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

Gustavo F.C. Ferreira and R. Wes Harrison

In the wake of a severe economic crisis in the 1980s Costa Rica abandoned an import substitution model of development adopted in the 1960s and implemented policies supporting foreign investment and the diversification of its exports. This study presents an application of the model proposed by Herzer and Nowak-Lehnmann to test the hypothesis that export diversification has contributed to economic growth in Costa Rica via externalities of learning-by-doing and learning-by-exporting over the period of 1965–2006. After using the autoregressive distributed lags and dynamic ordinary least squares models no long-run relationship was found between export diversification and growth.

Key Words: Central America, Costa Rica, export diversification, economic growth, time series

JEL Classifications: F14, O54

Costa Rica is an interesting case study in economic development not only because of its long democratic tradition and relative economic stability, but also because the economy of this small nation has evolved from being heavily reliant on exports of coffee and bananas to becoming the largest software exporter 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). In addition, and as a result of decades of policies emphasizing universal education and health care to its population, Costa Rica, today, has a well-educated labor force. According to the Heckscher-Ohlin trade model, given Costa Rica's endowment of a well-educated workforce, this country has a comparative advantage in the production of knowledge-intensive goods (Leamer, 1995). Another important characteristic of Costa Rica is the small size of its domestic market. This limits the capability of sustained growth in its Gross Domestic Product (GDP) and reduces the chances of producing certain goods that are subject to economies of scale. Export growth and export diversification could be the solution to these constraints, and a possible explanation of why international trade has played such an important role in this country's economy.

Well aware of these realities, Costa Rican authorities have been playing a very active role in the development of a domestic industrial sector during the 1960s and 1970s, in the recent diversification of the nation's economic activities, and in the attraction of investments from high-tech multinational firms. The outcome of these policies has been decades of sustained

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economic growth. This paper seeks 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. This hypothesis is tested using two econometric procedures, an autoregressive distributed lags (ARDL) model and a dynamic ordinary least squares (DOLS) model.

This paper is organized as follows: Section two discusses the literature on the linkages between export diversification and economic growth. Section three gives an overview of Costa Rica's export diversification experience. Section four presents the theoretical model and data sources, while section five describes the econometric methodology employed in this paper. Section six offers the empirical results, and section seven concludes and discusses some of the policy implications.

Review of Empirical Literature

There is a large body of literature that has investigated the linkages between export diversification and long-term economic growth, and 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).

The Effects of Export Diversification on Long-Run Economic Growth

A number of 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 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. The portfolio effect is often cited as a mechanism through which instability of export earnings can be reduced, and thus mitigate any unfavorable effects on government revenues, investment, import capacity, and producers' incomes. In a seminal paper, Love (1986) proposed that countries should avoid having a heavy concentration of their exports in a few products because this reduces a nation's capability of partially offsetting fluctuations in some export sectors with counter fluctuations, or stability in other sectors. His findings concluded that export concentration had a positive and significant influence on instability of export earnings. Jansen (2004) demonstrates 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. 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 unstable domestic markets, investment becomes riskier in those nations. In other words, increasing instability in a nation's export earnings may discourage investment, which in turn negatively impacts economic growth. Using a cross-country sample of 91 countries, a positive and robust relationship between export diversification and economic growth was found. 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. Once again, evidence that export concentration is detrimental to economic growth in developing countries was found. Feenstra and Kee (2004) analyze the effects of sectoral export variety on a country's productivity. After estimating a translog GDP function system for a sample of 34 countries, their results show that a 10% increase in export variety of all industries leads to a 1.3% increase of a country's productivity.

Other empirical studies have tested the positive links between export diversification and economic growth for specific regions or countries. The study of Gutiérrez-de-Piñeres and Ferrantino (2000) for Latin American countries finds associations between episodes of export diversification and rapid economic growth. Moreover, export specialization was significantly and negatively correlated with economic growth after controlling for other common determinants of growth. Also in Latin America, Gutiérrez-de-Piñeres and Ferrantino (1999) identified examples of countries where knowledge gained from exporting activities was 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, exports of fresh cut flowers were followed by other highly perishable goods. However, 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-Lehnmann (2006) studied the Chilean experience and tested the hypothesis that export diversification has had an impact on economic growth via externalities of learning-by-doing and learning-by-exporting. Using time series econometrics their results show that both horizontal and vertical export diversification have a positive effect on growth. At the regional level, Matthee and Naudé (2007) show that South African regions with more diversified export supplies experienced higher economic growth rates and contributed more to the nation's overall exports. Furthermore, only horizontal diversification, and not vertical diversification, is associated with higher economic growth.

