From Coffee Beans to Microchips: Export Diversification and Economic Growth in Costa Rica.

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ABSTRACT

During the early 1980s Costa Rica experienced its worst economic crisis since World War II, which led to the abandonment of the import substitution model of development adopted in the 1960s. This severe economic downturn also spurred the implementation of a series of new policies supporting foreign investment in high-value-added industries and the diversification of the nation's exports. As a result, Costa Rica has diversified its economic activity, moved away from its historical dependence on agricultural exports, and gained new competitive advantages in the manufacturing sector. This study presents a straightforward generalization of the model proposed by Herzer and Nowak-Lehnmann's (2006) to test the hypothesis that export diversification has influenced economic growth in Costa Rica via externalities of learning-by-exporting and learning-by-doing. To examine whether a long-run relationship exists between export diversification and economic growth, two types of statistical methodologies are used: the bounds test to cointegration within a distributed lag (ARDL) framework and the dynamic OLS (DOLS). Overall results sufficiently conclude that, at least in the Granger's sense, there is no long-run causality between export diversification and economic growth in Costa Rica over the period of 1965 to 2006.

1. Introduction

Costa Rica is an interesting case study not only because it has been often lauded for its long democratic tradition and relative economic stability, but also because the economy of this small nation has evolved from being heavily reliant on its coffee and bananas exports to become the highest software exports per capita in Latin America. As the World Bank states "…it has evolved from the production of its "golden bean" (high quality coffee beans) to the "Golden chip"." (World Bank, 2006). Figure 1 shows that Costa Rica has consistently outperformed Latin America throughout the 1961 to 2007 period, with the former growing at an average rate of almost 5 percent, while the latter grew at an average rate of 3.82 percent.

However, and because the size of its domestic market, Costa Rica has a limited capability of sustaining Gross Domestic Product (GDP) growth on the demand size. Moreover, its small domestic market reduces the chances of producing certain goods that are subject to economies of scale. Thus, the growth of exports and export diversification could be the solution to these constraints, and may be the reason why international trade and exports have played such an important role in this country. Furthermore, as a result of decades of policies with strong emphasis on providing universal education and health care to its population, today Costa Rica has a well developed human capital. According to the Heckscher-Ohlin trade theory, given its endowment of a well-educated workforce, Costa Rica has comparative advantage in the production of knowledge-intensive goods. Well aware of these facts, Costa Rican governments have been playing a very active role in the diversification of the nation's economic activities and export supply. This paper uses two

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econometric procedures, the ARDL and DOLS, to test the hypothesis that both vertical and horizontal export diversification has positively influenced economic growth in Costa Rica via externalities of learning-by-exporting and learning-by-doing.

The remainder of the paper is organized as follows: Section 2 discusses the literature on the linkages between export diversification and economic growth, and presents a brief discussion on the export diversification experience in Costa Rica. Section 3 presents the empirical model and the econometric methodology employed in this paper. Section 4 offers the empirical results, and section 5 concludes.

2. Review of empirical literature

2.1 Export diversification and economic growth

There has been little systematic empirical research on the linkages between export diversification and long term growth, and the literature on this issue has attempted to answer two important questions: Does export diversification have any effect on long-run economic growth? Is it possible for a country to improve its economic performance by exporting different types of goods? (Gutiérrez-de-Piñeres and Ferrantino, 2000).

"Does export diversification have any effect on long-run economic growth?"

A number of empirical studies have presented evidence that export diversification is conducive to higher per capita income growth. The generally proposed hypothesis is that nations with more diverse economic structures are more likely to consistently sustain periods of high economic growth than those nations with more concentrated export structures. Empirical growth literature has shown that income volatility has a negative impact on a nation's economic growth. Along this line of thought, the so-called "portfolio effect" is a widely accepted argument in favor of export diversification that has been borrowed from the finance literature. It is often cited as a mechanism through which export diversification can lead to higher economic growth, and its rationale is that a well diversified export portfolio can reduce the instability of export earnings. This is desirable because, instability in a country's export earnings can have unfavorable effects on domestic variables such as government revenues, investment, import capacity, and producers' income. In his seminal paper, Love (1986) proposed that a country should avoid having a heavy concentration of its exports on few products, because it reduces a nation's capability of partially offsetting fluctuations in

some export sectors with counterfluctuations or stability in other sectors. His findings concluded that export concentration had a positive and significant influence on instability of export earnings. Jansen (2004) demonstrated that income volatility in small economies is explained, to a great extent, by their high level of economic openness and by their lack of export diversification. Hence, these countries would benefit from further diversification of their exports. In another study, Al-Marhubi (2000) hypothesizes that instability in export earnings is a major source of economic uncertainty in many commodity-exporting nations, because under an unstable domestic, market investment in those nations become riskier. In other words, an increasing instability of a nation's export earnings may discourage investments, and in turn negatively impact economic growth. Using a cross-country sample of 91 countries for the period of 1961-88, Al-Marhubi found a positive and robust relationship between export diversification and economic growth. In his study, Hesse (2008) presents an extensive literature review on export diversification and economic growth, and estimates a simple augmented Solow growth model to investigate the relationship between export diversification and income per capita growth. His findings present strong evidence that export concentration, measured by a Herfindahl index, is detrimental to GDP per capita growth in developing countries. Feenstra and Kee (2004) studied the effects of sectoral export variety on a country's productivity. After estimating a translog GDP function system for a sample of 34 countries going from 1982 to 1997, they observed that a 10 percent increase in export variety of all industries leads to a 1.3 percent increase a country productivity.

