ARE EXPORTS CAUSING GROWTH? A BALANCE OF PAYMENTS APPROACH IN CUBA, 1960-2004

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Abstract: *In this paper, we analyze the role of exports as an engine of economic growth in Cuba during the long period from 1960 to 2004. In contrast with the traditional approach through the production function; we introduce a formalization of the indirect effects in the ELG hypothesis based on the balance of payments constrained framework by including the impact of both terms of trade and imports of good and services in the relationship between exports and output. For it, Toda and Yamamoto methodology is used to test for no Granger non-causality in vector autoregressive models involving integrated and possibly cointegrated variables. Our results suggest that our formal approach in this spirit of Thirlwall´s model is useful to systematize the empirical literature taking into account for indirect effects in the ELG hypothesis that cannot be included in the traditional production function framework.*

Keywords: Cuba, Export-led Growth, commercial agreements effects, Granger causality and augmented VAR modelling.

JEL Classification: C32, C52, F43

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I. INTRODUCTION.

Though since the ninetieth century connections between openness and growth have been an issue of interest, it is in the last thirty years when this traditional economic area of analysis has produced a great amount of works and a strong attention from the development international institutions. This reappearance coincides, on one hand, to the long time rapid growth achieved by the Asian newly industrialized countries (NICs) which have implemented since the seventies a (successful) outward oriented development strategy; on the other hand, the Latin American import substitution development strategy showed by the same time both their limits and their economic malfunction, especially when they are compared with economic growth dynamic of Asian countries.

Empirically, the causal relationship between exports and economic growth has been a primary topic of research in the openness growth issue and, till now, is an ongoing debate in the economic development literature. Exports have been considered the main channel through which openness increases the economic growth performance. The main question in the export-growth issue is whether causality goes from exports to economic growth, labelled Export-led Growth (ELG) hypothesis or, contrary, causality flows from economic growth to exports, namely Growth-led Exports (GLE) hypothesis. The establishment of the direction of this causal relationship has important implications for economic policy strategies. If causality flows from exports to growth then the implementation of export promotion policies is a proper strategy for a country to grow. But if causality goes on the reverse direction then a certain degree of development may

be a prerequisite for a country to increase its exports and, therefore, previous internal economic growth policies are necessary to expand exports. A bi-directional causality would imply that both strategies are necessary as long as one reinforcing the other one.

Among the set of developing countries, the Cuban economy is an appealing example due to *special* trade agreements periods in their unique economic growth and development path and political and social systems. Regarding the external sector, the period running from 1960 to 1991 was overbear by the integration of Cuba in the Council of Economic Mutual Assistance (COMECON), formed by socialist countries. This period implied for Cuba the definition of all the relevant aspects of the external sector: its international commercial partners, the prices of exports and imports and what is even more important, the pattern of goods to be exported and imported The COMECON implied special financial facilities for trade flows and commercial preferences for the Cuban economy and moved away from the country external capital flows. In this long period, the external sector was in fact no open and import and export flows were no price market directed. After the rupture of the socialist block in 1989, Cuban output and exports suffered an intense crisis and begun a period of structural reforms searching for macroeconomic stability and a "new" international pattern into the world economy. This new guide of international integration has been based more intensely in the services, mainly associated to tourism exports, rather than in deep changes in the goods trade flows.

Hence, the objectives of this paper are twofold: on one hand, to examine the evidence of the openness growth connection on the Cuban economy testing the ELG hypothesis in a balance of payments framework in the spirit of Hicks, Verdoon, Prebisch, Myrdal and more formally specified by Thirlwall (1979). In so doing, we

include services, in addition to goods, because of their increasing role in the balance of payments. On the other hand we seek to investigate the role of the COMECON economic integration process for the Cuban economy in the long period, 1960-2004. For that, we test different periods in our ELG model taking into account the COMECON era and post Berlin Wall fallen since 1990.

This article contributes to the existing ELG literature in the following ways. Firstly, we formalized a model testing the ELG hypothesis in a well specified balance of payments framework, extending the traditional two-variable basis models into a multi-variable demand model with the inclusion of terms of trade (Model *(i)* and imports of goods and services (Model *(ii)*. In this sense, causality takes into account for the indirect effects in the ELG literature avoiding those problems related to causality misleading interpretations extremely sensitive to ommited variables but in a quite different fashion than the traditional production function framework Second, the use of time series analysis applied in this case to Cuba avoids the limitations of the cross-country works (as we explain in the next section). In this sequential study, Granger causality is sequentially implemented by means of the modified-Wald test (MWALD) for augmented level VAR model with integrated and cointegrated processes introduced by Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) (TYDL henceforth). Finally, it provides new insights on the effects of the COMECON period in the causal relationship between exports and output in the recent economic history of Cuba and, therefore, providing future guidelines for external economic strategies related to development performance.