Linkages between Economic Performance and the Exports of Different Products

Several studies have tested the hypothesis that the exports of certain products have different effects on a nation's economic growth. Greenaway, Morgan, and Wright (1999) disaggregated exports into key components based on the argument that different components have different effects on GDP growth. Their findings suggest not only that export growth is an important driver of economic growth, but also corroborate the widely held view that the manufacturing sector produces larger externalities than other economic sectors. These externalities are important in the sense that they may result in further horizontal diversification and improvements in the ability of all industries to compete internationally (Matthee and Naudé, 2007).

The ratio of manufactured exports to 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. Levin and Raut (1997) conclude that increases in the ratio of manufactured exports to total exports have positive and significant impact on economic growth, whereas growth of the primary goods exports share has a negligible effect. Fosu (1990) also tests the effect of manufactured exports on growth comparatively to ones from the primary sector and concludes that, in developing countries, the former has a positive impact in the economy. In another study, Moreno-Brid and Pérez (2003) studied the effect of the external sector on the long-run rate of economic growth for three Central American countries: Costa Rica, El Salvador, and Guatemala. In the case of Costa Rica, the shift from exports of 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 the structural transformation in export composition was a key factor for Spain's economic development. In addition, their findings lend support to the idea that allocation of resources toward more industrialized export sectors has a positive impact on the economy.

Despite the fact that the literature has identified strong links between export diversification and economic growth, the discussion is by no means closed. Empirical research is still limited to a few cross-country and country level studies, and Costa Rica represents a very specific case where this relationship is not clear and merits investigation.

Overview of Costa Rica's Export Diversification Experience

Until the second half of the twentieth century, Costa Rica was an agro-exporting economy highly dependent on the exports of a few agricultural products. Coffee and bananas alone accounted for almost 90% of the value of its total exports, and drove economic growth through the 1960s (Mesa-Lago, Arenas-de-Mesa, and Brenes, 2003). Aware 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 intermediate and capital goods. In addition, export taxes were applied on those goods in which Costa Rica had a strong comparative advantage (Cattaneo, Hinojosa-Ojeda, and Robinson, 1999).

The import substitution industrialization (ISI) strategy was relatively successful in creating a domestic industrial sector and resulted in high rates of economic growth for more than two decades. However, in the beginning of the 1980s, Costa Rica went through its worst economic crisis since World War II, which evidenced some of the shortcomings of the ISI model. With the support of international financial and developmental organizations, Costa Rica adopted new policies of development that would include export promotion and export diversification. This new economic outward orientation secured a wide consensus among Costa Rican policy makers, and important structural reforms were implemented throughout the 1980s. As part of this new export-led model, Costa Rican authorities established free trade zone (FTZ) regimes where fiscal and economic incentives were granted to those firms locating there. This policy was an important step toward the promotion of new exports and attraction of foreign firms. Mitchell and Pentzer (2008) observe that most exporting firms located there are large foreign companies attracted by the incentives offered by the Costa Rican authorities. The most illustrative example was the investment of Intel in a microprocessor plant in Costa Rica in 1997, and its indisputable impact on the national economy.[1] The FTZs coupled with Costa Rica's relatively educated population, political stability, and a series of pro-investment public policies allowed the country to become an important offshore manufacturing and customer service location for a number of multinational corporations.