Other empirical studies have tested the positive links between export diversification and economic growth for specific regions or countries. Gutiérrez-de-Piñeres and Ferrantino, (2000) studied Latin American countries and found associations between episodes of export diversification and rapid economic for the last 35 years. Chile, Colombia, Uruguay, El Salvador, Paraguay, Bolivia and Costa Rica are examples of countries that experienced significant diversification of its exports and a relatively strong growth performance. The results of their study show that export specialization was significantly and negatively correlated with economic growth after controlling for other common determinants of growth. Still in Latin America, Gutiérrez-de-Piñeres and Ferrantino (1999) identified examples of countries in where knowledge gained from exporting activities were later utilized by other exporters. This knowledge can take several forms such as the diffusion and awareness of export opportunities, diffusion of transportation and production technologies, and development of domestic services (i.e. insurance, banking, etc.). In the case of Colombia, export of fresh cut flowers was followed by other highly perishable goods. After applying cointegration and error-correction methodologies, the authors found no long run effect of

export diversification on economic growth. In Chile, the export success of table grapes was later followed by the export of an array of fresh fruits. Herzer and Nowak-Lehnman (2006) studied the Chilean experience and tested the hypothesis that export diversification has an impact on economic growth via externalities of learning-by-doing and learning-by-exporting. Using time series methodologies their results showed that both horizontal and vertical export diversification have positively influenced Chilean economic growth. At the regional level, Matthee and Naudé (2007) found that South African regions with more diversified export supplies experienced higher economic growth rates and contributed more to the nation's overall exports. Furthermore, it was horizontal diversification, and not vertical diversification per se, that was associated with higher economic growth. In other words, an increase in the range of products exported had a positive effect on growth.

"Is it possible for a country to improve its economic performance by exporting different types of goods?"

To answer this second question, several studies have tested the hypothesis that the exports of certain products have different effects on a nation's economic growth. Greenaway et al. (1999) disaggregated exports into key components based on the argument that different components have different effects on GDP growth. Their findings suggest that not only export growth is an important driver of economic growth, but also that export composition does matter. His findings corroborate the widely held view that the manufacturing sector produces larger externalities than other economic sectors. Such externalities may result in horizontal diversification and improvements in the ability of all industries to compete internationally (Matthee and Naudé, 2007). Furthermore, the share of manufactures export in total exports is a good indicator of the degree to which an economy managed to develop forward linkages and reduced its dependence on the primary sector. In their study, Levin and Raut (1997) concluded that an increase in the ratio of manufactures export to total export has a positive and significant impact on economic growth, whereas a growth of the primary export share has a negligible effect. In another paper, Fosu (1990) tested the effect of manufactures export on growth comparatively to primary sector export and concluded that, in developing countries, the export from the manufacturing sector has a positive impact in the economy. In another study, Moreno-Brid and Pérez (2003) studied the role that the external sector has played on the long-run rate of economic growth of three Central American countries: Costa Rica, El Salvador and Guatemala. In the case of Costa Rica, shifting from exporting primary commodities to more manufacturing/high-technology goods was found to increase the

income-elasticity of its exports. Finally, Balaguer and Cantavella-Jordá (2004) demonstrated that in Spain, the structural transformation in export composition was a key factor for the nation's economic development. In addition, evidence was obtained on how the allocation of resources towards more industrialized export sectors had a positive impact on the economy. These results provide evidence that an increase of the share of manufactures exports may lead to economic growth.

The existing research on this topic is still scarce, and the discussion on how export diversification affects economic growth is by no means closed. Moreover, empirical findings of whether vertical and/or horizontal export diversification and economic growth are cointegrated are limited to a few cross-country and country level studies, warranting further study.

2.2 Overview of Costa Rica's export diversification experience

Until the second-half of the twentieth century, Costa Rica was characterized as an agro-exporting economy highly dependent on the export of few agricultural products, with coffee and bananas alone accounting for almost 90 percent of the value of total exports, and driving economic growth through the 1960s (Mesa-Lago *et al.*, 2000). However, and because of the vulnerability of this commodity-export model to external shocks, Costa Rican authorities implemented a new development strategy that would lead the country through an economic transition during the 1960s and 1970s. The country veered toward a model of development based on industrialization through import substitution, in particular of consumer goods. For that, Costa Rica imposed high tariff rates for consumer goods, and maintained low import taxes for intermediates and capital goods. In addition, export taxes were applied on those goods in which Costa Rica had a strong comparative advantage (Cattaneo *et al*, 1999). The import substitution industrialization (ISI) strategy was relatively successful and resulted in high rates of economic growth and economic development for more than two decades. However, in the beginning of the 1980s, Costa Rica went through its worst economic crisis since World War II that clearly evidenced the limitations of the ISI model. With the close support of international financial organizations, Costa Rica adopted a new model of development that would include export promotion and export diversification. Very quickly, this new orientation secured a wide consensus among Costa Rican policy makers, and numerous structural reforms were implemented throughout the 1980s. As part of this new export-led model Costa Rica authorities successfully created free trade zones (FTZ) regimes

in where fiscal and economic incentives were granted to those firms that would locate their operations. This policy was arguably the most important step toward the promotion of new exports and attraction of foreign firms, and coupled with Costa Rica's relatively educated populated, political stability, and a series of pro-investment public policies allowed the country to become an important offshore manufacturing and customer service for a number of multinational corporations. No doubt the establishment of these FTZ increased exports greatly; however Mitchell and Pentzer (2008) observe that it was mainly large foreign companies that were able to take advantage of the incentives offered by the Costa Rican authorities. The most representative example of this is was the decision of Intel to invest in a microprocessor plant in Costa Rica in 1997 with an indisputable impact on the national economy [1]. Nevertheless, during the 1990s Costa Rica's export supply went through major structural changes: with the share of manufacturing exports continually increasing, while the economic dependence on traditional export commodities continued its gradual decrease. For the 1992 to 2000 period the exports of manufactures became the main contributor to economic growth. Today, Costa Rica is no longer highly reliant on exports of few primary goods, and has flourishing high-tech and medical equipment manufacturing export sectors, and well diversified agricultural and service sectors.

