams, 1973; Crafts, 1973; Edwards, 1992; Scott, 1992), the interesting phenomenon is that "empirical examinations have typically examined the relationship

[2] It is clear, however, that the ability of Governments to promote exports through these mechanisms has diminished substantially since the late 1980s, when economic integration agreements started to become increasingly popular in both the developed world and developing countries (i.e. EU, NAFTA, MERCOSUR), a situation which continued during the 1990s characterized by the creation of economic blocs.

[3] Although the advantages and disadvantages of each strategy began to be an unavoidable topic to be examined by policy makers in DCs, especially after the Asian economic crisis started at the end of 1997, becoming fully developed since then.

between exports and growth" (Levine and Renelt, 1992, p. 953).

Therefore, the next section briefly reviews the empirical literature related to the export-led strategy, considering in particular the role that exports played in output growth and paying close attention to the issue of causal links between exports and economic growth.

B. Exports and growth

Since the late 1960s studies have been conducted to examine the role of export performance in the economic growth process. Although the empirical literature can be considered to be vast, its results are clearly contradictory for both DCs and industrialized economies, a feature that could explain why this topic is still at the top of the agenda for many economists.

According to the so-called new orthodoxy, most authors as well as multilateral institutions would agree that promoting exports and achieving export expansion are beneficial for both developed and DCs for many reasons, including the following (i) they generate a greater capacity utilization; (ii) they take advantage of economies of scale; (iii) they bring about technological progress; (iv) they create employment and increase labour productivity; (v) they improve allocation of scarce resources throughout the economy; (vi) they relaxe the current account pressures for foreign capital goods by increasing the country's external earnings and attracting foreign investment; and (vii) they increase the TFP and consequently the well-being of the country (World Bank, 1993).

III. EMPIRICAL STUDIES

Table 1 presents a summary of a set of 42 empirical studies conducted between 1967 and 1998, which includes time period, methodology, variables, econometric technique and conclusions reached by the researchers. Although a substantial part of the earlier studies found evidence of a correlation between exports and growth which was used to support the ELGH, this tends to hold only for cross-section studies. In fact, the recent evidence on time series, which makes extensive use of cointegration techniques, casts doubts on the positive effects of exports on growth in the long run, and is thus not as conclusive as it was previously thought to be. Therefore, explanations regarding this extensive empirical literature are in order.

Among earlier empirical studies Emery (1967, 1968), Syron and Walsh (1968), Serven (1968), Kravis (1970), Michaely (1977), Heller and Porter (1978), Bhagwati (1978) and Krueger (1978) should be mentioned. This first group of studies explained economic growth in terms of export expansion alone, in a two-variable framework. That is, they used bivariate correlation — the Spearman rank correlation test — in cross-country format to illustrate the alleged superior effects of the ELGH (Lussier, 1993, p. 107).

A second group of researchers, which includes Balassa (1978, 1985), Tyler (1981), Feder (1983), Kavoussi (1984), Ram (1985, 1987) and Moschos (1989), studied the relationship between export and output performance within a neoclassical framework. In most of these studies exports were included in an ad hoc manner in the production function, together with labour and capital. They claimed that by including exports they were taking into consideration a broad measure of externalities and productivity gains generated by this sector which stimulated the domestic economy. The majority of these investigations aimed at analysing DCs by using ordinary least squares (OLS) on cross-section data and used their results to demonstrate the advantages of the export promotion strategy in comparison with the import substitution policy.

It was not until recently that this line of research began to focus on country-specific studies, for both industrialized countries and DCs. Surprisingly, more than half the empirical investigations published in the 1990s found no long-run relationship between exports and economic growth; rather, the studies suggest that it arises only from a positive short-term relationship between export expansion and growth of gross domestic product (GDP).

The studies of industrialized nations have analysed the cases of Canada, France, Germany, the United Kingdom, the United States and Switzerland, among others. In only a few cases have the empirical results confirmed that export expansion was a key element in the economic success of those countries (see e.g. Kugler, 1991; Afxentiou and Serletis, 1991; Henriques and Sadorsky, 1996). Even more astonishing is the finding in relation to Japan, which is that internal forces were the handmaidens of the great Japanese economic success in the twentieth century, including the post-war period, and not trade as many have claimed in the recent past (see Boltho, 1996).

Table 1. A brief framework of the related economic literature on the export-led hypothesis

Study	Sample[a]	Period of study	Methodology					Conclusions
			Data set	Economic growth	Exports	Econometric technique	Other variables	
Emery (1967)	50	1953–1963 Averages	Cross-section	GNP growth	Export growth	OLS	Current account	Support for the export-led hypothesis.
Syron & Walsh (1968)	50	1953–1963	Cross-section	GNP growth	Exports	OLS		Support for the hypothesis but the results are sensitive depending on the type of country under scrutiny LDCs or developed countries.
Serven (1968)	50	1953–1963	Cross-section	GNP growth	Export growth and/or export change/output	OLS		Support for the hypothesis and recommends the use of export growth and export change/output.
Kravis (1970)	37	1835–1966	Cross-section	GNP	Export growth	Spearman rank correlation	None	Supports the export-led hypothesis; however, indicates that LDCs that have been capable of diversifying their exports have been more successful in terms of growth.
Michaely (1977)	41	1950–1973	Cross-section	Per capita GNP growth	Growth of export share	Spearman rank correlation	None	Support for the export growth hypothesis and suggests the existence of a threshold effect.
Balassa (1978)	11	1960–1973	Cross-section	Real GNP growth	Real export growth	Spearman rank correlation, OLS, production function	Labour force, domestic investment and foreign investment/output	Support for the export growth hypothesis.
Heller & Porter (1978)	41	1950–1973	Cross-section	Output growth rate GNP	Per capita exports	Spearman rank correlation	None	Little support for export growth causing growth.
Fajana (1979)	1	1954–1974 Nigeria	Time series	GDP growth	Export share of GDP and export change/GDP	OLS, two-gap model	Foreign capital	Supports the export-led hypothesis and suggests that it is due to changes in domestic investment resources.
Tyler (1981)	55 & 49	1960–1977 Middle-income LDCs	Cross-section	Real GNP growth and GNP per capita	Real export growth	Pearson and Spearman rank correlation, OLS, production function	Labour force growth, investment growth	Supports the export growth hypothesis and suggest the existence of an threshold effect.
Feder (1983)	32	1964–1973	Cross-section	GDP growth	Export growth and export change/output	OLS, production function	Labour force growth, investment/output	Supports the export growth hypothesis.
Kavoussi (1984)	73	1960–1978 Low- and	Cross-section	Real GDP growth	Real export growth	Spearman Rank correlation, OLS,	Labour growth, capital growth	Support for the hypothesis, however, the effects tend to diminish according to the level

Study	Sample[a]	Period of study	Methodology					Conclusions
			Data set	Economic growth	Exports	Econometric technique	Other variables	
		middle-income LDCs				production function		of development.
Balassa (1985)	43	1973–1979 Semi industrialized countries	Cross-section	Real GNP growth	Real export growth	OLS, production function	Savings, labour GDP per capita, share of exports (manufactured products)	Supports the hypothesis and suggests that outward trade orientation is beneficial.
Jung & Marshall (1985)	37	1950–1981 LDCs	Time series	Real GNP or GDP	Lagged real export growth	OLS, Granger causality test	Lagged GNP and GDP growth	Only in 4 cases out of 37 was there evidence that supported the export-led hypothesis (Indonesia, Egypt, Costa Rica and Ecuador).
Ram (1985)	73	1960–1970 1970–1977 Low- and middle-income LDCs	Time series two-sub periods	Real GDP growth	Real export growth	OLS, White test for specification bias and heteroskedasticity	Labour force growth and Investment growth	Supports the export growth hypothesis and suggests the existence of an threshold effect.
Chow (1987)	8	1960–1980 NICs	Time series	Manufacturing output growth	Export growth of manufactured goods	Sim's causality Test (1972), bivariate model	None	Support for reciprocal causality hypothesis regarding export growth and industrial development.
Darrat (1987)	4	1955–1982 Four-little dragons	Time series	Real GDP growth	Lagged real export growth	OLS, White test, bivariate model	None	Rejects the export growth hypothesis in 3 out of 4 cases. Is able to support it in only one case (Republic of Korea) on the basis of the causality test.
Heitger (1987)	36	1950–1970 Averages	Cross-section	Real GDP per capita	Export share of GDP	OLS, ad hoc production function	GDI/GDP effective rate of protection, labour force, technological adaptation and adult literacy	Supports the case for trade liberalization.
Ram (1987)	88	1960–1972 1973–1982 Low- and middle-income LDCs	Cross-section two sub-periods	Real GDP growth	Real export growth	OLS, production function	Government size, GDI/GDP, labour growth	Supports the export led- hypothesis but asserts that the huge intercountry differences and diversity suggest caution when interpreting the results.
Moschos (1989)	71	1970–1980 Averages	Cross-section	Real GDP growth	Real export growth	OLS, production function	Labour growth, real domestic investment growth	Supports the export-led growth hypothesis and suggests the existence of an threshold effect. The rate of growth seems unaffected by labour because of its magnitude, while capital has limited effects owing to its low productivity levels.
Colombatto (1990)	47	1971, 1978 and 1985	Cross-section 3 separate years			OLS, correlation coefficients	Government consumption, agricultural exports and	Rejects the export -led growth hypothesis.

Study	Sample[a]	Period of study	Methodology					Conclusions
			Data set	Economic growth	Exports	Econometric technique	Other variables	
							degree of openness	
Fosu (1990)	28	1960–1970 1970–1980 African countries	Pooled cross-sectional two periods	GDP growth	Rate of growth of merchandise exports	OLS, production function	Rate of growth of GDI, labour growth	Supports the export -led hypothesis.
Kugler (1991)	6	1970(1)-1987(4) Industrial countries	Time series	GDP exception in the case of the US (GNP)	Real export growth	ADF unit roots, Johansen's procedure, VARs	Consumption (durable, non-durable and services), investment (business fixed)	There is only weak empirical evidence supporting the export-led growth hypothesis. In only 2 cases out of 6 is a long-run relation verified (France, West Germany).
Afxentiou & Serletis (1991)	16	1950–1985 Industrial countries	Time series	Real GNP growth	Real export growth	Phillips-Perron unit roots, EG procedure, Granger causality tests	None	No systematic relationship between exports and GDP is verified. Only in 2 cases out of 16 was a bidirectional causality manifested (US and Norway).
Sengupta (1991)	5	1967–1986 South-East Asia (Republic of Korea)	Time series	Real GDP growth	Real export growth	OLS, production function	Labour growth and capital growth.	Supports the export-led hypothesis and suggests the positive externality effects of exports on growth.
Serletis (1992)	1	1870-1985 Canada	Time series	Real GNP growth	Real export growth	ADF unit roots, EG procedure, Granger causality tests	Imports	Supports the export-led growth hypothesis in the short run; however, no cointegration between the variables was found.
Khan & Saqib (1993)	1	1972–1988 Pakistan	Time series	GDP growth	Real export growth: primary products and manufactured goods	3SLS, production function	Labour growth, capital growth, World GDP Index, relative prices	Supports the hypothesis of a strong association between exports and growth performance.
Lussier (1993)	24 & 19	1960–1990 African economies	Cross-section and panel data	GDP growth	Real export growth	OLS, 4 versions of production function	Labour growth, GDI/GDP, export share of GDP	Supports the hypothesis in panel data but fails to find any positive association when using export growth as a share of GDP.
Sheehey (1993)	31 & 65	1960–1970 Semi-industrialized countries	Cross-section	GDP growth	Real export growth	OLS, production function	Labour growth, GDI/GDP, export share of GDP	Inconsistent evidence of higher productivity in the export sector compared with the non-export sector; thus, suggests caution when analysing empirical results.
Greenaway & Sapsford (1994)	19	1957–1985 1970–1985 1971–1985	Time series	Real GDP growth	Real export growth and export change/output	OLS, 3 versions of production function	Labour growth, rate of growth of investment, dummy for liberalization episodes	Little support for the export-led growth hypothesis and for the positive liberalization effects on growth.