The implementation of these export promotion and export diversification policies during the second half of the 1980s, and throughout 1990s transformed Costa Rica's export supply. The share of manufactured exports to total exports increased substantially, and for the period of 1992–2000 these exports became the main contributor to economic growth. At the same time Costa Rica managed to reduce its dependency on the exports of few primary goods, and now has flourishing high-tech and medical equipment manufacturing export sectors as well as diversified agricultural and service sectors. However, and despite these achievements, overall economic growth never reached the levels of the ISI period. The average rate of economic growth between 1965 and 1979 was 6.15% in comparison with a 5% average observed between 1984 and 2007. According to Vos et al. (2006), once the production from the export-processing regimes is excluded, a more modest economic performance is revealed. This may be explained by the fact that export diversification in Costa Rica has been directly dependent on the establishment of foreign firms in FTZs and linkages between the export enclaves and the rest of the economy may be very limited in nature. Figure 1 shows the ratio of foreign direct investment (FDI) to Costa Rica's GDP. A steady increase of this measure can be observed since the application of the economic structural reforms in the 1980s. This increase in FDI was only interrupted around the year 2000 due to an economic recession that affected major industrialized nations. Nevertheless, a few years later FDI in Costa Rica resumed its growth, and actually accelerated in more recent years. Today, multinational firms operating in the FTZs are the

[1] For good discussions on the impact that Intel has had on Costa Rica's economy see Larrain, Lopez-Calva, and Rodriguez-Clare (2000) and World Bank (2006).

Figure 1. Foreign Direct Investment as a Percentage of Costa Rica GDP (1970–2007) (Source: World Development Indicators, World Bank [2008])

nation's main exporters surpassing Costa Rican firms, which remain more oriented toward the domestic and Central American markets. This anecdotal evidence raises questions as to what degree export diversification in Costa Rica has generated the externalities and spillovers identified by the economic literature.

Theoretical Model and Data

The Model

This section presents a generalization of the model proposed by Herzer and Nowak-Lehnmann (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. The model assumes that the economy is composed of a total of n sectors from which S are export sectors, thus $S \in n$. It is also assumed that there is only one firm in each sector, and that at a given point in time, t, the production function of each sector $f \in [1, n]$ is characterized by a neoclassical production function:

$$(1) \qquad Y_{ft} = F_{ft}\left(K_{ft}, L_{ft}, P_t\right),$$

where Y_{ft} is the output of a sector, and K_{ft} and L_{ft} are standard capital and labor inputs, respectively. The input P_t corresponds to an index of public knowledge in period t, and is regarded as a positive externality in Equation (1). This knowledge externality has two main properties. One is that knowledge spillovers are primarily generated by 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 its foreign purchasers who share part of their know-how and offer advice on productivity enhancement. On the other hand, the central premise of 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.

It is assumed that each export sector S_t produces an equal amount of public knowledge p. Hence, a nation's level of aggregated knowledge is given by the following equation:

$$(2) \qquad P_t = S_t p_t.$$

Because p_t is not directly observable and is assumed as a constant parameter, the level of knowledge in the economy can be expressed instead as a function of the number export sectors without including p_t:

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

In their study, Herzer and Nowak-Lehnmann (2006) assumed that primary goods tend to have a lower potential for learning-by-doing and learning-by-exporting comparatively to manufactured goods. Consequently, they hypothesize that the pace of knowledge creation in the economy will increase with increases in the share of manufactured products in total exports. Based upon this premise, a new knowledge equation can take the following form

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

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

The second main property of this model is that the level of aggregated knowledge P_t is considered a public good and constant within all sectors. It is assumed that P_t affects all sectors equally, and by treating P_t as a given, F_{ft} behaves as a constant-returns-to-scale production function. It is also assumed that all firms operate in perfect competition and are price takers. Next, the components of the production function are set:

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

where Y_t is Costa Rican real GDP measured in constant prices (2000 U.S. dollars). Now, Y_t can be rewritten as function:

$$(6) \qquad Y_t = \sum_{f=1}^{n} Y_{ft} = F_t(K_t, L_t, P_t)$$

Equation (7) is obtained by inserting the public knowledge parameter of Equation (4) into the production function expressed by Equation (6). Equation (7) is then expressed as a Cobb-Douglas production function.

$$(7) \qquad Y_t = F((K_t, L_t)(S_t, MX_t)) = \alpha K_t^{\beta} L_t^{\theta} S_t^{\psi} MX_t^{\gamma}$$

K_t and L_t represent the stock of accumulated capital and labor force of the economy respectively, and the parameters β, θ, ψ, and γ are constants. The shift parameter α is included in Equation (7) to account for all the influences on growth other than capital and labor. By adding the number of export sectors and the share 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

$$(8) \qquad \begin{aligned} \ln Y_t = {} & \alpha + \beta \ln K_t + \theta \ln L_t + \psi \ln S_t \\ & + \gamma \ln MX_t + \mu_t, \end{aligned}$$

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

H_o: $\psi, \gamma = 0$

H_1: $\psi, \gamma > 0$.