3. The empirical model formulation and econometric methodology

3.1 The theoretical model and data

This section presents a straightforward generalization of the model proposed by Herzer and Nowak-Lehnmann's (2006) in order to test the hypothesis that export diversification has influenced economic growth in Costa Rica via externalities of learning-by-exporting and learning-by-doing can be tested.

The economy is constituted by n sectors from which S are export sectors, thus S $\in$ n. It is also assumed that each i sector is represented by one firm, and that their corresponding output, at a given point in time t, is determined by a neoclassical production function:

$$Y_{it} = f_{it}(K_{it}, L_{it}, P_t) \qquad (1)$$

where K_{it} and L_{it} are the standard capital and labour inputs respectively. The input P_t corresponds to an index of public knowledge and is regarded as a positive externality in equation (1). This knowledge externality has two main properties. One is that these knowledge

spillovers are primarily generated by the export sectors as a result of both learning-by-exporting and learning-by-doing. Learning-by-exporting arises when an export sector acquires knowledge from their foreign purchasers who share part of their know-how and offer advice on productivity enhancement. On the other hand, the basic idea behind learning-by-doing is that knowledge creation occurs as a byproduct of production and it depends on the firm's cumulative output. Hence, firms will increase their stock of knowledge as they expand their exports, and this accumulation process will accelerate as a firm exposes itself to competitive international markets.

For the sake of simplicity it is assumed that each export sector S_t produces an equal amount of public knowledge P_z. Hence, a nation's level of aggregated knowledge is given by the following equation

$$P_t = S_t P_{et} \qquad (2)$$

Given that P_{et} is a constant and not directly observable parameter, the level of knowledge in the economy can be instead expressed as a function of the number export sectors

$$P_t = Z(S)_t \qquad (3)$$

In their study Herzer and Nowak-Lehnmann assumed that primary goods tend to have a lower potential for learning-by-doing and learning-by-exporting comparatively to manufactured goods. Consequently, they hypothesized that the pace of knowledge creation in the economy will increase with an increase in the share of manufactured products in total exports. Based upon this premise a new knowledge equation can take the following form

$$P_t = Z(S_t, MX_t) \qquad (4)$$

where the share of manufactured products in total exports (MX_t) and the number of export sectors (S_t) are proxies for the stock of knowledge in the economy.

The second main property of this model is that knowledge P_t is considered a public good and constant within all sectors. By treating P_t as a given our production function f_{it} has constant-returns-to-scale. It is also assumed that all firms operate in perfect competition and are price takers. Next, we set

$$Y_t = \sum_{i=1}^{n} Y_{it}, \qquad K_t = \sum_{i=1}^{n} K_{it}, \qquad L_t = \sum_{i=1}^{n} L_{it} \qquad (5)$$

Now, the aggregate production Y_t can be rewritten as function

$$Y_t = \sum_{i=1}^{n} Y_{it} = f_{it}(K_{it}, L_{it}, P_t) \qquad (6)$$

By inserting the public knowledge parameter of equations (4) and (5) into the production function we get

$$Y_t = f_{it}(K_{it}, L_{it})(S_t, MX_t) = K_t^{\beta} L_t^{\delta} S_t^{\psi} MX_t^{\gamma} \qquad (7)$$

$$K_t^{\beta} L_t^{\delta} S_t^{\psi} MX_t^{\gamma}$$

where K_t and L_t represent respectively the stock of accumulated capital and labour force of the economy, and the parameters β, δ, ψ and γ are constants. By adding the number of export sectors and the shares of manufactured exports as explanatory variables to equation (7) it is implied that both horizontal and vertical export diversification influence economic growth via externalities of learning-by-doing and learning-by-exporting. That is, ψ and γ are greater than zero.

To empirically test the long-run relationship between growth and export diversification equation (7) is transformed into a log-linear regression form

$$\ln Y_t = \alpha + \beta \ln K_t + \delta \ln L_t + \psi \ln S_t + \gamma \ln MX_t + \mu_t \qquad (8)$$

where ln is the natural logarithm of the variables, and the estimates of β, λ, ψ, and γ represent elasticities. The error term, μ_t is assumed to be white-noise normally and identically distributed. Equation (8) will be subject to empirical scrutiny, and the model will test the diversification-led growth hypothesis for the manufacturing sector:

$$H_o: \quad \psi, \gamma = 0$$
$$H_1: \quad \psi, \gamma > 0$$

Accordingly, it is hypothesized that the estimates of ψ, γ are positive and statistically significant, thus confirming the diversification-led growth.

The Data

To estimate equation 8, Costa Rican annual data for the period 1965-2006 is used. S_t is the number of export sectors classified by the Standard International Trade Classification

(SITC) at the three-digit level, and has been gathered from the United Nations dataset (COMTRADE). The data for remaining variables in this study is collected from the World Development Indicators (2008) from the World Bank. The Costa Rican aggregated output (Y_t) is the real GDP measured at 2000 constant prices. The labor (L_t) series represents Costa Rica total labor force while the capital variable (K_t) is proxied using gross capital formation measured at 2000 constant prices. Finally, MX_t corresponds to the share of manufactured exports to total exports.