Study	Sample[a]	Period of study	Methodology					Conclusions
			Data set	Economic growth	Exports	Econometric technique	Other variables	
Lee & Cole (1994)	73	1960–1970 1970–1977	Cross section two sub-periods	Real GNP growth	Real export growth	2SLS, production function, Hausman's test	Labour growth, GDI/GDP	Supports the existence of a bidirectional causality between exports and growth.
Van den Berg & Schmidt (1994)	17	1960-1987 Latin America	Time series	Real GDP growth	Real export growth	Phillips-Perron unit root, EG two-step procedure, OLS, VARs, production function	GDI/GDP, population growth	Points to a positive long-run relationship between exports and growth in 11 of the 16 cases analysed. Costa Rica is among those countries where the hypothesis was verified.
Jin (1995)	4	1976(2)-1993(2) Four little tigers of Asia	Time series	Real GDP	Real exports	F-tests, ADF, impulse response function, VARs, EG two-step procedure	Real exchange rate, foreign price shock, output shock	Bidirectional causality was found in the short run but no cointegration was detected; therefore, no long-run relationship is proved.
Figueroa de la Barra & Letelier-Saavedra (1994)	1	1979(1)–1993(4) Chile	Time series quarterly	Real GDP	Real exports and export change/output	ADF unit root, VARs, Johansen's procedure	Labour force, capital, exports + imports/GDP	Supports the hypothesis of export-led growth. The results do not change independently of the indexes of outward orientation used.
Henriques & Sadorsky (1996)	1	1870-1991 Canada	Time series	Real GDP growth	Real export growth	ADF unit roots, VARs, Johansen's procedure, Granger causality test	Terms of trade	No support for the export-growth hypothesis but failed to reject it.
Al-Yousif (1997)	4	1973–1993 Arab Gulf countries	Time series	Real GDP growth	Real growth of exports and export change/ output	ADF unit roots tests, White test, production function	Labour force and GDI/GDP	Evidence that supports the hypothesis in the short run; however, it fails to find any long-run relationship, i.e. does not find cointegration.
Islam (1998)	15	1967–1991 NICs of Asia	Time series	Real GDP growth	Export growth and export change/output	ADF unit root tests, Granger causality test, error correction model	Imports, government non-defence expenditures, trade orientation, investment, instability in exports earnings.	Evidence that supports the hypothesis in the short-run but only in 5 cases was a long-run relation (no cointegration) found.
Shan & Sun (1998)	1	1978(5)–1996(5) China	Time series monthly	Real industrial output	Export growth	Ad hoc production function, VAR	Labour force, investment and energy consumption	Indicates a bidirectional causality between export and real output. Therefore, the export-led hypothesis defined as a unidirectional causal ordering from exports to growth is rejected.
Begum & Shamsuddin (1998)	1	1961–1992 Bangladesh	Time series	Real GDP	Export growth and export change/output	OLS, VAR production function, MLE estimation and arch model	Labour force, GDI/GDP, dummy and trend	Supports the hypothesis.

Sources: Based partially on the studies of Balassa (1985), Greenaway & Sapsford (1994) and Shan and Sun (1998).

[a] Number of countries included in the study.

Similarly, the empirical results from the analysis of DCs do not confirm export expansion as being significant. For example, Catão (1998) has analysed the case of Mexico during the period 1870–1911. Using a new set of macroeconomic data, the author shows that the country's rate of growth in that period was twice as fast as its historical trend and coincided with a substantial expansion of exports; but he indicates that the size of the export sector was very small and had weak linkages with the rest of the economy. Thus, it is unlikely that exports could have propelled the domestic sector of the Mexican economy, as many researchers have claimed in the past.

In general, these empirical studies regarding the relationship between exports and growth can be separated into two categories. The first type of empirical investigation focuses on *cross-section analysis*, and the second points to *country-specific studies*.

A. Cross-section analysis

The first group has employed the growth of exports as a proxy for policy orientation in order to judge the advantages and disadvantages of different types of trade strategies, mostly the inward strategy as opposed to one with an outward orientation. Some studies have combined cross-section analysis with time series (see e.g. Ram, 1987). Most of these studies published in the late 1970s found a significant positive relationship between export performance and the growth of national income. Balassa (1980, p. 18) summarized them, stating that "The evidence is quite conclusive: countries applying outward-oriented development strategies performed better in terms of exports, economic growth and employment than countries with continued inward orientation".

Many of the earlier studies, which include Syron and Walsh (1968), Kravis (1970, 1973a, 1973b) Michaely (1977), Heller and Porter (1978) and Balassa (1978), claimed that these positive effects flourish only after countries have achieved a certain level of economic development. Consequently, their results indicate that nations heavily dependent on agricultural commodities are less likely to benefit from exports, in comparison with countries that have a higher level of development and whose exports contain a higher domestic value added (see e.g. Kohli and Singh, 1989).

Although such empirical investigations can explain to some extent why growth differs across a wide spectrum of countries, this type of cross-section investigation has several deficiencies, which raise doubts about their usefulness.

The first deficiency is that these studies do not provide any useful country-specific information to policy makers in DCs. By assuming the same production function across different types of economies they do not take into account the level of technology, which is likely to differ across countries. Therefore, the empirical results obtained are averages that do not capture the particularities of many developing countries. Second, those results are often disputed because of the limited size of their samples. Most of these investigations included fewer than 12 countries (see e.g. Balassa, 1978; Bhagwati, 1978; Krueger, 1978; Chow, 1987, 1989). Third, even those studies in which the sample was larger were limited to specific types of DCs, i.e. most researchers chose a priori middle-income countries and excluded low-income countries and major oil exporters (see e.g. Feder, 1983; Kavoussi, 1984).

Because of the use of this strategy the empirical results reported in the economic literature based on cross-section data are clearly susceptible to criticism from analysts of low-income nations such as China and India, and especially those that study major petroleum exporters. It is obvious that such results cannot explain the effects of different trade strategies, and in particular the importance of the export sector and its performance, on the rate of growth of many DCs.

The exclusion of oil exporters, in particular those that are members of the Organization of the Petroleum Exporting Countries (OPEC), from cross-section studies has been highly arbitrary, since most of these studies included in their samples middle-income countries which are also highly dependent on exports of primary products and particularly minerals. Examples are abundant: most of these investigations include countries such as Botswana (diamonds), Chile (copper) and South Africa (gold), which still depend to a large extent on exports of minerals to finance imports, these exports representing a large share of total public revenues.

All of these economic activities have four distinctive common characteristics. First, the export sector is highly capital-intensive; second, the ownership, management and technology were frequently under foreign control; third, the export sector is considered an "enclave" which has limited linkages with the domestic economy (although not demonstrated); and fourth, they basically export non-renewable natural resources with low value added.

One of the most popular empirical reasons for excluding major oil exporters is appraised by Tyler (1981, p. 124), who argues that the "statistical relationship is stronger" when major oil exporters, such as the OPEC members, are omitted from the sample in cross-section investigations. This position indicates clearly a prejudice against petroleum exporters that does not have solid support in economic theory. However, it could be interpreted also as a tacit recognition that this group of countries are special cases among DCs, which have to be studied separately and if possible in a country case framework.

B. Country specific studies

Although, like several other authors, Caves (1971, p. 424) stated many decades ago that "Tests of the export-led model, then, must intrinsically involve country case studies — present industrial countries, or now-wealthy nations in their years of rapid growth, or of presently underdeveloped countries ", this second type of examination is still less frequent in the literature. In fact, it is only during the 1990s that a modification has started to occur, for both developing and industrialized countries. These investigations have examined the connection between export performance and the rate of economic growth in particular nations, in some cases using modern time series analysis (see e.g. Khan and Saqib, 1993; Serletis, 1992; Henriques and Sadorsky, 1996; Al-Yousif 1997; Begum and Shamsuddin, 1998).

While the results that emanate from cross-section studies, based on bivariate models or ad hoc aggregate production function, generally agree on the positive relationship between export performance and economic growth, it is odd that the empirical results obtained by researchers involved in country case studies strongly differ between nations and periods of time studied (see e.g. Shan and Sun, 1998). This disparity might imply that although cross-section studies are empirically attractive for researchers, they

could obscure intercountry differences and sacrifice revealing information about the behaviour of many countries.

It is clear, therefore, that cross-section studies might be an unreliable source of knowledge for scholars and policy makers, especially in DCs.

Finally, we come to the issue of causality and in particular whether there is empirical evidence that exports and economic growth have a common trend in the long run (see e.g. Chow, 1987,1989; Sephton, 1989).

The most recent time series investigations concerning DCs that have used the econometric methodology of cointegration have not been able to establish unequivocally that a robust relationship between these variables indeed exists in the long term, namely that the variables are cointegrated (see e.g. Islam, 1998). While some have been able to find a long-run relationship, many others have rejected the export-led hypothesis, i.e. that export expansion causes growth in the long term. In fact, in most studies the results suggest that this arises owing to a simple short-term relationship, a feature that is not surprising if we take into account the fact that the studies that have concentrated their attention on industrialized nations have also been unable to find a robust relationship between these variables (see e.g. Kugler, 1991).

Al-Yousif (1997) attempted to remedy the lack of empirical evidence related to major oil exporters by analysing four Arab Gulf countries: Saudi Arabia, Kuwait, the United Arab Emirates and Oman, which are all members of OPEC. As in other empirical studies in this field, he was unable to verify the existence of a long-term relationship between exports and economic growth in the four major petroleum exporters of the Persian Gulf. Thus, one tentative explanation could be that their exports are highly concentrated on oil and petroleum derivatives; thus, exports, terms of trade and government expenditure tend to have very similar patterns in countries that are greatly dependent on the export of a single mineral or raw material which, moreover, is mostly owned and managed by the State. By the ad hoc inclusion of five variables in the augmented production function, three of which are highly correlated, the model might have been mis-specified, and this could have distorted the results. However, as mentioned before, these results are not significantly different from others that have been published recently, as shown in table 1.

There are very few time series studies concerning Latin American countries which have used modern econometric techniques, and an augmented neoclassical production function as a theoretical framework.

In the case of Chile, Figueroa de la Barra and Letelier-Saavedra (1994), using quarterly data, were able to corroborate the existence of a long-run relationship between exports and growth independent of the index employed. Equally, Van den Berg and Schmidt (1994) found cointegration in 11 of the 16 LACs analysed. In fact, in the case of Costa Rica they were able to verify the existence of a long-term relationship. Although the results seem to endorse in general the export-led hypothesis, they seem to deviate from those recently reported by the empirical literature (Rodrik, 1999).

However, a possible justification of the positive results obtained in the investigation conducted by Van den Berg and Schmidt (1994) is that these researchers employed population and investment as proxies for the appropriate aggregate inputs, i.e. labour force and capital stock. Although they have been

widely used in many cross-section growth studies as well as time series analysis (see e.g. Al-Yousif, 1997), many researchers have had serious doubts about them and have thus expressed their suspicion regarding studies that have tested the export promotion hypothesis by using, for instance, the investment–output ratio, i.e. gross domestic investment (GDI)/gross domestic product (GDP), as opposed to capital stock or population instead of labour force.

For instance, Alexander (1994) among others, rejected the use of these proxies in growth studies not only on theoretical grounds but also from an empirical point of view, and suggested that if capital stock data are available, they should be used instead of investment because of the "significant measurement errors" present in these types of empirical growth studies. However, if data regarding the stock of capital are not available, a common recommendation nowadays is to construct a series of capital stock (Khan and Saqib, 1993).

Even though this is a sensible and logical strategy, the basic constraint that researchers have encountered when trying to construct a series of capital stock for DCs is the non-existence of two vital sets of information: the initial base year for the capital stock and the rate of depreciation.

The use of population as a proxy for labour force is based on very strong assumptions concerning the rate of unemployment, the participation rates and the significance of the underground economy. Although in the case of many DCs all these suppositions could be considered unrealistic, they can be defensible, particularly when the series of population employed as well as labour force is not available for the entire period under investigation or exists only for a limited period.

C. Summary of the empirical literature

From the review of the empirical literature on exports and growth since the late 1960s, which is summarized in table 1, it is clear that the recent evidence available suggests that exports do not necessarily cause growth, as many economists believed and maintained until recently and as early studies suggested.

The results reported are clearly sensitive to the variables employed, e.g. investment instead of capital, population instead of labour force, and also to the theoretical framework assumed, i.e. bivariate models and ad hoc production functions instead of an augmented neoclassical production function.

Although an augmented Cobb–Douglas production function could be considered ad hoc, we can tackle this issue by constructing a simple two-sector growth model, which is based on the following assumptions. First, the economy is composed of two sectors, each of which produces a single good. One is a tradable good and the other is non-tradable merchandise; that is, the first one is produced for the foreign market, while the second is entirely for the domestic market. Second, both sectors demand inputs from the economy, essentially labour and capital. Third, there are significant productivity differences between the two sectors. Fourth, the production of the domestic sector (non-export sector) depends on the volume of exports. This type of model has been widely used since Feder (1983) first presented it. It focuses on the likelihood of non-optimum allocation of resources due to a differential of productivity between the two sectors and where exports can capture a range of positive spillovers and externalities which are not measured by the conventional national

accounts.

From the voluminous literature on the relationship between export expansion and economic growth that is summarized in table 1, it is clear that the results obtained depend not only on the theoretical approach used but also even on the econometric methodology employed. For example, cross-section studies are more likely to corroborate a positive relationship between exports and growth, while the results of time series studies depend substantially on the countries analysed, the period chosen and the econometric method used. In addition, since cross-section studies can obscure particularities of DCs, especially those that are low-income countries as well as major oil-exporting countries, the correct strategy to follow from an empirical point of view is to address the issue in a country case framework, using as much as possible the recent developments in time series analysis.