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

The Data

To estimate Equation (8) annual data for the period of 1965–2006 are used for all variables. S_t represents the number of export sectors classified by the Standard International Trade Classification at the three-digit level, and has been gathered from the United Nations dataset. The data for the remaining variables are from the 2008 World Development Indicators online version. First, Y_t represents Costa Rica's real GDP, while K_t represents gross fixed capital formation and is used as a proxy for capital accumulation. These two variables are measured in inflation-adjusted U.S. dollars and the year 2000 is used as the base year. The series L_t corresponds to Costa Rica's total labor force given by the economically active population (EAP). The EAP comprises persons of either sex above a specified age who furnish the supply of labor for the production of economic goods and services. Finally, MX_t corresponds to the share of manufactured exports to total exports and it is expressed in percentages. Complete variable definitions and data sources are provided in Appendix 1.

Econometric Methodology

Tests for Univariate Integration

The first step in the empirical analysis is the examination of the time series properties of all the variables in logarithmic terms. A visual inspection of all variables in levels and logs in Figure 2 suggests that they are trending, and therefore are nonstationary. That is, their variances and covariances are not finite or independent of time.

The sample autocorrelation functions and the partial autocorrelation functions provide further evidence that the series are not stationary in levels or logs and may contain unit roots. When variables are nonstationary the standard ordinary least squares (OLS) model cannot be applied and there might be a spurious regression. Spurious regressions are normally characterized by having a high R^2 and statistically significant t-statistics but their results have no economic meaning (Granger and Newbold, 1974). The stationarity of the series is first investigated by applying the augmented Dickey-Fuller unit root test (ADF) and the Phillips and Perron (1988) test (PP). 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 stationarity of a series that exhibits a structural break. More specifically, they 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. Both procedures allow for formal evaluation of the time series properties in the presence of a structural break at an unknown point in time. 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.

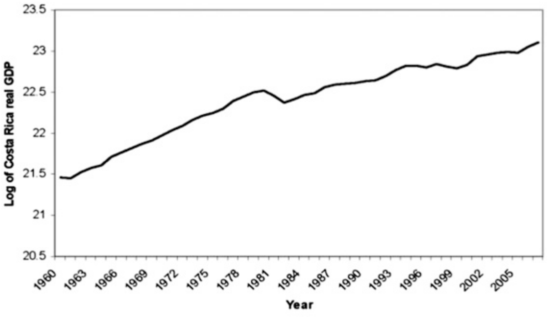
Test for Multivariate Cointegration – Auto Regressive Distributed Lag

Before testing the proposed empirical model, a discussion of the ARDL approach to cointegration is presented to justify the choice of this methodology over other cointegration methods. First, Pesaran and Shin (1995) and Pesaran, Shin, and Smith (2001) showed that the ARDL models yield consistent estimates of the long run coefficients that are asymptotically normal irrespective of whether the underlying regressors are purely stationary, $I(0)$, purely integrated of order one, $I(1)$, or fractionally cointegrated. This represents an advantage over the Johansen procedure, which allows for testing for the absence of a long-run relationship only under the restrictive assumption that all the model's variables are integrated of order one. Furthermore, the ARDL circumvents the low power of unit root tests and the resulting degree of uncertainty regarding the order of integration of the underlying variables. Additionally, the ARDL methodology provides unbiased estimates of the long-run model coefficients and valid t-statistics by the inclusion of dynamics in the model, even when some of the regressors are endogenous (Inder, 1993). This is advisable for this model because of potential endogeneity of the export diversification variables due to potential linkages with the inflows of foreign direct investment in Costa Rica. Lastly, when compared with other alternative techniques, this methodology performs better with small samples like the one in this study.