3.2 Econometric Methodology

3.2.1 Test for univariate integration

To undertake this empirical analysis, the first step is to examine the time series properties of all the variables in logarithmic terms(LY, LK, LL, LS and LMX). The visual inspection of all variables in levels in figure 2 suggests that they are trending, and therefore nonstationary. That is, their variances and covariances are not finite or independent of time.

The sample autocorrelation functions (ACF) and the partial autocorrelation functions (PACF) provide further evidence that the series are not stationary in levels and may contain unit roots. As econometric theory shows, when the variables are nonstationary, the standard ordinary least squares cannot be applied and there might be a so-called spurious regression. Spurious regressions are normally characterized by having a high R^2 and a statistically significant t-statistics however they have no economic meaning (Granger and Newbold, 1974). The stationarity of the series is first investigated by applying the augmented Dickey-Fuller (ADF) test and the Phillips and Perron (PP) unit root tests. However, recent studies have found that these standard unit root tests tend to perform poorly in the presence of small samples as the one used in this paper. In addition, these tests suffer from a well-known weakness when testing stationary of a series that exhibits a structural break. More specifically, these tests tend to identify a structural break in the series as evidence of nonstationarity, and thus fail to reject the null hypothesis. To deal with this problem, a number of methods were developed to improve the statistical tests in the presence of structural breaks. The Zivot and Andrews (1992) and the Perron and Vogelsang (1992) unit root tests are undertaken in this study, because both procedures allow formal evaluation of the time series properties in the presence of a structural break at an unknown point in time. Finally, the results from the four unit root tests will be compared so that valid conclusions can be drawn on the order of integration of the variables in the model.

3.2.2 Test for multivariate cointegration (ARDL)

Before testing the model, a brief discussion of the ARDL approach to cointegration is presented. The choice of this methodology over other alternatives is based on several considerations. Firstly, the Johansen procedure allows for testing for the absence of a long-run relationship under the restrictive assumption that all the model's variables are integrated of order 1. However, and as shown at Pesaran and Shin (1995) and Pesaran *et al.* (2001), the ARDL models yield consistent estimates of the long run coefficients that are asymptotically normal irrespective of whether the underlying regressors are purely I(0), purely I(1) or fractionally cointegrated. In addition, given the low power of unit root tests, there is always a certain degree of uncertainty with respect to the order of integration of the underlying variables. The bounds testing procedure circumvents these two problems. Secondly, the ARDL methodology provides unbiased estimates of the long-run model and valid t-statistics by the inclusion of dynamics in the model, even when some of the regressors are endogenous (Inder, 1993). This is particular advisable in this model because of potential endogeneity of the export diversification variables due to their close linkages with the inflows of FDI in Costa Rica. Lastly, when compared to other alternative techniques, this methodology performs better with small samples like the one in this study.

To conduct the bounds test, the growth equation (8) is converted into an unrestricted error correction model (UECM) form represented by equation (9)

$$\Delta \ln Y_t = \alpha + \sum_{k=1}^{n} \delta_1 \Delta \ln Y_{t-k} + \sum_{k=0}^{n} \delta_2 \Delta \ln K_{t-k} + \sum_{k=0}^{n} \delta_3 \Delta \ln L_{t-k}$$

$$+ \sum_{k=0}^{n} \delta_4 \Delta \ln S_{t-k} + \sum_{k=0}^{n} \delta_5 \Delta \ln MX_{t-k} + \beta \ln K_{t-1} + \delta \ln L_{t-1}$$

$$+ \psi \ln S_{t-1} + \gamma \ln MX_{t-1} + \varepsilon_t \qquad (9)$$

Where α is the drift component, and ε_t are white noise errors uncorrelated with the variables in right-hand side of the equation. In this setup, the short-run effects are inferred by the sign and significance of the estimates of δ_1, δ_2, δ_3, δ_4, and δ_5. The long-run effects are inferred by the sign and significance of the estimates of β, δ, ψ and γ. Because all the variables in the model appear to be trended, a second ARDL-UECM including a trend term t is also estimated.

$$\Delta \ln Y_t = \alpha + \xi t + \sum_{k=1}^{n} \lambda \Delta \ln Y_{t-k} + \sum_{k=0}^{n} \theta \Delta \ln K_{t-k} + \sum_{k=0}^{n} \Omega \ln L_{t-k}$$

$$+ \sum_{k=0}^{n} \pi \Delta \ln S_{t-k} + \sum_{k=0}^{n} \varphi \Delta \ln MX_{t-k} + \beta \ln K_{t-1} + \delta \ln L_{t-1}$$

$$+ \psi \ln S_{t-1} + \gamma \ln MX_{t-1} + \xi_t \qquad (10)$$

There are two steps for implementing the ARDL approach to cointegration procedure. The first is to estimate equations (9) and (10) use ordinary least square (OLS). The second step is to trace the presence of cointegration among the variables by restricting all estimated coefficients of lagged level variables so that the inclusion of the lagged level of variables is warranted. Thus, the null hypothesis of no cointegration ($H_0 = \beta = \delta = \psi = \gamma = 0$) is tested against the alternative (H_1: $\beta \neq \delta \neq \psi \neq \gamma \neq 0$). This is done by the familiar F-test with critical values tabulated by Pesaran et al. (2001). Two asymptotic critical value bounds provide a test for cointegration when the dependent variables are $I(d)$ with $0 \leq d \leq 1$. The upper bound assumes all variables are $I(1)$ while the lower bound assumes that all the variables are $I(0)$. If the computed F-statistics exceed their respective upper critical values, the null hypothesis of no cointegration is rejected. If the test statistics fall below the lower critical values, the null hypothesis cannot be rejected. If the statistics fall within their respective bounds, inference would be inconclusive and the order of integration of the underlying variables has to be investigated more deeply