IV. CASE STUDY

There are four main reasons for choosing Costa Rica as a case study. First, a sufficiently long series of macroeconomic data is available. Second, during the period under investigation, the country has had an enviable record of political stability among DCs; therefore, the political factor can be excluded a priori from the analysis. Third, exports are to some extent diversified and the country does not depend on exports of minerals. Lastly, the country is considered to some extent a success story among LACs because of the systematic increase in GDP and GDP per capita, which has led to substantial improvements in most economic and social indicators. Several questions therefore arise. What were the main engines of growth? What was the role played by exports during the second part of the twentieth century? Furthermore, how did a poor and backward country that experienced a violent civil war in 1948 become the most successful country in Latin America during the second part of the twentieth century?

A. Variables and data sources

The data are derived from both national and international statistical yearbooks. The principal national source was the data available from the Banco Central de Costa Rica (BCC) through publications such as *Actualidad Económica* and *Evolución de las Principales Variables Macroeconómicas*. The principal international source of data was the *International Financial Statistics* (IFS) published by the International Monetary Fund (IMF). In addition, there were the *World Tables*, *Global Development Finance* (formerly known as *World Debt Tables*), *World Development Indicators* and *World Bank Atlas*, published by the International Bank for Reconstruction and Development (IBRD). Other international sources used in this study include the *International Trade Statistics Yearbook* issued by the United Nations (UN) and the *Statistical Yearbook of Latin America and the Caribbean* published by the UN's Economic Commission for Latin America and the Caribbean (ECLAC).[4]

The data used in this analysis have a number of limitations, and they should be highlighted. First, the sample period is limited to 1950–1997 because of the non-availability of official national account data prior to this period. Consequently, the estimates obtained using some of the current econometric techniques have some limitations that must be taken into account.

Second, owing to the shortage of reliable quarterly data for most of the variables under consideration for the entire period, the periodicity of all the data used in this investigation is annual.

Third, because of the inherent difficulties in measuring the stock of physical capital (KT), the lack of official and credible series of aggregated and disaggregated terms for the period studied restricted the inclusion of certain variables and limited the testing of certain models and hypotheses. Thus, one strategy would have been to construct a capital stock series; however, for that task we need two basic sets of information that to our knowledge do not exist: the initial base year for the capital stock and the rate of depreciation.

[4] All the data used in this study are available from the author upon request.

Therefore, the only plausible strategy at this stage to overcome these obstacles was to use data related to investment, specifically GDI and gross fixed capital formation (GFCF), at current prices in millions of Colons, taken mainly from data published by the BCC. It is important to note that this strategy has been widely used by researchers engaged in testing the ELGH for both cross-section and country case studies of DCs and even for industrialized nations.[5]

Fourth, the level of prices was obtained from the deflator of the GDP index or the implicit deflator of GDP. This uses 1990 as the base year and it was taken from the IFS (line 99bi.*p*). It is constructed by the BCC by taking the ratio of GDP at current prices (line 99b*)* and at constant prices in millions of Colons, which are also published by the IFS (line 99b.*p)*.

Fifth, the information related to the labour force comes in the first instance from several national censuses and surveys. In this study the figures regarding employment gathered by national sources were not consistent between different publications, and therefore in order to employ a consistent series, the statistics were taken primarily from the latest *Yearbook of Labour Statistics* published by the International Labour Organization (ILO), and were evaluated by comparing them with the data constructed by the World Bank. Some estimations were made for the period 1960–1997, using the labour force series published by the World Bank.[6] Unfortunately, neither the breakdown of the labour force nor the statistics regarding employment within the economy was obtainable for the period under investigation; therefore, we decided not to use the labour force series and relied on population for this investigation and used as a proxy.[7]

Although this procedure could be considered by some unrealistic from an economic point of view, it can be defended from an econometric point of view. If we take into consideration the limited size of the both series: labour force (1960–1997) and employment (1976–1997), i.e. 38 and 22 observations respectively, this would raise serious questions concerning the robustness of the empirical results obtained through cointegration tests, which are extremely sensitive to finite sample sizes.[8]

[5] Table 1 shows in the column "Other variables" the different variables used by researchers as proxies for the rate of physical capital accumulation.

[6] These results are available from the author upon request.

[7] The first population census carried out in the second part of the twentieth century was in 1950. Since then several censuses have been carried out by the Dirección General de Estadísticas y Censos in 1963, 1973, 1984 and, most recently, in 1994. Unfortunately, the surveys regarding employment only started to be organized systematically in 1976. It is important to note that Costa Rica's rate of natural population, which was already high up to 1950, increased even more during the period 1950–1970 by approximately 4 per cent, a figure which is substantially higher than the average population growth in Latin America (2.7 per cent) with the exception of Venezuela. This was because these two countries experienced an earlier start in the reduction of mortality than other DCs, while the birth rate overall (43 per 1,000) remained the same as in Asia. In addition, in both countries an open-door immigration policy was introduced after the Second World War. However, after 1975 the population growth rate in Costa Rica dropped to 2.5 per cent and during the 1990s it decreased even more, reaching 2.1 per cent per year (Collier et al., 1992).

[8] Furthermore, in many of the studies mentioned in the review of the literature, the average rate of growth of the population has been included as a proxy for labour growth. This is especially important when the researcher has considered that the data regarding the labour force is unreliable or is simply not available. The disadvantages of using population growth (Δp) in this particular case are similar in relation to other studies concerning DCs. As a result, it is important to bear in mind that the use of population in an empirical study such as this could result in overestimating the

We now turn our attention to the problem of how the period for the estimations was chosen and the ultimate sample size used to estimate the model. A priori, there were two options for selecting the period: one was straightforward and consisted in using the whole sample period available (1950–1997), and the other was to focus on a specific period which had a substantial and distinctive economic and, possibly, political regime.

Although Costa Rica had timidly promoted industrialization since the 1940s, it was not until the early 1950s that its effects on the entire economy started to operate. In common with the rest of Central America as well as the rest of Latin America, the country pursued import-substitution industrialization after the Second World War as a development strategy. Successive Governments quickly started to offer incentives for the establishment of industries inside the country through various mechanisms, such as tariffs, subsidies, and local and national tax concessions, all of which were an integral part of a broad and aggressive ISS to protect so-called infant industry from international competition.

The ISS was kept in place by successive Governments until the early 1980s, when a newly elected Government was forced to implement a severe adjustment programme in order to correct major macroeconomic imbalances which were clearly evident by 1981. However, it is important to state that most measures were incremental rather than the typical shock therapy that most of Latin America had to pursue. Since then successive policy-makers have embraced the export promotion (EP) strategy slowly but steadily. An example of their shift of development efforts towards export expansion was the implementation from the mid-1980s of the so-called export contract system, which has been used by the State since then to promote exports.[9]

However, it is clear that the residue of the ISS endured through the early 1990s and diminished at a very slow rate. An interesting fact to take into account is that Costa Rica is now the most industrialized country in Central America and during the entire period studied was characterized by an enviably stable democratic system. Consequently, the period 1950–1997 was used to estimate several models, which coincided to a great extent with the epoch of the ISS and was characterized by a stable democratic system.

Finally, it appropriately to mention that all the empirical estimations in this study were carried out using the time series econometric package Microfit 4.0, developed by Pesaran and Pesaran (1997).

B. Methodology and results

Prior to testing for a causal relationship between the time series, the first step is to check the *stationarity* of the variables used as regressors in the models to be estimated. The aim is to verify whether the series had a stationary trend, and, if non-stationary, to establish orders of integration.

For this purpose, all the variables are examined through graphical inspection of their time series plots. The variables are real gross domestic product (y), real export of goods and services (x), real gross domestic investment or

contribution of labour as a factor of production to the rate of economic growth.

[9] The system was introduced in 1984 as the Government's principal instrument to promote exports, particularly to extraregional markets (Wu and Chuang, 1998).

real gross fixed capital formation (i), and the series of population (p).

All the series are expressed in logarithms and annual rates of growth of all the variables are approximated by first differences of the logarithms of the corresponding variable value of successive years.

All the variables were transformed to constant prices, with the obvious exception of population, by using the GDP price index referred to in the previous section.

The plots of the variables under scrutiny are presented in Figures 1.1 to 1.10 in the appendix. The inspections of all the variables in levels clearly suggest that the series are linearly trended and, given that each variable seems to have a non-constant mean, it appears from the graphs that they are not stationary in levels, i.e. their distribution depends on time.

Subsequently, the plots of the variables in first differences, in contrast, show no evidence of trending time series, different mean values at different points in time or considerable changing variances. The visual evidence provided by the diagrams is consistent with the variables being integrated at an order of 1 denoted as $I(1)$.

Although graphical evidence is useful as a first approximation to decide whether the variables are non-stationary, most econometricians agree that this is clearly an unreliable method to use to make inferences about unit roots and, therefore, at this stage we turn to the formal testing procedures currently available in order to examine each of the variables under scrutiny (see e.g. Harris, 1995).

1. Testing for unit roots

To test the level of integration of the variables that will be employed in the growth equations, the well-known Dickey–Fuller (DF) and the augmented Dickey–Fuller (ADF) tests are used. The aim is to determine whether the variables follow a non-stationary trend and are in fact of the order of 1 denoted as $I(1)$ or whether the series are stationary, i.e. of the order of 0 denoted as $I(0)$.

First, if the series are non-stationary the use of classical methods of estimation such as OLS could lead us to mistakenly accept spurious relationships, and thus their results would be meaningless.

Second, in cases where the series are non-stationary around their mean, the traditional suggestion was to differentiate the series. This usually leads to stationarity, allowing the researcher to apply conventional econometrics (Granger and Newbold, 1974).

However, first differencing is certainly not an appropriate solution to the above problem and has a major disadvantage: it prevents detection of the long-run relationship that may be present in the data, i.e. the long-run information is lost, which is precisely the main question being addressed.

Table 2a. Unit root tests **Time period 1950 - 1997**

Variables in levels (in natural logarithms)	DF[a]	ADF(3)[a]
GDP (LY)	-0.77305	-0.93825
Population (LP)	-2.1639	-2.1218
Gross domestic investment (LGDI)	-2.1721	-0.98142
Gross fixed capital formation (LGFCF)	-1.3986	-1.2207
Exports of goods and services (LXGS)	-2.7721	-1.7953

Table 2b. Unit root tests **Time period 1950 - 1997**

Variables in first differences (Rates of growth)	DF[b]	ADF(3)[b]
GDP (DLY)	-4.9505(***)	-3.3436(**)
Population (DLP)	-6.4818(***)	-3.3894(***)
Gross domestic investment (DLGDI)	-8.3884(***)	-3.3722(**)
Gross fixed capital formation (DLGFCF)	-6.9170(***)	-3.2473(**)
Exports of goods and services (DLX)	-7.7139(***)	-4.1579(***)

Note: The number of lags included in both tests was 3.
[a] The tests include a constant (intercept) and a linear trend.
[b] The tests include a constant (intercept) but not a trend.

* Significant at a 10% level.
** Significant at a 5% level.
*** Significant at a 1% level.

Tables 2a and 2b present the results of both tests, namely the DF and the ADF. The results obtained provide strong evidence that all the time series in levels are non-stationary, which means they are integrated at an order of 1, i.e. *I*(1) at the 95 per cent confidence level. Thus, they have a stochastic trend and they indicate that the null hypothesis cannot be rejected for any of the variables under scrutiny. In addition, when taking first differences, the tests strongly reject the unit root, which means that they are integrated at an order of 0, i.e. *I*(0) at the 95 per cent confidence level, which means that they are stationary.

However, it is important to note that in all cases, irrespective of the order of the augmentation chosen for both tests, the DF and the ADF statistics are all well below the 95 per cent critical value in table 2a or above in table 2b respectively.

The results of the unit root tests performed corroborate previous findings in the empirical literature, i.e. as with most macroeconomic series, the variables under consideration in this study appear to be non-stationary and trended in levels. Only their first differences are stationary. Considering that the data appear to be stationary in first differences, no further tests are performed.

Since the series are *I*(1), the use of traditional econometric techniques such as OLS and the use of tests such as *t*-tests and *F*-tests can lead to mistaken (false) acceptance of spurious relationships between the variables. Actually, these regressions produce empirical results that are characterized by high levels of R^2, which suggests the existence of a statistically significant relationship between the variables in the estimated model.

The spurious problem has other entanglements; for instance, Phillips (1986) demonstrated that the DW statistics converge towards zero, and thus equations that report

high R^2 and low value of DW are typical characteristics of spurious regressions.

Nevertheless, the only fact that in reality could emanate from this type of estimations at this stage is the existence of a contemporaneous correlation between the variables, rather than meaningful economic causal relationships between them.