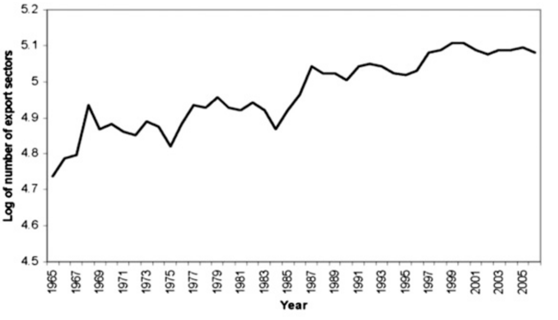
To conduct the bounds test, Equation (8) is converted into an unrestricted error correction model (UECM) form represented by Equation (9):

$$\begin{aligned}\Delta \ln Y_t = \alpha &+ \sum_{k=1}^{n} \delta_1 \Delta \ln Y_{t-k} + \sum_{k=0}^{n} \delta_2 \Delta \ln K_{t-k} \\ &+ \sum_{k=0}^{n} \delta_3 \Delta \ln L_{t-k} + \sum_{k=0}^{n} \delta_4 \Delta \ln S_{t-k} \\ &+ \sum_{k=0}^{n} \delta_5 \Delta \ln MX_{t-k} + \beta \ln K_{t-1} + \theta \ln L_{t-1} \\ &+ \psi \ln S_{t-1} + \gamma \ln MX_{t-1} + \varepsilon_t, \end{aligned} \tag{9}$$

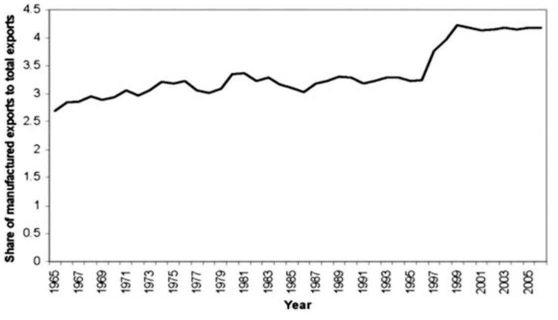
where α is the drift component, Δ represents the first differences, and ε_t are white noise errors



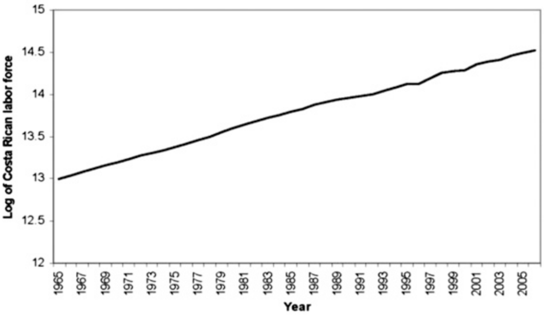
Log of Costa Rican Real GDP at 2000 US$ Constant Prices (1960-2007).



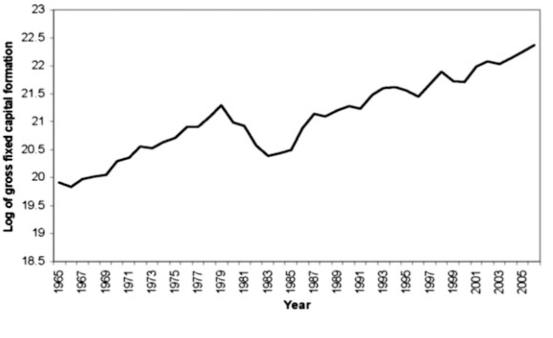
Log of the Number of Exports Sectors in Costa Rica (1965-2006).



Log of Percentage Share of Manufactured Exports Relative to Total Costa Rican Exports (1965-2006).



Log of Costa Rican Total Labor Force (1965-2006).



Log of Gross Fixed Capital Formation in Costa Rica (1965-2006).

Figure 2. Time Series of Variables Used

uncorrelated with the variables in the 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, while 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 (ξ_t) is presented in Equation (10).

$$\begin{aligned}\Delta \ln Y_t &= \alpha + \xi_t + \sum_{k=1}^{n} \delta_1 \Delta \ln Y_{t-k} + \sum_{k=0}^{n} \delta_2 \Delta \ln K_{t-k} \\ &\quad + \sum\nolimits_{k=0}^{n} \delta_3 \ln L_{t-k} + \sum_{k=0}^{n} \delta_4 \Delta \ln S_{t-k} \\ &\quad + \sum\nolimits_{k=0}^{n} \delta_5 \Delta \ln MX_{t-k} + \beta \ln K_{t-1} \\ &\quad + \theta \ln L_{t-1} + \psi \ln S_{t-1} + \gamma \ln MX_{t-1} + \xi_t \end{aligned} \tag{10}$$

The implementation of the ARDL approach to cointegration procedure requires two steps.