3.2.3 Estimation of long-run equilibria: Stock-Watson dynamic OLS

Stock and Watson (1993) developed a powerful and practically convenient modeling procedure known as Dynamic OLS (DOLS), and several arguments validate its use in the present study. Firstly, evidence from Monte Carlo simulations has shown how estimators from this procedure are superior to a number of alternative estimators of long-run parameters, including those proposed by Engle and Granger (1987), Johansen (1988) and Phillips and Hansen (1990). Moreover, DOLS allows for variables of different integration order, it tackles for any possible simultaneity bias within regressors, and it guarantees valid estimations even in the presence of endogenous independent variables. Finally, DOLS it is not only asymptotically equivalent to Johansen's maximum likelihood estimator, but it also tends to perform well with small samples like the one in this study.

The DOLS procedure involves regressing any $I(1)$ variables on other $I(1)$ variables, as well as on $I(0)$ variables and the leads and lags of the first differences of any $I(1)$ variables.

Thus, the final equation of DOLS model is presented in the following section of the paper, and it is constructed based on the results from the unit root tests for each series.

4. Empirical Results

4.1 Tests of the unit root hypothesis

Given that all variables exhibit upward trends overtime, the ADF and PP tests were undertaken with and without the inclusion of a deterministic trend. Table 2 reports the ADF and the PP test statistics for the log levels and first differences of all variables. The results from both tests show that the null hypothesis of a unit root cannot be rejected for all variables in levels, with the exemption of the number of export sectors variable, which is trend stationary in levels. When the tests were computed using first-differenced data, the null hypothesis was strongly rejected in all cases. This suggest that all variables, with the exemption of S_t, are $I(1)$ in levels but $I(0)$ in first differences. Despite the consistency of the results of these two tests, one needs to be cautious in interpreting these results.

The literature on Costa Rican economy identifies two potential structural breaks in the last forty years: The first break occurred when a severe economic crisis affected the country in the late 1970s and early 1980s, resulting in important structural reforms in the mid-1980s; the other break was likely to have happened in the late-1990s when the American multinational, Intel, began its operations in Costa Rica. A visual inspection of the graphs of the variables in log levels shows that at least one of the above mentioned structural breaks may be present in the series, with the exception of labor force variable. Thus, two further unit root tests are computed to check whether in the presence of a structural break, the series are integrated of order one or otherwise.

In Table 3 the results from the Zivot and Andrews test indicate that, when a structural break is considered, all variables are $I(0)$ in levels, except for the labor force variable which becomes $I(0)$ only after being differenced. The Perron and Vogesland unit root test shows that both export diversification variables are stationary at the levels, while GDP, labor and capital variables are integrated of order 1. The latest results seem to question the integration orders found by the ADF and PP unit root tests, and provide evidence that both vertical and export diversification variables are both likely to be $I(0)$, while GDP, labor and capital variables are $I(1)$.

4.2 Multivariate Integration: ARDL

To determine the optimal number of lags to be included in the ARDL-UECM, the Akaike's Information criterion (AIC), the Schwarz's Bayeasian information criterion (SBIC), and the Hanna and Quinn information criterion (HQIC) were used. Nevertheless, there is no agreement among the criterion on whether to include 1 or 2 lags, thus the ARDL-UECM was computed with both order of lags. The computed F-statistics for the joint significance of lagged levels in equation (9) and (10) lags are presented in table 4 for each order along with the 10% level critical values.

The results in table 4 indicate that the computed F-statistics are not significant at the 10%, thus the null hypothesis of no cointegrating relationships between the examined relationships cannot be rejected, meaning no cointegration between real GDP, capital, labour and the export diversification variables. The conclusions do not change for the ARDL model in where a trend term is included, suggesting that there is no long-run impact of export diversification on Costa Rican growth. To further confirm this finding, the DOLS procedure is applied to equation (8).

4.3 Long-run elasticities: Stock-Watson DOLS

In estimating the long-run parameters of the growth equation, the DOLS procedure is adopted and represented by equation (11). Given that annual data is used, the model is estimated with inclusion of n = ± 2 leads and lags[2].

$$
\begin{aligned}
\ln Y_t = \sigma + \beta \ln K_t + \lambda \ln L_t + \ \psi \ln S_t + \gamma \ln MX_t \\
+ \sum_{k=-n}^{k=n} \xi_1 \Delta \ln L_{t-k} + \sum_{k=-n}^{k=n} \xi_2 \Delta \ln K_{t-k} \\
+ du80 + d80 + \omega_t \qquad (11)
\end{aligned}
$$

The step dummy, *du*80, and impulse *d*80 are included in equation (11) to account for the severe economic downturn that affected Costa Rica in the early 1980s[3].

The results in table 5 show that while capital and labor have a positive and significant effect on Costa Rica's economic growth, both vertical and horizontal export diversification do not significantly influence Costa Rican economic growth. The diagnostic tests presented

underneath table 6 do not indicate any problems of heteroskedasticity or nonnormality of the errors. However, the presence of serial correlation was detected, thus equation (11) was again estimated using robust standard errors without noteworthy changes in the statistical significances of the estimated elasticities. The DOLS procedure confirms the lack of a long-run causality between export diversification and economic growth in Costa Rica over the period 1965 to 2006.