If, by contrast, the variables are found to have been stationary, it is not necessary to proceed to testing for cointegration since classical regression methods of estimation such as OLS are appropriate and can be applied to stationary variables in levels. Ultimately, if the variables are found to be integrated at different orders, it is possible to conclude that various subsets of variables under consideration may be cointegrated (only where there are more than two variables under consideration). However, further analysis would obviously be required to test this conjecture.

The contribution of Engle and Granger (1987) was to demonstrate that although the individual series could be non-stationary, i.e. they are *I*(1), like those previously examined, a linear combination of them might be stationary, i.e. *I*(0).

Consequently, the next section of the empirical study investigates whether the series under scrutiny are cointegrated, so that a well-defined linear relationship exists among them in the long run. Thus, we proceed to test for cointegration between the variables on levels using several tests, all of which are based on the null hypothesis of no cointegration.[10]

2. Cointegration

Although finding cointegration in empirical studies is not a frequent result, it is one that has attracted the greatest attention among applied econometricians and macroeconomists. This implies that if we wish to estimate the long-run relationship between the two variables, let us suppose, y_t and x_t, it is necessary only to estimate a static model such as the equation (1.1) or (1.2) and check whether the residuals ε_t from the regression are stationary, i.e. *I*(0).

Taking into account that both DF and ADF tests suggest that all the variables appear to be integrated at an order of 1, i.e. *I*(1), and thus have a stochastic trend, and in addition their changes or first differences appear to be stationary, they are all candidates for inclusion in a long-run relationship concerning the interdependence between exports and output, using as a theoretical benchmark an augmented neoclassical production function. Thus, the aim at this stage is to test whether these variables are indeed cointegrated.

Not only has the economic literature adopted a supply-side approach as the basic framework to test empirically the relationship between export and growth, but also nearly all the studies mentioned in the review of the literature have specified a linear relation. Consequently, we will follow this strategy and in the first instance estimate a simple Cobb–Douglas production function using a linear equation of the following form:

$$y_t = \phi_0 + \phi_1 p_t + \phi_2 i_t + \mu_t \qquad (1.1)$$

where y_t, p_t, i_t are real GDP, population, real GDI (subcase a) or GFCF (subcase b) as a proxy of the stock of physical capital respectively. Subsequently, we estimate an augmented Cobb–Douglas production function, such as the following equation, which includes

[10] Although tests with cointegration as null hypothesis do exist, they have not been widely used in the empirical literature (see Maddala and Kim, 1998 p. 205–210).

real exports of goods and services denoted by x_t. As usual, all the variables are expressed in natural logarithms:

$$y_t = \phi_0 + \phi_1 p_t + \phi_2 i_t + \phi_3 x_t + \mu_t \quad (1.2)$$

The results are obtained after estimating equations in levels using two alternative specifications of the so-called static or cointegrating regression that employed GDI and GFCF, such as equations (1.1) and (1.2) through OLS which are shown in tables 3a and 3b.

It is extremely important to note that, with the exception of the adjusted R^2 and the DW statistics, the customary diagnostic tests have not been reported. In addition, even though the ϕ_i coefficients reported in the following table could be interpreted as approximations of partial elasticities, they do not provide any kind of basis for sensible and valid inferences at this stage. Furthermore, they cannot be used to draw any kind of inferences without confirming a priori that the variables are in fact cointegrated. Even if the variables are in fact cointegrated, although the estimates obtained through the cointegration regression using OLS are "super-consistent", i.e. the estimates of ϕ obtained converged faster than in the case of OLS models using stationary variables, the estimated standard errors are not (Stock, 1987). By contrast, if the variables are not cointegrated, the results are meaningless and show only a "spurious correlation" that has no economic significance.

Although from a theoretical point of view the appropriate investment variable is GFCF, in this case we decided to estimate both specifications by using both variables, i.e. using GDI and GFCF for the entire period (1950–1997).[11] The results are shown in tables 3a and 3b, which set out the basic results and in addition include two cointegration tests, namely the CRDW and the EG.

The two cointegration tests are single equation methods amongst various residuals-based tests which have been proposed in the econometric literature since the mid-1980s. They are obtained after estimating the equations in levels using the two alternative specifications of the so-called static or cointegration regression that employed GDI and GFCF.

In all four cases, independently of the specification taken into account and the investment variable employed, the CRDW clearly exceeds the value of 0.99, which is the approximate critical value for $n = 50$ at the 0.05 level of significance. Therefore, the CRDW test is able to reject the null hypothesis that the variables are not cointegrated and, in fact, the residuals estimated suggest that the variables have a long-term relationship in all cases for the 1950–1997 period.

Using the EG cointegration test for equations concerning the neoclassical theory of production, i.e. (1.1a) and (1.1b), the null hypothesis of no cointegration can be rejected at the 5 per cent significance level in one of two cases and can be easily rejected at the 10 per cent significance level in the other one.

[11] Conceptually, GDI includes inventories and this category of investment clearly does not add to output; thus, its inclusion in a production function is questionable and suggests that it is therefore preferable to rely on models that use GFCF from a theoretical point of view.

Table 3a. Static long-run relationship (using GDI) **Time period: 1950 - 1997**

Regressions	(1.1a)	(1.2a)
Dependent variable	LY	LY
Number of observations	48	48
Variables		
C	6.3529	6.0285
LP	0.57646	0.50803
LGDI	0.52568	0.48373
LXGS		0.073454
Adjusted R^2	0.99584	0.99594
DW-statistics (CRDW)	1.2587	1.0895
Engle and Granger cointegration test		
DF	-5.1636 (***)	-4.8702 (***)
ADF (2)	-3.9368(**)	-3.9924(*)

Table 3b. Static long-run relationship (using GFCF) **Time period: 1950 - 1997**

Regressions	(1.1b)	(1.2b)
Dependent variable	LY	LY
Number of observations	48	48
Variables		
C	7.1029	6.5397
LP	0.82170	0.69559
LGFCF	0.44872	0.41197
LXGS		0.092371
Adjusted R^2	0.99780	0.99808
DW-statistics (CRDW)	1.0382	1.0050
Engle and Granger cointegration test		
DF	-4.2200 (**)	-4.5562 (**)
ADF (2)	-3.6131(*)	-4.2268 (*)

Notes: Regressions (1.1a) and (1.1b) are based on the standard neoclassical framework (Cobb–Douglas production function).
Regressions (1.2a) and (1.2b) represent the main case under scrutiny, which estimates an augmented production function that includes exports as a third input of production.

* Significant at a 10% level.
** Significant at a 5% level.
*** Significant at a 1% level.

It is also important to mention that the system variables appear to be cointegrated independently of the investment variable taken into account, i.e. GDI or GFCF. Thus, both tests suggest that a linear combination of the series of output, population and investment exists in the long term.

Furthermore, in the main case under scrutiny, the so-called ELGH, represented by equations (1.2a) and (1.2b), both cointegration sub-tests are able to find evidence of a long-run relationship between exports and output, independently of the investment variable employed — GDI or GFCF.

In general, evidence of cointegration includes high R^2, "apparently" significant coefficients,[12] significantly non-zero CRDW

[12] It is extremely important to note that because the variables are non-stationary, the standard properties of OLS do not hold. Furthermore, because of the autocorrelation of the residuals, the t-statistics from the static long-run relationship are biased upwards

and significant DF and ADF tests on the residuals from the static long-run regressions. Since all of them are present in all the specifications shown in tables 3a and 3b, the evidence at this stage strongly suggests that a cointegration relationship or relationships exist.

However, it is important to mention that although both CRDW and the EG procedure have distinct advantages and in spite of the positive results mentioned earlier, both tests have several important defects. This issue emerged after several Monte Carlo studies that considered the robustness of these tests (and others not employed in this analysis) showed that in general the most standard tests are not powerful. Moreover, most of the studies come to the conclusion that no one test predominates over the others. Thus, the literature holds that it is very important for empirical studies to carry out several tests for cointegration instead of using one single procedure (Maddala and Kim, 1998). In fact, in cases where the sample size is finite, the estimations conducted through the EG procedure are sensitive to the imposition of normalization.

Thus, before making any kind of judgement, some further cointegration tests are employed to verify the existence of cointegration, which will be shown in the next sections.

In the following section, the Johansen procedure will be briefly explained. The method is completely different from the previous ones because it is a multiple equation method where the objective is to identify the cointegration space which is based on canonical correlation methods, a procedure which enables us to test how many cointegration relationships there are.

3. Johansen maximum likelihood approach

The Johansen procedure is a multiple equation method that permits the identification of the cointegration space using a canonical correlation method, which enables the testing of how many cointegration relationships exist.

To briefly illustrate it, let us define $S_t = (y_t, p_t, i_t, x_t)$, a vector of four elements (P = 4) and consider the following autoregressive representation of S_t:

$$Y_t = p_0 + \sum_{i=1}^{k} p_i U_{t-i} + u_t \qquad (1.3)$$

where $\Gamma_i = -(I - p_0,,\ldots\ldots\ldots, p_0)$, and $p = (I + p_1,, \ldots\ldots\ldots, p_k)$.

The Johansen procedure involves estimating equation (1.3) by employing the maximum likelihood (ML) technique and testing the null hypothesis of no cointegration, that is that H_0: ($p = yx$) of r cointegrating relationships, $\xi Y_{t-i} = \eta_{it}$, and where r is the rank of the matrix $p (0 < r < P)$, y is the matrix of weights with which the variables enter cointegrating relationships, and x is the matrix of the cointegrating vector. As stated in the previous section, this procedure could lead us to find up to three independent cointegrating vectors.

The null hypothesis of no cointegration between the system of variables is rejected

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and it is thus not possible to determine at this stage the true significance of the coefficient estimates. Nevertheless, if the variable is insignificant when the original t-value is used, it is obvious that when the "true" or corrected values are employed the variables will still be insignificant; thus, it is feasible to acknowledge the insignificance of the coefficients at the levels stage.

when the estimated likelihood ratio tests statistic, f_i, exceeds the critical value, where

$$f_i = -n \sum_{i=r+1}^{p} \ln (1-\lambda_i) \qquad (1.4)$$

The Johansen ML technique has several distinct advantages in comparison with the EG method illustrated in the previous section to test for cointegration. First, it is an invariant test, which permits the existence of cointegration between the system variables without imposing bias on the estimates. Thus, it does not assume somewhat arbitrarily the direction of the regression, which may lead to different and misleading results. Second, it can identify whether more than one cointegrating vector really exists. Third, it can also estimate the long run or cointegrating relationships between the non-stationary variables using a ML procedure. This last feature could be useful for comparing the estimates obtained with the ones obtained using, for instance, the EG two-step procedure and the unrestricted error correction model.

Summing up, the Johansen test for cointegration is a multivariate unit root test which estimates the cointegrating rank r in the multivariate case, and which is also able to estimate the parameters β of these cointegrating relationships.

To test for cointegration this procedure uses two test statistics. The first is called the *maximum eigenvalue test* (λ_{max}), which tests the null hypothesis that there are r + 1 cointegrating vectors versus the alternative hypothesis that there are r cointegrating vectors. The second, labelled the *trace test*, is employed to test the hypothesis that there are at most r cointegrating vectors.

Even though Johansen and Juselius (1990) initially indicated that the first test might perform better, the Monte Carlo experiments reported by Cheung and Lai (1993, p. 326) suggest that regarding non-normality, skewness in innovations has a statistically significant effect on the test sizes of both the trace and the maximal eigenvalue test. However, they state that between the two Johansen procedures to test "for cointegration, the trace test shows more robustness to both the skewness and excess kurtosis in innovations than the maximum eigenvalue test". Since there is not complete agreement among econometricians, in this case we have preferred to be cautious and prudent, and report and rely on both sub-tests.

Before turning to the empirical estimations, we had to determine the lag K of the vector autoregressive (VAR) model in levels, which is a critical stage of the Johansen ML procedure. The literature recommends the use of the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) to select the lag length of the VAR system, which is achieved by minimizing the AIC and SBC. In most cases, incidentally, both criteria concur in suggesting the use of a VAR with a lag of 2, while in those few cases where the choice criteria are different, we have decided to use the one that suggests the smaller order. This is because if, for instance, we use a VAR of a greater order, i.e. 4, 5, or 6, we could be taking an unnecessary risk of over-parameterization, a situation which is more acute in cases where the sample size is finite such as this one. Moreover, since the data are of annual periodicity, an inspection of the results suggests that serial correlation is not a problem when we set the order of the VAR at 2.[13]

[13] The results of the AIC and the SBC are not reported in this study.

Tables 4a and 4b contain the results obtained by the application of the Johansen procedure to test for cointegration using a VAR at an order of 2. The results correspond to the entire time period (1950–1997). The tests are performed by the use of the so-called augmented production function, which includes exports in real terms and is represented by the specification given by regressions (1.2a) and (1.2b).