The first step involves estimating Equations (9) and (10) using OLS, and the second step includes tracing 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 ($H_0 = \beta = \theta = \psi = \gamma = 0$) is tested against the alternative (H_1: $\beta \neq \theta \neq \psi \neq \gamma \neq 0$) using the familiar *F*-test with critical values tabulated by Pesaran, Shin, and Smith (2001). Two asymptotic critical value bounds provide a test for cointegration when the dependent variables are $I(d)$ with zero $\leq d \leq 1$. 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.

Estimation of Long-Run Elasticities: Stock-Watson Dynamic OLS

Stock and Watson (1993) developed a powerful and practically convenient modeling procedure known as DOLS. Several arguments that validate its use in the present study are now presented. First, evidence from Monte Carlo simulations has shown that 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 accounts for any possible simultaneity bias within regressors, and it guarantees valid estimations even in the presence of endogenous independent variables. Finally, DOLS is asymptotically equivalent to Johansen's maximum likelihood estimator, but it tends to perform well with small samples like the one in this study.

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

Empirical Results

Tests for Unit Roots

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 1 reports the ADF and

Table 1. Augmented Dickey-Fuller and Phillips-Perron Tests for Units Roots

	Augmented Dickey-Fuller		Phillips-Perron		
Variable Levels	Z(t)df	Z(t*)df	Z(t)pp	Z(t*)pp	Result
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. *, **, and *** denote the rejection of the null hypothesis of a unit root at the 10%, 5%, and 1% level, respectively.

the PP test statistics for the log levels and first differences of all variables. The results from both tests indicate that the null hypothesis of a unit root cannot be rejected for all variables in levels, with the exception 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. In sum, the results from these two unit root tests suggest that all variables, with the exception 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 them.

Literature on Costa Rican economy identifies two potential structural breaks in the last 40 years. The first break occurred when a severe economic crisis affected the country between the late 1970s and early 1980s, resulting in important structural reforms in the mid-1980s. The other potential break was likely to have happened in the late 1990s when the American multinational, Intel, began its operations in Costa Rica. Once again, a visual inspection of Figure 2 reveals that at least one of the above mentioned structural breaks may be present in the series, with the exception of labor force variable. Based on this, two further unit root tests are computed to check if, in the presence of a structural break, the series are integrated of order one or otherwise.

The results in Table 2 show that results from the Zivot and Andrews (1992) test suggest that, when a structural break is considered, all variables are $I(0)$ in levels with the exception of the labor force variable which becomes $I(0)$ only after being differenced. The Perron and Vogelsang unit root test shows that both export diversification variables are stationary at the levels, while GDP, labor, and capital variables are integrated of order one. These results question the integration orders found by the ADF and PP unit root tests, and at the same time provide evidence that both vertical and export diversification variables are likely to be stationary in levels, while GDP, labor, and capital variables are $I(1)$.

Multivariate Integration: ARDL

To determine the optimal number of lags to be included in the estimation of the ARDL-UECM procedure, the Akaike's Information criterion, the Schwarz's Bayesian information criterion, and the Hanna and Quinn information criterion were used. Nevertheless, because there was no agreement among the criteria on whether to include one or two lags, the ARDL-UECM was estimated with both orders of lags. The computed F-statistics for the joint significance of lagged levels in Equations (9) and (10) lags are presented in Table 3 for each order along with the 10% level critical values. The results in Table 3 indicate that

Table 2. Zivot and Andrews, Perron and Vogelsang Unit Root Tests with Structural Break

	Zivot and Andrews			Perron and Vogelsang		
	Minimum t-Statistic	Break Year	Result	Minimum t-Statistic	Break Year	Result
Variable 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 for the Zivot and Andrews test are taken from Zivot and Andrews (1992). Critical values for the Perron and Vogelsang test are taken from Perron and Vogelsang (1992). The lag length used in the test for each series was determined by the Akaike's information criterion, the Schwarz's Bayeasian information criterion, and the Hanna and Quinn information criterion. *, **, and *** denote the rejection of the null hypothesis of a unit root at the 10%, 5% and 1% level, respectively.