4. Concluding Remarks

By estimating an augmented Cobb-Douglas production function using time series data, this paper has presented empirical evidence that both vertical and horizontal diversification are not associated with faster economic growth in Costa Rica over the period of 1965 to 2006. These findings contradict those from other empirical studies that identified positive linkages between export diversification and economic growth. But more specifically, it is essential to attempt to understand why the present results differ from those found for Chile by Herzer and Nowak-Lehnmann's (2006). These two countries are regarded as success stories in terms of their economic performance and diversification of their exports. However, a closer look to the latter issue reveals some essential differences that may explain why export diversification has played an important role in the economy of Chile and not so in Costa Rica.

In the case of Chile, the most striking source of export diversification has been the emergence of non-traditional agricultural exports. Examples of these resource-based products are those produced by forestry and mining conglomerates, a thriving wine sector, and an expanding salmon-farming industry. Although these products have low levels of technological content, they often are produced by domestic firms. On the other hand, Costa Rica went from being highly reliant on exports of few primary goods to a country with a flourishing high-tech and medical equipment manufacturing export sectors, and well diversified agricultural and service sectors. However, this was mainly the result of the creation of export processing zones by Costa Rican authorities, which attracted foreign capital in sectors with high technological contents throughout the 1990s. The close interdependence between export diversification and foreign investment by large multinationals may have posed limitations to the amount of knowledge spillovers generated by the export sectors as a result of both learning-by-exporting and learning-by -doing. Consequently, Costa Rica has not been able to use its high-tech and high value-added exports to trigger a sustained process of economic growth. This corroborates the argument of Sanchez-Ancochea (2006) that although Intel and other multinational corporations operating in Costa Rica contributed to an increase in exports and generated direct employment, they failed to generate substantial linkages with the rest of the

economy. In the particular case of Intel, some economists maintain that this firm has operated as an enclave, importing most of its components for its assembly, and generating a low economic multiplier (World Bank, 2006). Furthermore, despite the surge of non-traditional agricultural exports in the last decades, Costa Rica is still exporting mainly raw agricultural products with little value added (Barquero, 2006a). Finally, Mitchell and Pentzer (2008) make an important observation that despite the fact that the range of export products in Costa Rica has grown, a group of few products, including manufactured and agricultural products, continues to account for the majority of export value. Thus, progresses made in Costa Rica in terms of horizontal and vertical export diversification may fail to reveal inherent a persistent concentration in terms of value. In fact, in 2005, 84 percent of the total value of all goods exported was produced by large corporations - which account only for 20 percent of the total number of manufacturers in Costa Rica (PROCOMER, 2005)

In terms of policy implications, this paper presents evidence that increases and diversification of exports per se may not be sufficient to promote economic growth, unless they lead to the creation of new productive capabilities in other sectors of the economy via knowledge externalities. Given the apparent limitations of their hitherto export-led model of development, Costa Rican authorities should design a new set of policies aiming at the improvement of the nation's long-term economic growth potential. Some of those new policies would include: the creation further linkages between the export sector and the rest of the economy so that new channels for knowledge spillovers may be open; to use the presence of multinational companies in the country to spur development of domestic-owned suppliers and other satellite business, and to provide additional support to the creation of small and medium domestic export-oriented firms.

REFERENCES

Al-Marhubi, F. (2000). Export diversification and growth: an empirical investigation, *Applied Economics Letters*, 7, 559-562.

Andrews, D. and Zivot, E. (1992). Further evidence on the Great Crash, the oil price shock, and the unit-root hypothesis. Journal of Business and Economic Statistics 10, 251-70.

Balaguer, J. and Cantavella-Jordá, M. (2004). Structural change in exports and economic growth: cointegration and causality analysis for Spain (1961-2000), *Applied Economics*, 36, 473-477.

Barquero S., M. (2006a.). "Menos de 10% de ingressos por café y melón llegan al productor."*La Nación*, March 29, sec. "Economía."

Cattaneo, A., Hinojosa-Ojeda, R.A. and Robinson, S. (1999). Costa Rica trade liberalization, fiscal imbalances, and macroeconomic policy: a computable general equilibrium model, *North American Journal of Economics and Finance*, 10, 39-67.

Engle, R.F. and. Granger, C.W.J. (1987). Cointegration and error correction: representation, estimation and testing, *Econometrica*, 55, 251-276.

Feenstra, R., and H.L. Kee (2004) "Export Variety and Country Productivity," *NBER Working Paper* 10830, National Bureau of Economic Research: Cambridge MA.

Fosu, K. (1990). Export composition and the impact of exports on economic growth of developing economies, *Economic Letters*, 34, 71-76.

Granger, C.W.J. and Newbold, P. (1974). Spurious regression in econometrics, *Journal of Econometrics*, 2, 111-120.

Greenway. D., Morgan, W., and Wright P. (1999). Exports, export composition and growth, *The Journal of International Trade & Economic Development*, 8:1, 41-51.

Gutiérrez-de-Piñeres, S. A. and Ferrantino, M. (1999). Export sector dynamics and domestic growth: the case of Colombia, *Review of Development Economics*, 3(3), 268-280.

Gutiérrez-de-Piñeres, S. A. and Ferrantino, M. (2000). Export Dynamics and Economic Growth in Latin America: A Comparative Perspective. Ashgate Publishing, 2000.

Herzer, D. and Nowak-Lehnmann D. F. (2006). What does export diversification do for growth? An econometric analysis, *Applied Econometrics*, 38, 1825-1838.