Both tests — the maximum eigenvalue and trace statistics — are used to determine the number of cointegrating vectors (r), from which it is concluded that the results support the existence of two cointegrating relationships, which clearly could lead to interpretation problems in this case.

However, Cheung and Lai (1993, p. 326), among other researchers, have suggested that the critical values used to test the number of cointegration relationships through the Johansen procedure can be misleading (see e.g. Enders, 1995). Therefore, corrections to the critical values are strictly necessary when applied to sample sizes of 100 or smaller, typical of finite sample sizes.

Table 4a. Johansen cointegration tests **Equation (1.2a)**
List of variables included: LY, LP, LGDI, LX, intercept **Time period 1950 - 1997**

Null hypothesis	Alternative hypothesis	Maximum eigenvalue test	Adjusted 95% critical values	Trace test	Adjusted 95% critical values
r = 0	r = 1	**36.3943**	**35.7095**	**77.9446**	**67.5537**
r <= 1	r = 2	20.3606	27.8400	41.5503	44.0463
r <= 2	r = 3	15.7565	20.0463	21.1897	25.4905
r <= 3	r = 4	5.4332	11.5705	5.4332	11.5705

Table 4b. Johansen cointegration tests **Equation: (1.2b)**
List of variables included: LY, LP, LGFCF, LX, intercept **Time period 1950 - 1997**

Null hypothesis	Alternative hypothesis	Maximum eigenvalue test	Adjusted 95% critical values	Trace test	Adjusted 95% critical values
r = 0	r = 1	**35.2820**	**35.7095**	**80.2205**	**67.5537**
r <= 1	r = 2	27.5330	27.8400	44.0385	44.0463
r <= 2	r = 3	12.7096	20.0463	17.4055	25.4905
r <= 3	r = 4	4.6959	11.5705	4.6959	11.5705

Note: Table 4a exhibits the estimations using GDI as a proxy of real capital stock, while table 4b shows the estimations using GFCF.

The justification for this correction is the fact that the Johansen cointegration tests are "sensitive to under-parametrization in the lag length". This is due to the fact that the Johansen likelihood ratio (LR) test for cointegration is derived from asymptotic results and statistical inferences which might be inappropriate. Thus, the ML procedure tends to over-reject the null hypothesis of non-cointegration when this is true. This is critical when the system being estimated contains more than two variables (n) or many lags (k), and even more when the sample size is finite. Consequently, the normal critical values based on the asymptotic

distributions are dubious, and the results are often biased and are thus misleading in that cointegration is too often found when they are used. Thus, in this case we have followed the advice given by Cheung and Lai (1993) and have adjusted the critical values, which are shown in table 4a and 4b.[14]

Although this situation is commonly encountered by most applied economists, especially when using time series macroeconomic data, it must be taken into consideration when final judgements are to be made from the empirical results of this study.

Using the normal critical values, the existence of two or even three cointegrating vectors is found. However, when using the adjusted critical values, instead of the normal critical values, we are able only to find one cointegrating vector. That is, the null hypothesis of no cointegration can be rejected at the 5 per cent significance level in all cases. It is also important to mention that the system variables appear to be cointegrated, independently of the specification taken into account and, moreover, in the period of estimation, a situation similar to that encountered in other cointegration tests. That is, the results of the Johansen procedure seem consistent with the previous cointegration tests.

The Johansen procedure can also be employed to obtain long-run parameter estimates that could be used to compare the estimates obtained with the ones obtained through the error correction models. However, in this case we prefer to rely on the error correction approach because of the intrinsic limitations of the Johansen procedure in small sample sizes.

4. Error correction model and cointegration

The initial concept of this type of model can be traced back to the work done by Sargan in the mid 1960s, who considered a class of models subsequently to be labelled error correction mechanisms (ECMs). However, it was the work of David Hendry and his many collaborators during the late 1970s and 1980s that popularized their use among econometric practitioners and especially among applied macroeconomists (see e.g. Enders, 1995; Maddala and Kim, 1998).

Almost at the same time the methodology pioneered by Granger (1981, 1986), Hendry (1986) and Engle and Granger (1987), among others, opened a new channel for testing for cointegration. The Granger representation theorem, broadly speaking, states that if a linear combination of variables is stationary or $I(0)$, then the variables are said to be cointegrated and can therefore be considered to be generated by an ECM. Consequently, they proved that ECM generate cointegrated series and that, to be expressed conversely, cointegrated series have an ECM representation, which allows the short-term disequilibrium relationship within an ECM framework (see e.g. Engle and Granger, 1991).

[14] According to Cheung and Lai (1993, p. 322), the response surface estimation shows that the finite sample bias of Johansen's tests is a positive function of $T/(T- np)$, where T is the sample size, n is the number of variables and p is the number of lags in the VAR. Since $T/(T- np)$ is greater than unity for any finite sample size T, both tests — the maximum eigenvalue tests and the trace tests — "are seriously biased toward spuriously finding cointegration" too often when using the critical values based on asymptotic results and statistical inferences. Thus, in tables 4a and 4b, T = 48, n = 5 and p = 2 the critical values for the entire period of estimations have been corrected by 1.2631. However, there is no complete agreement in this respect; for instance, Doornik and Hendry, amongst other econometricians, have raised doubts about whether this is the preferred correction (see Harris, 1995, p. 88).

According to Hendry (1986, p. 204) one of the most important consequences of the seminal work of Engle and Granger (1987) has been "thus reconciling the two approaches as well as clarifying when level information could legitimately be retained in econometric equations". Furthermore, this led in the 1990s to the development of cointegration tests based on the Granger representation theorem, which are based directly on ECMs.

The first method, which involves estimating an ECM, is the Engle and Granger (EG) two-step procedure, which provides information about the short-term dynamics responses of the variables. The method is straightforward and involves running regressions using stationary time series $I(0)$, which in this case are achieved by using first differences of the variables (rates of growth) and including in the regressions as an explanatory variable the lagged residuals from the levels regressions. This lagged term, RES(-1), is intended to capture the error correction process.

Kremers, Ericsson and Dolado, among other researchers, initiated and developed the second method during the early 1990s (see Kremers et al. 1992). This new approach to test for cointegration suggests the use of the ECM test instead of the residual-based tests. The main reason given by these researchers was that the residual-based tests, which are often used to test for cointegration and which have been discussed, employed and judged in this study in previous sections, had been found to have low power. They argued that these residual-based tests (as well as the DF and ADF test for testing unit roots) imposed a common factor restriction by ignoring equation dynamics in the so-called cointegration regression or static regression given by equation (1.1) or (1.2), which carries over to the second stage of the cointegration systems.

If the common factor restriction does not hold, i.e. the observed error dynamics are spurious because equation dynamics are ignored, then the ECM-based tests can be more powerful than the residual-based test, since the Granger representation theorem states that there is an error correction representation for every cointegration relationship. Although the procedure was initially suggested by Kremers et al. (1992), Zivot and Banerjee among others, have recently highlighted new ways of applying it (see Maddala and Kim, 1998, p. 203-205).

Consequently, we first make use of the EG two-step procedure and subsequently we estimate all the long- and short-run parameters in the ECM in one single step. It is important to note that in both circumstances OLS can be applied. This is because in the first case all the variables included are $I(0)$ and therefore the standard properties of OLS hold, and in the second procedure, although LY_{t-1}, LP_{t-1}, $LGDI_{t-1}$, $LGFCF_{t-1}$ and $LXGS_{t-1}$ are $I(1)$ variables, OLS can still be employed, particularly since we have verified that the variables are cointegrated using other methods (CRDW, DF, ADF and Johansen), and thus there is a linear combination of them that is $I(0)$ (see e.g. Thomas, 1997).

In this case, we have preferred, for several reasons, to follow both methods instead of using only one of them. First, even though the EG two-step procedure is still by far the most popular method for testing for cointegration, it has been widely shown to be biased in small sample sizes. This is due to the fact that the estimations of the initial cointegration regression using OLS are biased, which carries over into the second stage

through the disequilibrium errors and consequently to the short-run parameters.

Second, estimating the ECM in one step will produce an alternative set of estimates to those previously obtained from the cointegration regression and, furthermore, will enable testing for the "true" significance of the variables both in levels and in difference forms. In addition, some studies have suggested that the estimates obtained through this method are superior to those obtained through the EG two-step procedure, in particular when using small sample sizes. However, a word of warning is necessary at this stage: since we are dealing with a small sample size, there is no assurance that the two approaches — the EG two-step procedure and the unrestricted error correction model, also described as the general-to-specific approach — will lead to the same model. Moreover, it is important to note that in both ECMs an implicit assumption is made that the right-hand side variables of the model are exogenous.[15]

Table 5 shows the results of the estimations using the EG two-step method, utilizing first GDI and afterwards directly the series of GFCF for the entire period (1950–1997). From the four different dynamic equations for growth reported in the table, the most important points that emerge from this estimate are the following.

The first two columns show the results of a simple Cobb–Douglas production function, while the last two columns exhibit the regression results that are based on an augmented production function that includes exports as a third input of production.

All the residuals from the four level regressions estimated by OLS are included in lagged form and labelled as RES(-1), with the objective of capturing the process by which the economic agents adjust their prediction errors from the last period. This represents the short-term adjustment mechanism from the equilibrium point, which is always significant, regardless of the specification employed. The significance of the lagged residuals provides strong evidence of the adequacy of an error correction framework.

This implies that an ECM exists whereby the economic agents adjust their behaviour to unanticipated changes in output. In this case, around 50 per cent on average of the adjustment is achieved during the first period. Additionally, when we check the DF and the ADF tests from the residuals of all the regressions estimated based on the EG two-step procedure also provides further proof regarding cointegration, given that the DF is always significant even at the 1 per cent level, which indicates once again that the variables are co-integrated.

If an error correction mechanism exists whereby the economic agents adjust their expectations to unanticipated changes in output, then on the basis of the Granger representation theorem, this also implies that the variables are cointegrated, and vice versa.

[15] It is very important to note that if this assumption holds, the parameters' estimates will be efficient and their distribution asymptotically normal. If so this would allow use of estimated standard errors to determine the true significance of the coefficient estimates. However, if this is not the case, the results will be biased. Note that even though several exogeneity tests have been developed and are widely employed, they were considered beyond the prime objective of this study and therefore, not made use of (see e.g. Engle and Granger, 1991; Maddala and Kim, 1998).

Table 5. Engle and Granger two-step procedure

Regressions	(1.1a)	(1.1b)	(1.2a)	(1.2b)
Years (sample)	1952-97	1952-97	1952-97	1952-97
No. of observations (n)	46	46	46	46
Dependent variable	DLY	DLY	DLY	DLY
Variables				
C	0.011464	0.0041865	0.016741	0.5793E-3
	(1.0420)	(0.43941)	(2.3399)	(0.064478)
RES(-1)	-0.44974	-0.51421	-0.40272	-0.54901
	(-4.1114)	(-4.2585)	(-3.5696)	(-4.3941)
DLY(-1)	0.30432	0.20460	0.28926	0.19127
	(2.9381)	(2.2672)	(2.8427)	(2.2786)
DLP	0.26352	0.63423		0.62874
	(0.98850)	(2.6710)		(2.8690)
DLGDI	0.27070		0.24892	
	(6.3895)		(6.1021)	
DLGFCF		0.31776		0.31525
		(8.3014)		(8.7649)
DLX			0.073156	0.076611
			(1.9099)	(2.4823)
Basic statistics				
R^2	0.56363	0.68254	0.58374	0.73438
Adjusted R^2	0.52106	0.65157	0.54313	0.70118
RSS	0.034133	0.024831	0.032560	0.020777
F-statistics	13.2391	22.0376	14.3739	22.1181
DW-statistics	1.9954	1.9968	1.8200	2.0131
Durbin's h-statistics	0.021752	0.013908	0.84341	-0.054222
Diagnostic tests				
Serial correlation				
LM version	0.14448	0.15682	0.97913	0.031596
F version	0.12603	0.13683	0.86994	0.026807
Functional form				
LM version	0.96588	0.45058	0.86305	0.054832
F version	0.85791	0.39568	0.76483	0.046543
Normality				
LM version	2.0391	0.36476	5.8982(***)	2.8031
F version	NA	NA	NA	NA
Heteroskedasticity				
LM version	0.063676	0.45539	0.3247E-3	0.70331
F version	0.060992	0.43995	0.3106E-3	0.68317
Serial correlation LM				
Statistics CHSQ(3)	1.7655	2.9729	1.9071	0.29179
F-statistics (3, n)	0.50555	0.87520	0.54785	0.078733
Unit roots test for residuals				
DF	-6.7375(***)	-7.1810(***)	-6.0679(***)	-6.6917(***)
ADF (2)	-3.3008	-3.3438	-3.6511	-3.4846

Notes: Regressions (1.1a and 1.1b) are based on the standard neoclassical equation based on the Cobb–Douglas production function, while regressions (1.2a and 1.2b) are based on the augmented neoclassical production function that includes exports as a third input of production. Also note that while regressions (1.1a and 1.2a) use GDI as a proxy of real capital stock, regressions (1.1b and 1.2b) are estimated using GFCF.