Table 3. Bounds Test for the Existence of a Long-Run Relationship between Economic Growth and the Hypothesized Explanatory Variables

	Lag	F-Statistics	10% Critical Bounds	
			$I(0)$	$I(1)$
ARDL with	2	1.84	2.45	3.52
no trend	1	1.43	2.45	3.52
ARDL	2	3.01	3.03	4.06
with trend	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 four regressors) and from Table C1.v (with an unrestricted intercept and unrestricted trend, with four regressors) in Pesaran, Shin, and Smith (2001).
*, **, and *** indicate significance at the 1, 5, and 10% levels.

the computed F-statistics are not significant at the 10% level. More specifically, given that the test statistics fell below the lower critical values, the null hypothesis that all coefficients (β, θ, ψ, and γ) equal zero cannot be rejected. These results suggest that there is no cointegration between real GDP, capital, labor, and the export diversification variables. The conclusions do not change for the ARDL model including a trend term. Both results suggest the lack of a linear long-run impact of export diversification on economic growth in Costa Rica, and contradict the evidence found in other countries and regions. On the other hand, these findings seem to confirm the evidence that Costa Rica experienced lower economic growth rates during the years of exports expansion and diversification in comparison with the ISI period. To confirm the robustness of this finding, the DOLS procedure is applied to Equation (8).

Long-Run Elasticities: Stock-Watson DOLS

To estimate the long-run parameters using the DOLS procedure the growth Equation (8) is transformed into Equation (11).

$$\begin{aligned} \ln Y_t &= \sigma + \beta \ln K_t + \lambda \ln L_t + \psi \ln S_t + \gamma \ln MX_t \\ &+ \sum_{k=-n}^{k=n} \zeta_1 \Delta \ln L_{t-l} + \sum_{k=-n}^{k=n} \zeta_2 \Delta \ln K_{t-k} + du80 \\ &+ d80 + \omega_t \end{aligned} \tag{11}$$

Given that annual data are used, the model is estimated with inclusion of n = ± two leads and lags.[2] A step dummy, *du*80, and an impulse *d*80 are also included in Equation (11) to account for the severe economic downturn affecting Costa Rica in the early 1980s[3] and for the resulting economic transformation. The results in Table 4 show that capital and labor have a positive and significant effect on Costa Rica's economic growth. On the other hand, neither vertical nor horizontal export diversifications significantly influence economic growth. Interestingly, horizontal export diversification appears with a negative sign, which contradicts the hypothesized relationship with economic growth, while vertical export diversification has the hypothesized positive impact. The Shapiro-Wilk test for normality shows a p value larger than 0.05, which indicates that the data are normally distributed. The Breusch-Godfrey test was included and found no evidence of serial correlation in the disturbance. Finally, in the context of time-series data, two specification tests on residuals were included: The Durbin-Watson (DW) test on residual autocorrelation and the Engle's Lagrange Multiplier test for autoregressive conditional heteroskedasticity. A DW value of 1.03 lies between the zone of indecision and the acceptance of the null hypothesis of no autocorrelation. Finally, the results from the Engle's Lagrange Multiplier test do not indicate any problems with autocorrelation conditional heteroskedasticity. Equation (11) was again estimated using now robust standard errors, and its results are shown in Table 5. No noteworthy changes in the statistical significances or signs of the estimated elasticities were found. In summary, the DOLS procedure confirms the lack of a long-run causality between export diversification and economic growth in Costa Rica over the period of 1965–2006.

It is important to understand why the present results differ from those found for Chile by

[2] The DOLS model was also estimated using one and three leads and lags without altering the results to any significant degree,

[3] The year of 1980 was chosen based on the literature on the economic crisis that affected Costa Rica, and on visual observation of the plots of the series in log levels. *du*80 is one from 1980 onwards and zero otherwise, while *d*80 has a value of one in 1980 and zero otherwise.