Hesse, H. (2008). Export diversification and economic growth, Comission on Growth and Development Working Paper No. 21, The International Bank for Reconstruction and Development/World Bank, Washington D.C..

Inder, B. (1993). Estimating long-run relationships in economics: a comparison of different approaches, *Journal of Econometrics*, 57, 53-68.

Johansen, S. (1988). Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control*, 12, 231-254.

Larrain, F. B., Lopez-Calva, L. F. and Rodriguez-Clare, A. (2000). Intel: a case study of foreign direct investment in Central America. Center for International Development at Harvard University working paper No. 58.

Levin, A. and Raut, L. K. (1997). Complementarities Between Exports and Human Capital in Economic Growth: Evidence from the Semi-industrialized countries, *Economic Development and Cultural Change*, 46(1), 155-174.

Love, J. (1986). Commodity Concentration and Export Earnings Instability, *Journal of Development Economics*, 24, 239-248.

Matthee, M.and Naudé, W. (2007). Export diversity and regional growth: Empirical evidence from South Africa, United Nations University Research Paper No. 2007/11.

Mesa-Lago, C., Arenas de Mesa, A. and Brenes, I. (2003). Market, Socialist, and Mixed Economies: Comparative Policy and Performance--Chile, Cuba, and Costa Rica. Johns Hopkins University Press, Baltimore, Maryland.

Mitchell, M. T. and Pentzer, S. (2008). Costa Rica: a global studies handbook. ABC-CLIO Inc.

Moreno-Brid, J. C. and Pérez, E. (2003). Trade liberalization and economic growth in Central America, The Economic Commission for Latin America (ECLA) Review 81, Santiago, Chile.

Phillips, P. C. B. and Hansen, B. E. (1990). Statistical Inference in instrumental variables regression with *I*(1) processes. *Review of Economic Studies*, 57, 99-125.

Perron, P., Vogelsang, T. (1992). Nonstationarity and level shifts with an application to purchasing power parity, *Journal of Business and Economic Statistics*, 10, 301-320.

Pesaran, M.H. and Shin, Y. (1995). An autogressive distributed lag modeling approach to cointegration analysis." In Centennial Volume of Rangar Frishc (Eds.). S. Strom, A. Holly, and P. Diamond, Cambridge University Press, Cambridge.

Pesaran, M.H., Shin, Y. and Smith, R.J. (2001). Bounds testing approaches to the analysis of level relationships, *Journal of Applied Econometrics*, 16, 289-326.

Promotora del Comercio Exterior de Costa Rica (PROCOMER). (2004). "Costa Rica: Estadísticas de Exportación." www.procomer.com/est/mercados/libros.cfm/.

Sanchez-Ancochea, D. (2006). Development trajectories and new comparative advantages: Costa Rica and the Dominican Republic, *World Development*, 34, No.6, 996-1015.

Stock, J. H. and Watson, M. (1993). A simple estimator of cointegrating vectors in higher order integrated systems, *Econometrica*, 61, 783-820.

World Bank (2006). The impact of Intel in Costa Rica: Nine years after the investment. Washington D.C.: World Bank.

ENDNOTES

[1] For good discussions on the impact that Intel has had on Costa Rica's economy see Larrain *et al* (2000) and World Bank (2006).

[2] The model was also estimated with 1 and 3 leads and lags without altering results to any significant degree.

[3] The year 1980 was chosen based on the literature on Costa Rica economic crisis, and on a visual observation of the graphs of the log levels of each series. *du*80 is 1 from 1980 onwards and zero before 1980; *d*80 has a value of 1 in 1975 and zero otherwise.

TABLES

Table 1. Number of export products and export companies in Costa Rica: 1998-2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of export products	3,292	-	3,306	3,342	3,453	3,572	3,599	3,643	3,797	4,014
Number of export companies	1,579	1,622	1,617	1,680	1,649	1,742	1,775	1,895	2,018	2,071

Source : PROCOMER (2007).

Table 2. The Augmented Dickey-Fuller and the Phillips-Perron tests for unit roots

Variable	Augmented Dickey-Fuller		Phillips-Perron		
	Z(t)df	Z(t*)df	Z(t)pp	Z(t*)pp	Result
Levels					
LY_t	-0.95	-2.02	-0.84	-2.282	
LL_t	-0.85	-2.22	-1.12	-2.058	
LK_t	-0.425	-1.99	-0.52	-1.9	
LS_t	-2.17	-4.20**	-2.17	-4.17**	$I(0)$+ trend
LMX_t	-0.61	-1.69	-0.71	-1.9	
First differences					
ΔLY_t	-3.78***	-3.69**	-3.72***	-3.62**	$I(1)$
ΔLL_t	-7.72***	7.74***	-7.98***	-8.08***	$I(1)$
ΔLK_t	-5.27***	-5.19***	-5.25***	-5.18***	$I(1)$
ΔLS_t	-7.47***	-7.46***	-7.81***	-7.79***	$I(0)$+ trend
ΔLMX_t	-5.34***	-5.32***	-5.31***	-5.27***	$I(1)$

Note: Z(t)df is the ADF test allowing for a drift term, whereas Z(t*)df is the ADF test allowing for a drift and a deterministic trend. Z(t)pp is the PP test allowing for a drift term, whereas Z(t*)df is the PP test allowing for a drift and a deterministic trend. *,**,*** denote the rejection of the null hypothesis of a unit root at 1%, 5% and 10% level respectively. The lag length used in the test for each series was determined via t-tests.