The normal t-values of the coefficients are in parenthesis.

NA = not applicable.

* Significant at a 10% level.

** Significant at a 5% level.

*** Significant at a 1% level.

In this case, the coefficients of the error correction term always have the correct sign (negative), and it is statistically different from zero, in terms of both magnitude and significance. The significance of the error correction term might be suggesting at this stage that the variables are cointegrated; however, it is important to note that the ECM test for cointegration requires a new set of critical values to judge accurately for significance and thus to test for cointegration. Even so, since the coefficients are significant at 1 per cent using normal t-value tables, this is considered a preliminary confirmation of the existence of cointegration. In addition, when we check the DF and the ADF tests from the residuals of all the regressions, the DF is always significant at the 1 per cent level, which clearly indicates once again that the variables are cointegrated.

The coefficients of the variables are in general significant and have the correct sign.[16] They confirm that the short-term effects of capital and labour (proxied by population) and investment are extremely important independently of the specification taken into account. The coefficient of population growth (DLP) has the greatest magnitude, followed by the rate of growth of investment (both DLGDI and DLGFCF) and finally the rate of growth of exports (DLX). However, when GDI is used as the investment variable independently of the production function employed, the coefficient of DLP is not significant, and it only becomes statistically significant when the variable employed is GFCF.

[16] In this case, since the variables are stationary, the standard properties of OLS do in fact hold; therefore, the t-statistics are unbiased, and thus it is possible to determine at this stage the true significance of the coefficient estimates and rely on the diagnostic tests which are disclosed.

Although all the models suggest that exports have a positive effect in the short term on growth, the magnitude is very small, a feature which is also present in the static cointegration equation.

In general, evidence includes medium high R^2 that are close to 0.7, which suggests that the overall fit of all the regressions is quite good and that they are able to explain up to 70 per cent of the variability of the growth rates. Despite the fact that neoclassical specification is good overall with some problems of normality in regression (1.2a), it is evident that the overall fit of the regressions is higher when exports are included. In addition, the results of the diagnostic tests employed improve when exports are included and are in general also very good, which suggests the importance of this variable. The tests apparently suggest no problem of autocorrelation of first or higher order, heteroskedasticity, normality or functional form. The only exception is regression (1.2a), which violates the assumption of normality as already mentioned; nevertheless, this problem is completely corrected when a dummy for the year 1981 is included (see table 7).

Now we start from an unrestricted error correction model and test down the model using the general-to-specific approach. Among the four different specifications for growth reported in table 6, the most important aspects of these estimates are the following.

The findings are favourable when using both categories of investment (GDI and GFCF) in the so-called neoclassical production function, but they improve when exports are included and, in particular, when using GFCF. In fact, all the coefficients of the variables in levels LY_{t-1}, LP_{t-1}, $LGDI_{t-1}$,

Table 6. Unrestricted error correction model

Regressions	(1.1a)	(1.1b)	(1.2a)	(1.2b)
Years (sample)	1952-97	1952-97	1952-97	1952-97
No. of observations (n)	46	46	46	46
Dependent variable	DLY	DLY	DLY	DLY
Variables				
C	2.8689	3.7275	2.4046	3.7797
	(4.0793)	(4.2617)	(3.5761)	(4.9059)
LY(-1)	-0.42613	-0.50106	-0.39224	-0.59369
	(-3.9772)	(-4.1515)	(-3.7336)	(-5.1975)
LP(-1)	0.24682	0.42497	0.17752	0.36723
	(2.9524)	(3.9618)	(2.2063)	(3.9768)
LGDI(-1)	0.21146		0.13583	
	(3.1009)		(1.9440)	
LGFCF(-1)		0.20960		0.20254
		(3.5771)		(3.9092)
LXGS(-1)			0.081096	0.10775
			(2.0555)	(3.5231)
DLP		0.48593		0.49363
		(1.8572)		(2.2430)
DLGDI	0.23941		0.19834	
	(5.2774)		(4.5477)	
DLGFCF		0.29052		0.26620
		(6.8064)		(7.2638)
DLX			0.088455	0.088400
			(2.1247)	(2.8567)
DLX(-1)			-0.10622	-0.10183
			(-2.5978)	(-3.0642)
DLY(-1)	0.22259	0.16970	0.32352	0.27610
	(2.0043)	(1.7118)	(2.9348)	(3.0340)
		Basic statistics		
R^2	0.59855	0.69995	0.68942	0.80670
Adjusted R^2	0.54836	0.65379	0.62226	0.75838
RSS	0.031401	0.023469	0.024294	0.015120
F-statistics	11.9276	15.1633	10.2663	16.6935
DW-statistics	1.9057	1.9400	1.6906	1.9395
Durbin's h-statistics	0.48597	0.27504	1.5797	0.26077
		Diagnostic tests		
Serial correlation				
LM version	0.23945	0.024618	2.9458	0.123278
F version	0.20408	0.020347	2.4631	0.094056
Functional form				
LM version	1.0177	0.35803	0.96227	0.63662
F version	0.88231	0.29808	0.76917	0.49448
Normality				
LM version	3.1076	0.97266	11.1519(*)	1.6130
F version	NA	NA	NA	NA
Heteroskedasticity				
LM version	0.11042	0.11905	0.21007	0.61239
F version	0.10587	0.11417	0.20185	0.59367

Notes: Regressions (1.1a and 1.1b) are based on the standard neoclassical equation production function, while regressions (1.2a and 1.2b) are based on the augmented production function that includes exports as a third input of production.

The normal t-values of the coefficients are in parentheses.

NA = not applicable.

* Significant at a 1% level.

$LGFCF_{t-1}$ and $LXGS_{t-1}$ are significant and have the correct sign, independently of the specification and the framework used, a feature that is clearly desirable.

This evidence corroborates once again the fact that, in the long run, labour (proxied by population) and investment were the main forces that drove the Costa Rican economy during the second part of the twentieth century. Moreover, the coefficients are relatively stable independently of the specification taken into account. The coefficient of population (LP) has the greatest magnitude, followed by investment (LGDI or LGFCF) and finally exports (LXGS).

With regard to the coefficients capturing the short-term effects, they show once again that population growth (DLP) has the greatest magnitude, followed by investment independently of the variable taken into account (DLGDI or DLGFCF), and ultimately the rate of growth of exports (DLX).

The first two regressions, based strictly on the neoclassical framework, include medium high R^2 that are between 0.6 and 0.7, which suggests that the overall fit of the equations is fairly good and that they are able to explain up to 70 per cent of the growth of output. Despite the fact that neoclassical specification is good overall, it is obvious that the overall fit of the regressions improves when exports are included with R^2 that are between 0.7 and 0.8, which suggests once again the importance of this variable, in terms of both significance and magnitude. Additionally, all the diagnostic tests used are in general also very good, which indicates that there is no problem of autocorrelation of first or higher order, heteroskedasticity, normality or functional form. The only exception is regression (1.2a), which violates the assumption of normality. Nevertheless, it is extremely important to state that this problem is also corrected when a dummy for the year 1981 is included (see table 7).

The economic justification for the inclusion of a dummy variable rests entirely on the economic crisis that started to severely afflict the Costa Rican economy in 1981. This situation forced a newly elected administration to implement a harsh adjustment programme in 1981 and, therefore, the dummy (DUM81) that is included in the estimations affects the short term not the long term. However, it is important to note that the coefficients of the variables do not change significantly in terms of magnitude and their significance, a feature that suggests that the dummy variable is capturing in reality the negative short-run effects that the economy stumbled upon during that year.

In addition, the estimation results show that all the coefficients of $y_{1,t-1}$ are statistically different from zero in terms of both magnitude and significance. The significance of the coefficients suggests once again that the variables are cointegrated across different equations, independently of the specification.

As mentioned earlier, even though there is no guarantee that both procedures will lead us to the same model, in this case there are definite similarities that should be highlighted. From both procedures it is obvious that the coefficient of DLP becomes insignificant when the investment variable employed is GDI independently of the specification, and it only becomes statistically significant when GFCF is used as the investment variable.

Table 7. EG two-step procedure and unrestricted error correction model with DUM81

Regressions	(1.2a-D)	(1.2a-D)
Years (sample)	1952-97	1952-97
No. of observations (n)	46	46
Dependent variable	DLY	DLY
Variables		
C	0.019333	1.4847
	(3.2911)	(2.6876)
RES(-1)	-0.28684	
	(-3.0019)	
LY(-1)		-0.29359
		(-3.5038)
LP(-1)		0.059281
		(0.88939)
LGDI(-1)		0.11876
		(2.1872)
LXGS(-1)		0.076829
		(2.5098)
DLP		
DLGDI	0.22789	0.20005
	(6.7728)	(5.9136)
DLX	0.18157	0.19286
	(4.6061)	(5.0300)
DLX(-1)		-0.097382
		(-3.0659)
DLY(-1)	0.18091	0.19343
	(2.0939)	(2.1662)
DUM81	-0.13677	-0.13476
	(-4.6239)	(5.0502)
Basic statistics		
R^2	0.72873	0.81821
Adjusted R^2	0.69482	0.77276
RSS	0.021218	0.014220
F-statistics	21.4912	18.0032
DW-statistics	1.9111	2.0046
Durbin's h-statistics	0.37191	-0.019489
Diagnostic tests		
Serial correlation		
LM version	0.041499	0.012230
F version	0.035215	0.0093080
Functional form		
LM version	2.3654	0.14160
F version	2.1141	0.10807
Normality		
LM version	0.63813	0.11321
F version	NA	NA
Heteroskedasticity		
LM version	0.47253	0.61223
F version	0.45667	0.59351

Notes: Both regressions are based on the augmented production function that includes exports as a third input of production, in addition both include a dummy for 198 (DUM81).

The normal t-values of the coefficients are in parentheses.

NA = not applicable.

5. Cointegration tests: An assessment

The consistency of the results obtained using five different tests employed in this investigation suggests that the results concerning the existence of a long term relationship between investment, labour (proxied by population), exports and growth appears to be clear-cut across different regressions. In fact, they are definitely robust to different specifications taken into account and the method employed to test for cointegration. Furthermore, it is evident that even though the long-term effects of exports on growth are different from zero, they are smaller if we compare them with the effects of traditional factors of production.

Given that we have confirmed that the variables are cointegrated, we can use the coefficients estimated from the static long-run equations to verify whether the overall production function followed constant returns to scale. This can be done because the coefficients from the static cointegrating regression are "super-consistent" (Stock, 1987).

The Cobb–Douglas production function assumes that the sum of elasticities with respect to all inputs is equal to unity. In this case, the contribution of population and investment to total output was a little less than two thirds and over one third respectively, which is what most studies would expect if we had assumed a priori constant returns to scale. It is important to emphasize that the sum of elasticities did not change substantially when exports were included in the regressions as an additional input of production and, furthermore, in all the cases, the value shares of inputs in the value share of outputs sums to unity or very close thereto. All of this clearly suggests that overall growth in this case exhibited constant returns to scale in the 1950–1997 period.

To recapitulate, the empirical evidence obtained in this case clearly suggests that exports operated as an additional engine of growth. However, it is very difficult to accept the idea that growth in the long run was export-led as some studies have attempted to indicate in the case of Costa Rica (see e.g. Jung and Marshall, 1985; Van den Berg and Schmidt, 1994). The findings imply that this was clearly not the case, and in addition it is certain that the overall economic performance of this Central American country from 1950 onwards was mainly driven by traditional inputs of production.

V. CONCLUDING REMARKS

The main objective of this study has been to investigate the relationship between exports and output using time series data on Costa Rica. The empirical results have shown that the ELGH hypothesis can be verified in this particular case.

On the basis of annual data extending from 1950 to 1997, various tests detect the existence of a long-term relationship between GDP, investment, population and exports. That is, the results suggest that the variables under consideration are cointegrated and therefore share a linear common trend, i.e. they move together in the long term.

Furthermore, the available evidence indicates that the strong correlation between the series is not spurious as many empirical studies have found it to be and that the co-movement between these variables reflects much more than an accounting identity. Additionally, the existence of cointegration between exports and output through different test justifies the application of the error correction approach. In fact, both methods — the EG two-step procedure and the unrestricted error correction model — make it possible to distinguish between short-run and long-run effects of exports on growth but also allow further checking for cointegration.

What are the economic interpretations of these empirical findings? Can these results be explained in terms of the economic development of Costa Rica in the second part of the twentieth century?

The first and most obvious answer is that exports can explain not only cyclical changes in output (short-term) but also the long-term trend of output. Moreover, the fact that the results obtained through the unrestricted error correction model indicate that all the variables had the correct sign, and were significant, corroborates the view that investment and population were significant in determining the overall rate of growth of output in the long run, but also indicates that exports were a significant variable in the growth process.