Table 4. Stock-Watson DOLS Long-Run Parameter Estimates

β	λ	Ψ	γ
0.26***	0.81***	−0.18	0.24
(3.14)	(4.38)	− (1.11)	(0.44)

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

Herzer and Nowak-Lehnmann's (2006). Even though these two countries are regarded as successful in terms of their economic performance and diversification of their exports, a closer look at their economies will reveal important differences. These differences can explain why export diversification has played such an important role in Chile and not so in Costa Rica. In the case of the former, the most important source of export diversification has been the emergence of non-traditional agricultural exports. Examples of exported resource-based goods 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 a few primary goods to a country with flourishing high-tech and medical equipment manufacturing export sectors, and well diversified agricultural and service sectors. However, this was likely 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. Such interdependence between export diversification and foreign investment by large multinationals poses limitations to the amount of knowledge spillovers generated by the export sectors. 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, 2006). 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 small group of products, including manufactured and agricultural products, continues to account for the majority of the export value. Thus, progress made in terms of horizontal and vertical export diversification may fail to reveal a persistent concentration in terms of value. For instance, in 2005, 84% of the total value of all goods exported was produced by large corporations, which account only for 20% of the total number of manufacturers in Costa Rica (Promotora del Comercio Exterior de Costa Rica, 2005).

Table 5. Stock-Watson DOLS Long-Run Parameter Estimates with Robust Standard Errors

β	λ	Ψ	γ
0.26***	0.81***	−0.18	0.24
(4.37)	(5.65)	−(1.20)	(0.80)

Conclusion and Policy Implications

By estimating an augmented Cobb-Douglas production function using time series data, this study has presented new empirical evidence that in Costa Rica neither vertical nor horizontal diversification is associated with faster economic growth over the period of 1965–2006. These findings are contrary to what was hypothesized and to what has been observed in other economies. On the other hand, this evidence generates a discussion on whether a government-backed export diversification based on FDI is conducive to long-term economic growth.

In terms of policy implications, the results from this study suggest that expansion 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. Although Costa Rica has been fairly successful in attracting FDI in manufactured goods, this study identifies the limitations of the hitherto export-led model of development. Hence, Costa Rica should design and implement a new set of policies seeking to improve the nation's long-term economic growth potential and increase the role of the domestic industrial sector in its exports. First, further linkages between the export sector and the rest of the economy should be created so that new channels for knowledge spillovers may be generated. Furthermore, the presence of multinational companies in the country should be used by Costa Rica to spur the development of clusters of domestic-owned suppliers and other satellite businesses. Financial instruments and access to credit should also be facilitated for potential domestic firms that wish to produce and export products that are more technologically involved. Finally, regulation reforms should take place to simplify the creation of small and medium domestic export-oriented firms. All these efforts should be done in close coordination with higher education institutions so that they can supply domestic firms with qualified workers.

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Appendix 1: Variable Definitions and Data Sources

GDP at Constant Prices (2000 U.S. $) (*Y*)

GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2000 U.S. dollars. Dollar figures for GDP are converted from domestic currencies using the 2000 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.

Source: World Development Indicators online version, World Bank 2008.

Gross Fixed Capital Formation (2000 U.S. $) (*K*)

Gross fixed capital formation is measured by the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period plus certain additions to the value of non-produced assets (such as subsoil assets or major improvements in the quantity, quality, or productivity of land) realized by the productive activity of institutional units.

Source: World Development Indicators online version, World Bank 2008.

Step Time Dummy Variable (*du*80)

This variable assumes the value 1 from 1980 onwards and zero otherwise.

Source: Author's own calculations.

Impulse Time Dummy Variable (*d*80)

This variable has a value of 1 in 1980 and zero otherwise.

Source: Author's own calculations.

Labor Force, Total (*L*)

Total labor force comprises people who meet the International Labor Organization definition of the economically active population: all people who supply labor for the production of goods and services during a specified period. It includes both the employed and the unemployed. While national practices vary in the treatment of such groups as the armed forces and seasonal or part-time workers, in general the labor force includes the armed forces, the unemployed, and first-time job-seekers, but excludes homemakers and other unpaid caregivers and workers in the informal sector.

Source: World Development Indicators online version, World Bank 2008.

Vertical Export Diversification (*MX*)

This is the manufactured exports as a percentage of total merchandise exports. The manufactured comprise commodities in Standard International Trade Classification sections five (chemicals), six (basic manufactures), seven (machinery and transport equipment), and eight (miscellaneous manufactured goods), excluding division 68 (non-ferrous metals).

Source: World Development Indicators online version, World Bank 2008.

Horizontal Export Diversification (*S*)

This is the number of export sectors classified by the Standard International Trade Classification at the three-digit level.

Source: United Nations dataset.