Table 3. The Zivot and Andrews and the Perron and Vogelsang unit root tests with structural break

Variable	Zivot and Andrews			Perron and Vogelsang		
	Minimum t-statistic	Break year	Result	Minimum t-statistic	Break year	Result
Levels						
LY_t	-4.96**	1981	$I(0)$	-2.34	1994	
LL_t	-4.24	1991		-1.97	1989	
LK_t	-5.59***	1982	$I(0)$	-2.33	1984	
LS_t	-6.368***	1987	$I(0)$	-4.02**	1988	$I(0)$
LMX_t	-7.221***	1997	$I(0)$	-6.41***	1995	$I(0)$
First differences						
ΔLY_t				-5.82***	1980	$I(1)$
ΔLL_t	-7.078***	1996	$I(1)$	-7.06***	1989	$I(1)$
ΔLK_t				-5.99***	1981	$I(1)$

Note: Critical values values for the Zivot and Andrews test are taken from Zivot and Andrews(1992). Critical values values for the Perron and Vogesland test are taken from Perron and Vogesland (1992). *,**,*** denote the rejection of the null hypothesis of a unit root at 1%, 5% and 10% level respectively. The lag length used in the test for each series was determined by the Akaike's Information criterion (AIC), the Schwarz's Bayeasian information criterion (SBIC), and the Hanna and Quinn information criterion (HQIC).

Table 4 .Bounds test for the existence of a long-run relationship

	Lag	F-Statistic	10%Critical Bounds	
			I(0)	I(1)
ARDL with no trend	2	1.84	2.45	3.52
	1	1.43	2.45	3.52
ARDL with trend	2	3.01	3.03	4.06
	1	1.66	3.03	4.06

Note: The relevant critical value bounds are obtained from Table C1.iii (with an unrestricted intercept and no trend, with 4 regressors) and from Table C1.v (with an unrestricted intercept and unrestricted trend, with 4 regressors) in Pesaran *et al.* (2001). *,** and *** indicate significance at the 1, 5 and 10% levels.

Table 5 . Stock-Watson DOLS long-run parameter estimates

β	δ	ψ	γ
0.26***	0.81***	-0.18	0.24
(3.14)	(4.38)	-(1.11)	(0.44)

Notes:

Adj. R² = 0.99	DW = 1.03	*SW* = 0.96(0.15)
ARCH(1) =0.99	ARCH(2) =0.98	ARCH(3) =0.99
BG(1) = 0.00	BG(2) = 0.00	BG(3) = 0.00

Note: The parentheses under the coefficients denote *t* statistics.*,** and *** indicate significance at the 1, 5 and 10% levels. BG is the Breusch-Godfrey test for higher-order serial correlation in the disturbance and ARCH is Engle's LM test for autocorrelation conditional heteroskedasticity, with *k*= 1, 2 and 3 lags. SW is the Shapiro-Wilk test for normality

Table 6 . Stock-Watson DOLS long-run parameter estimates with robust standard errors

β	δ	ψ	γ
0.26***	0.81***	-0.18	0.24
(4.37)	(5.65)	-(1.20)	(0.80)

Note:*,** and *** indicate significance at the 1, 5 and 10% levels.
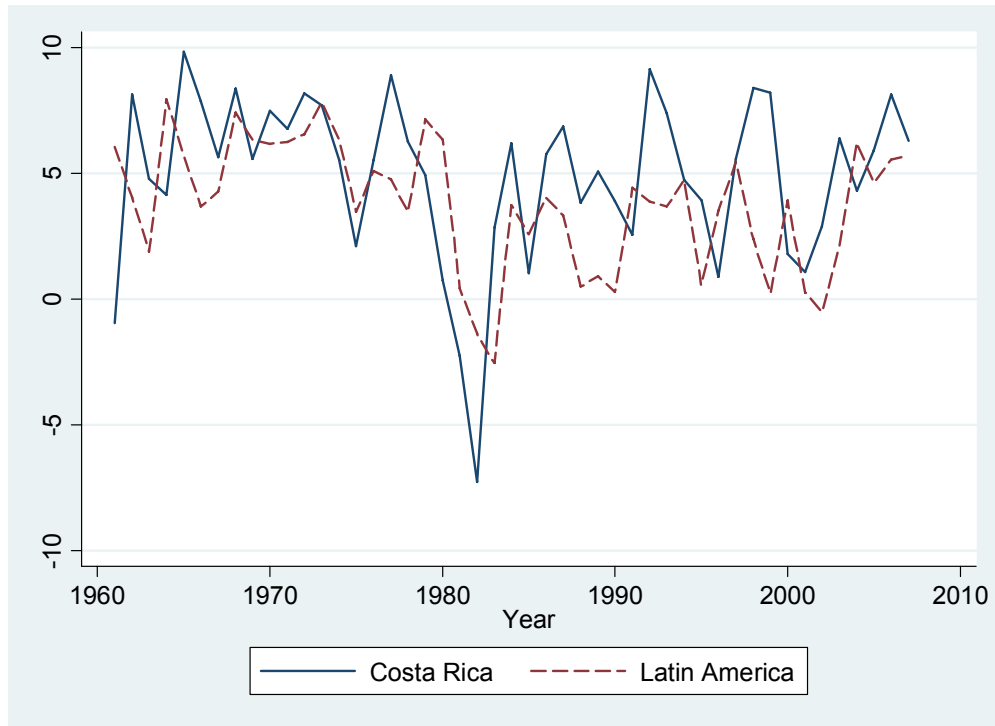
FIGURES

Figure 1. GDP growth (annual %) of Costa Rica and Latin America

Figure 2. Time series used in the models