It is reasonable to recognize that a large number of factors, such as capital accumulation, entrepreneurship, innovation, learning by doing and human capital accumulation, determine economic growth. However, in this particular case it should be emphasized to the reader that the evidence obtained from the supply side implies that growth was driven primarily by traditional factors of production and, although exports acted as an additional engine of growth, the impact was relatively small and limited.

The evidence obtained is in fact in accordance with recent studies of South-East Asia which highlight the importance of investment and in particular physical capital accumulation in the extraordinary growth experienced by the so-called Four Tigers (see e.g. Krugman, 1994; Young, 1995). It also openly raise questions regarding the traditional story and express serious reservations about the ELGH in general and the so-called new orthodoxy. In addition, this exercise clearly endorses the neoclassical theory of production and supports to a lesser extent the so-called new-fashioned economic wisdom represented by the advocates of free trade and the ELGH (see e.g. Edwards, 1998; Frankel and Romer, 1999).

However, a crucial question arises. If investment was the main force driving this economy in the last 50 years, and we accept and embrace the neoclassical economic theory, then marginal productivity of capital must be diminishing as time goes by. What does this mean? It means that in the long run the Costa Rican economy is not going to be able to grow as it did in the recent past unless there is a systematic increase in its overall productivity. As a matter of fact, the meagre and sluggish performance of the economy during most of the 1990s could be an indication of this and opens the door to other studies concerning TFP growth and determinants of investment.

Even though, since the 1980s many researchers, including Balassa (1983) and Edwards (1992) among others, have employed the growth of exports as a proxy for policy orientation (see e.g. Levine and Renelt, 1992). This led to classifying studies that investigated empirically the relationship between the pace of exports expansion and the overall economic performance as a distinct category of work related to trade policy orientation. In this study I do not take this into consideration because the use of export growth as a proxy for trade orientation is first of all highly suspect. Furthermore, the issue of categorising the type of trade orientation followed by Costa Rica was not an objective of this investigation.

It should be emphasized that the intention of this study was not to derive a growth model for the Costa Rican economy, nor identify growth determinants, participate directly in the export promotion-import substitution controversy or determine the effects of trade policy orientation. Its scope was more limited and thus the results should not be used for any of the purposes mentioned above and furthermore the empirical results should be taken with the appropriate caution. Rather the driving force was to study the long-term properties of the main generating forces of growth and in particular to focus on the role of exports. The paper's main objective was to inquire about the validity of the ELGH at the aggregate level in the particular case of a developing country, which is considered by many to be a success story.

As for future research, however, an analysis of Costa Rica's growth requires an understanding of the reasons that motivated foreign and domestic entrepreneurs to invest in this economy. Was the overall physical capital accumulation driven by direct investment or was domestic capital formation mainly responsible for the high rates of growth? Which type of capital accumulation was crucial in reaching a sustained rate of growth from 1950 onwards?

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APPENDIX

Figures

Figure 1.1. Gross domestic product in 1990 prices

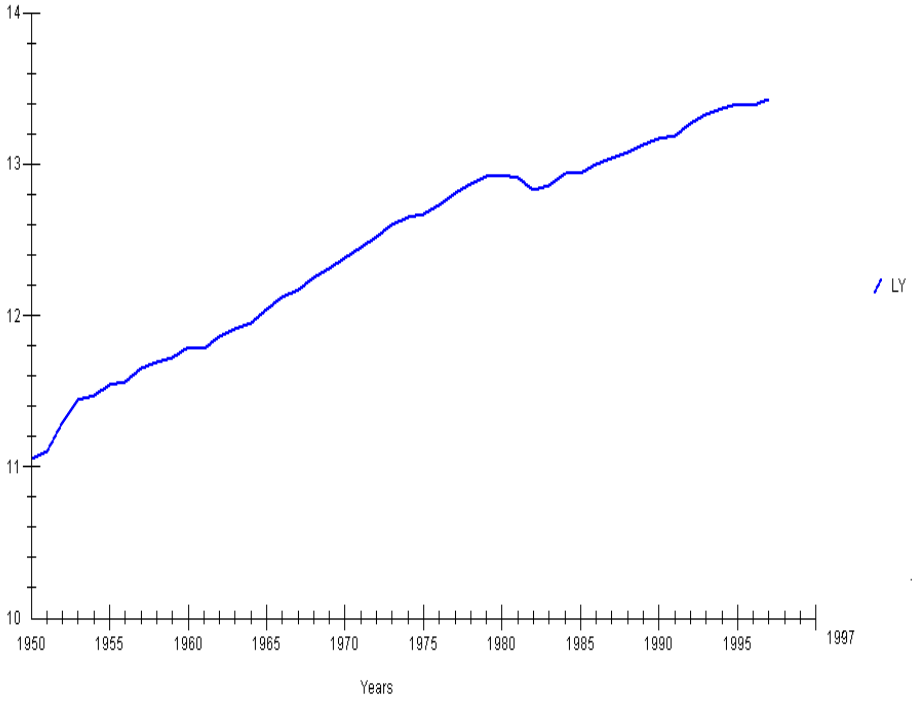


Figure 1.2. Rate of growth of GDP

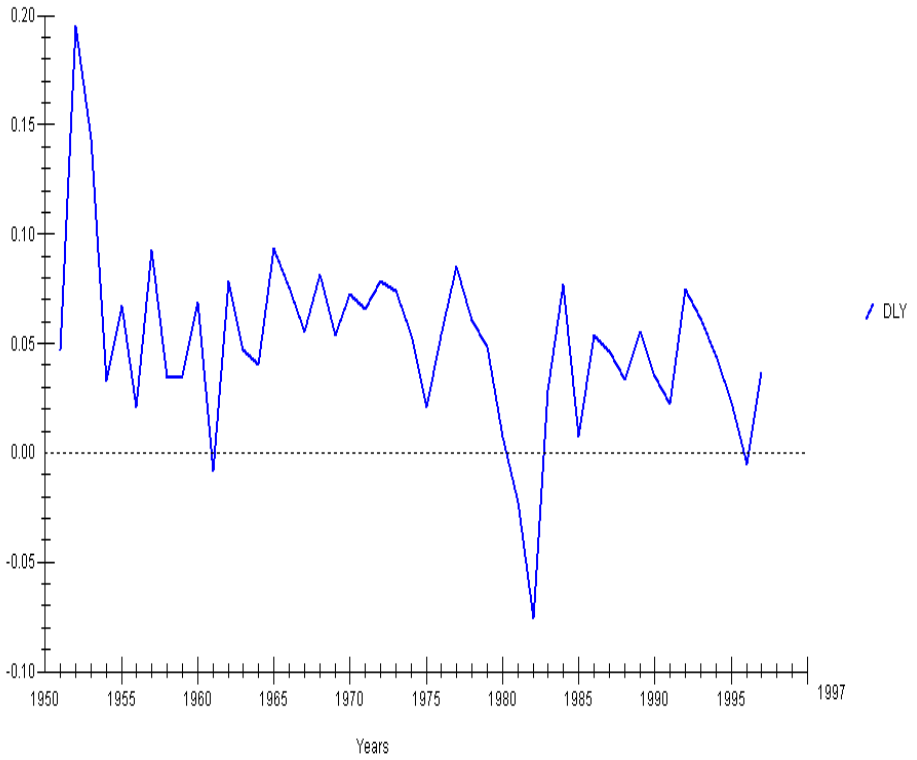


Figure 1.3. Population

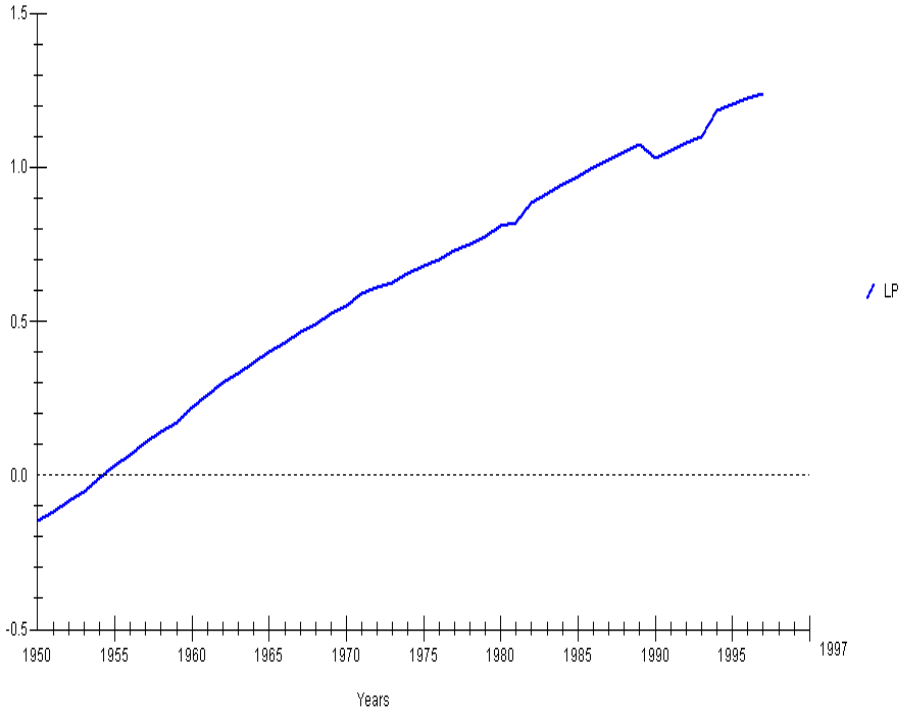


Figure 1.4. Rate of growth of population

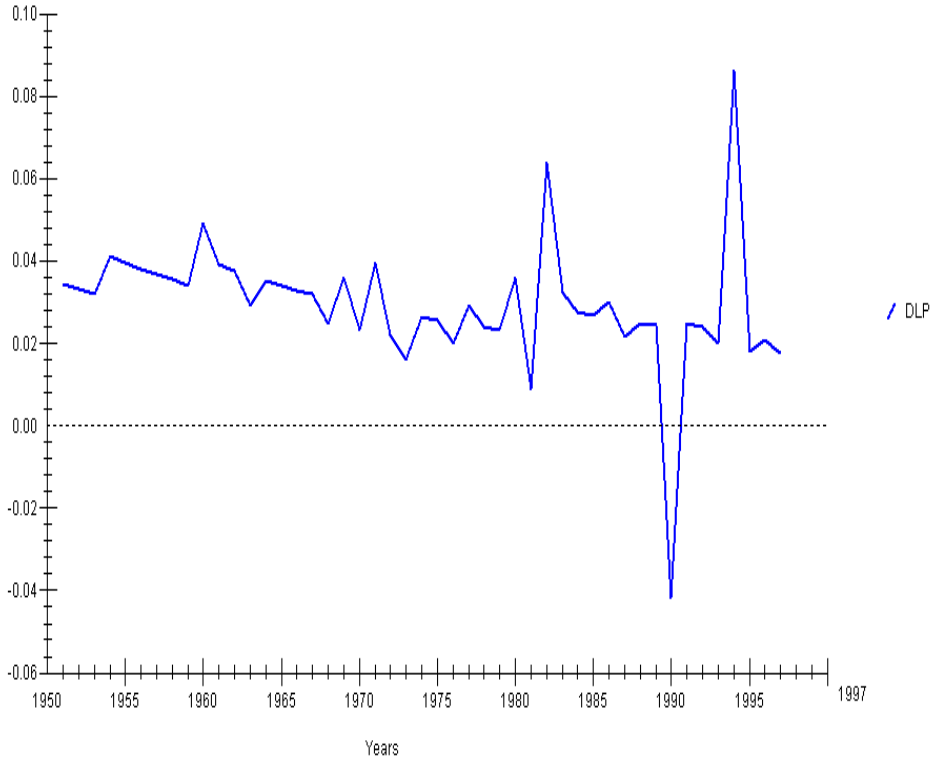


Figure 1.5. Gross domestic investment in 1990 prices

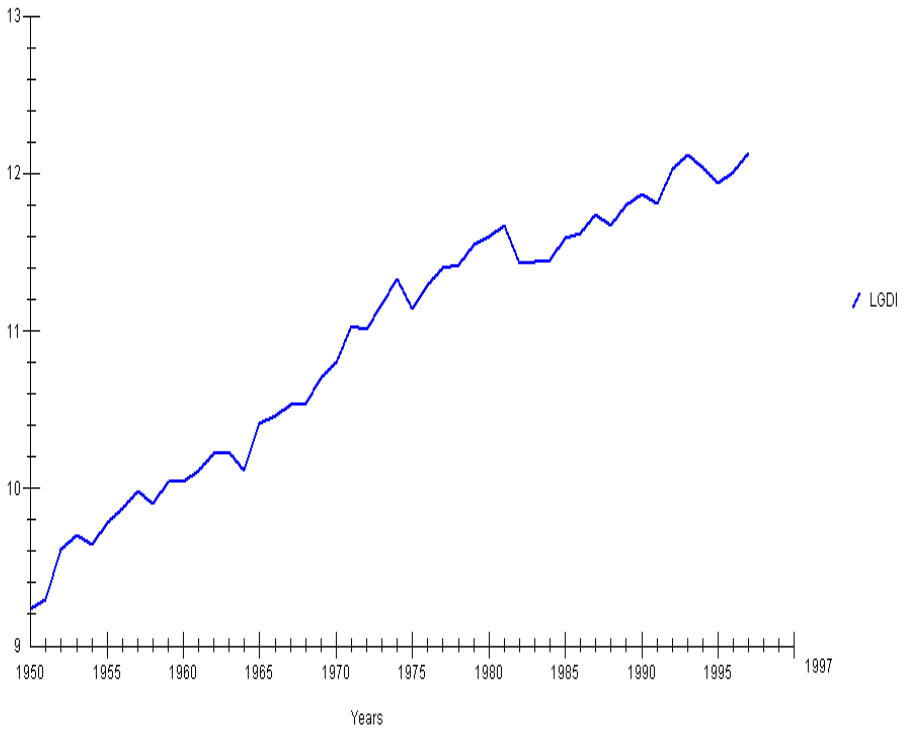


Figure 1.6. Rate of growth of GDI

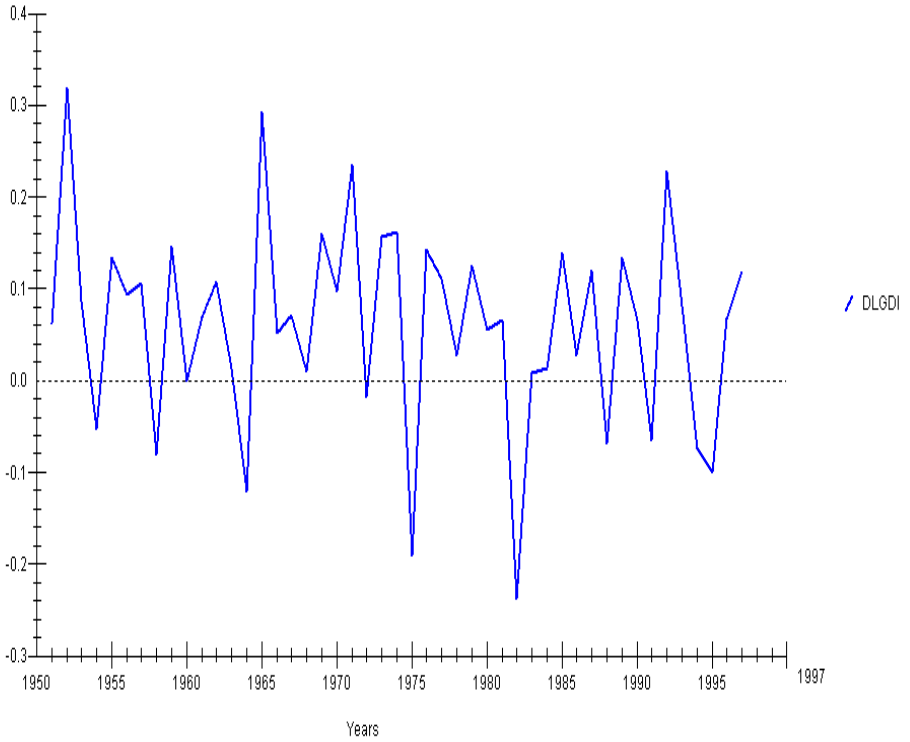


Figure 1.7. Gross fixed capital formation in 1990 prices

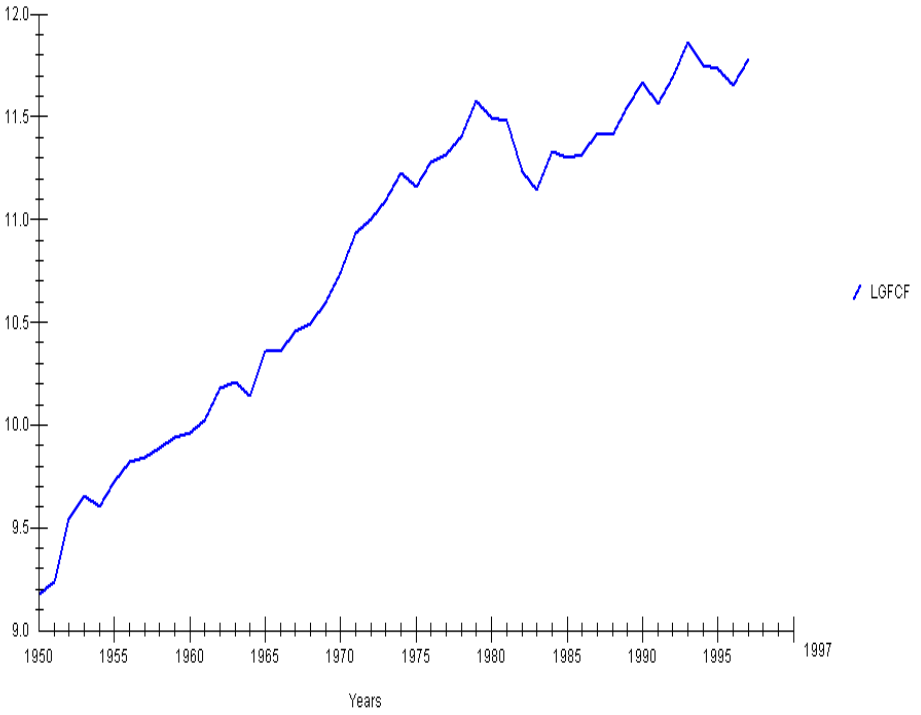


Figure 1.8. Rate of growth of GFCF

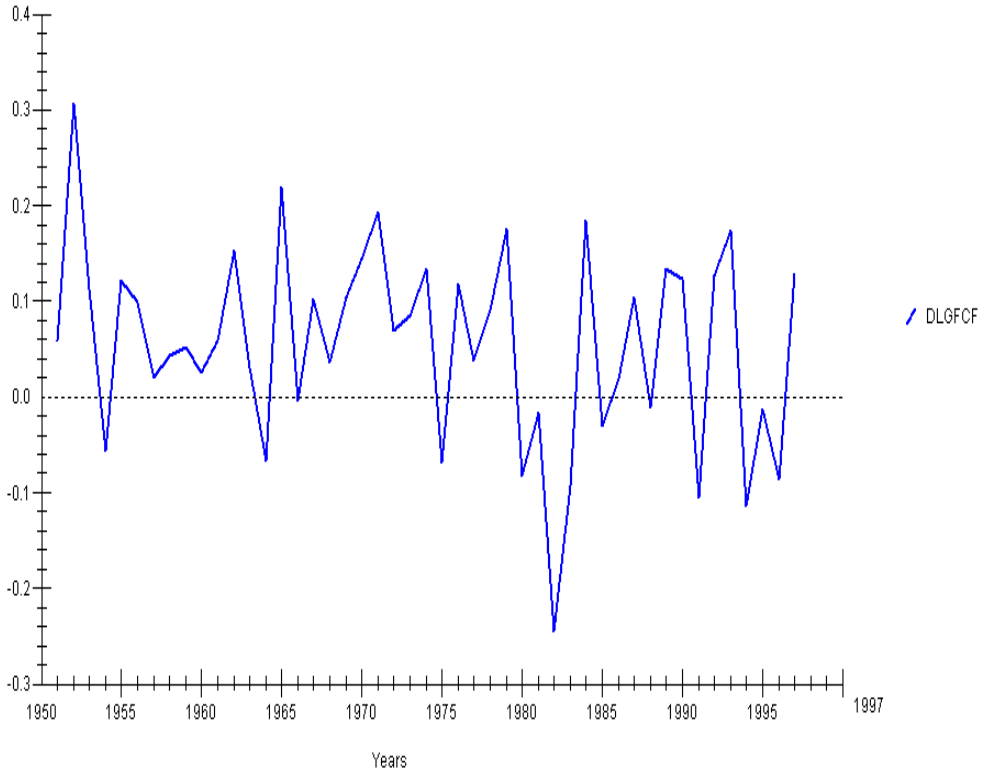


Figure 1.9. Exports of goods and services in 1990 prices

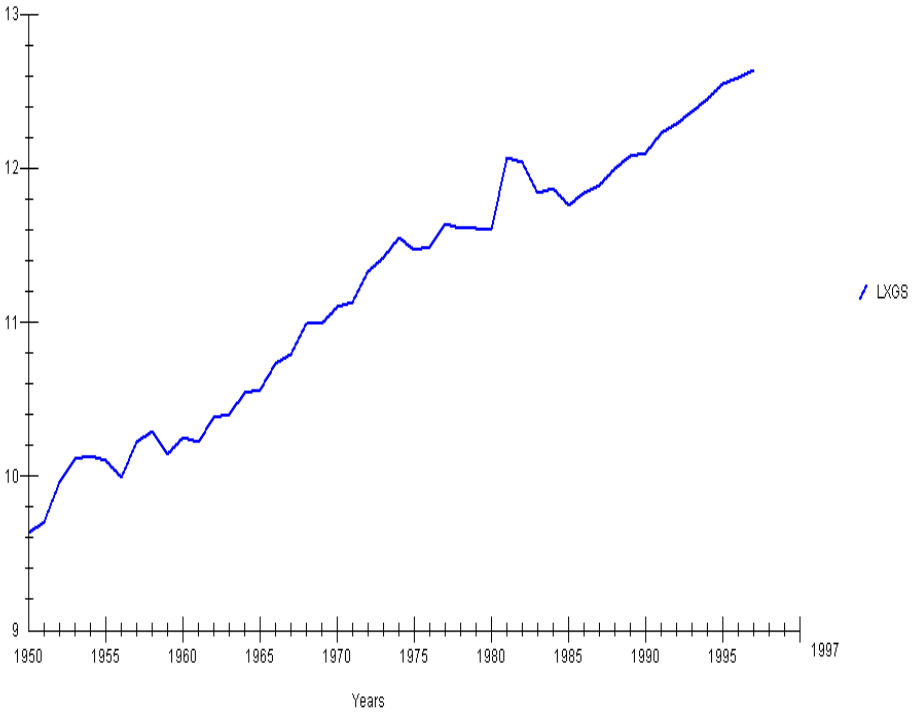
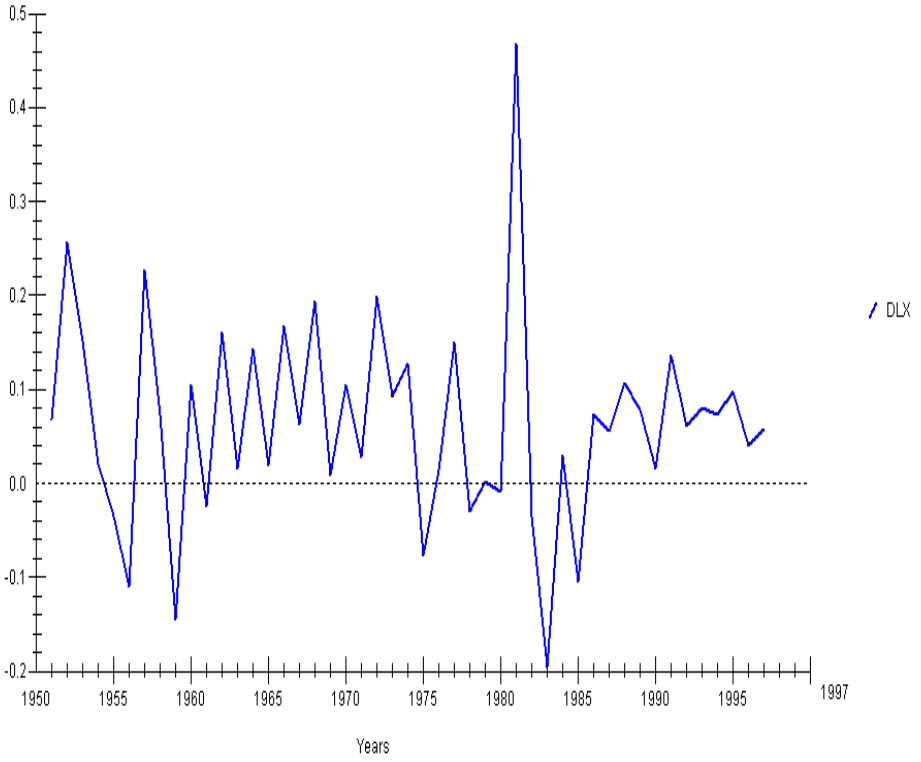


Figure 1.10. Rate of growth of exports of goods and services



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