The rest of the paper is organized as follows. Section 2 provides an empirical and theoretical on the export-led-growth hypothesis and presents the empirical model. In the

third section data and a descriptive analysis are presented. Section 4 contains the econometric methodology and the models will be systematically introduced and discussed while Section 5 sets our empirical results for Cuba. The paper closes with a brief discussion of the results.

II. EXPORT-LED GROWTH. A BRIEF REVIEW ON THE LITERATURE AND EMPIRICAL MODEL.

A. Theoretical and Empirical background.

From a theoretical point of view and with regard to exports as a generator of economic growth several approaches can be distinguished (see, Krugman, 1987; McCombie and Thirlwall, 1994; Giles and Williams, 2000, for a surveys). First, the rate of growth of exports, as a determinant of aggregate demand, affects directly to output growth; an increase in foreign demand can produce a rise in output due to greater employment, income and investment in the exportable sector. Of course, this direct connexion is related to the foreign trade multiplier exposed by Hicks (1950). Second, the increase of exports can indirectly raise output growth based on the assumption of increasing returns to scale and spill-over effects from exports to other sectors of the economy. These externalities can produce a more efficient resource allocation, moving resources from relatively inefficient non-tradable sectors to the higher productive export sector. Besides, exports sectors can promote the diffusion of improved techniques, exploitation of economies of scale, learning by doing gains, greater capacity utilization and improved technological and management abilities due to more competitive markets faced by export sectors. New growth and international trade theories emphasised these

indirect channels of benefits of a dynamic export sector to economic growth (for example Arrow, 1962; Lucas, 1988; Helpman and Krugman, 1985; Grossman and Helpman, 1991). Third, growth requires imports of capital and intermediate goods that allows a faster capital formation and, therefore, increasing rates of growth, and if exports do not rise as fast as import requirements, growth could be constrained by the balance of payments (as suggested, for instance, by Lamfalussy, 1963; Mckinnon, 1964 and Thirlwall, 1979). Forth, the smaller is the domestic market, the greater is the importance of the external demand to achieve economies of scale and to obtain capital and intermediate goods as was suggested by Adam Smith more than two centuries ago.

Though all these reasons support outward-oriented policies to achieve higher rates of growth, there are theoretical critics to the ELG hypothesis. For instance, the traditional import substitution strategies implemented by Latin American and other countries to foster domestic firms and sectors because of the hypothesis of deterioration of terms of trade exposed by Prebisch (1950, 1959) and Singer (1950). Grossman and Helpman (1991) showed that protection of key sectors in economies with comparative disadvantage may lead to higher economic growth. Technological approaches of international trade, based on absolute advantage (Smith, 1776), support this possibility of negative effects of openness in growth depending on the absolute advantage of tradable sectors (see, for instance, Dosi and Soete, 1998 and Krugman, 1996). There is also support for GLE hypothesis based on the assumption that economic growth leads to enhancement of abilities to produce, to use and develop new technologies, and so on, that increase productivity creating that comparative advantage necessary to export (Krugman, 1984). Finally, the role of imports as an engine for long-run economic and export expansion have been emphasized into the endogenous growth models (Coe and

Helpman, 1995). Imports serve as a channel to get foreign R&D knowledge and more advance capital and intermediate goods suggesting Import-led Growth (ILG) alternative causality relationship (Awokuse, 2007).

Since trade theories does not provide a definitive answer on the causality between exports and growth, the debate has generated a vast amount of empirical work, especially applied to less developed countries. Results from these studies are, at best, mixed and contradictory (Ahmad and Kwan, 1991 and Bahmani Oskooee et al., 2005).

The majority of empirical studies can be separated in three groups (see Giles and Williams, 2000; Begum and Shamsuddin, 1998; Bahmani Oskooee et al., 2005 for more extensive reviews on the empirical literature). The first group includes studies based on cross-sectional data using correlation coefficients or ordinary least squares (OLS) regressions between exports and output. A huge number of countries and time periods can be found but in general those results tend to support a positive association between exports and output (for example, Kravis, 1970; Balassa, 1978 and Feder, 1982). A second group includes works using standard time series regression techniques such as OLS (for example, Ram, 1985 and Foster, 2006). However, these two first groups though they are analyzing possible relationships do not analyse the direction of causal influence from exports to growth or vice versa. Finally, the third group includes all those more recent studies that have used new time series methods to establish integrating properties of exports and output in order to analyze causality on the basis of either the cointegrating properties of their long-run relationship through the introduction of cointegration and error correction modelling by Engle and Granger (1987) or augmented VAR levels and acyclic graphs. These studies include cross-country and single country analysis of the ELG hypothesis and, independently, results are mixed

(Islam, 1998; Bahmani Oskooee and Alse, 1993; Van den Berg and Schmidt, 1994; Richards, 2001, Balaguer and Cantavella-Jordá, 2004; Awokuse, 2005a, 2005b, Bahmani Oskooee et al., 2005 and Siliverstovs and Herzer, 2006).

In general, cross-country analysis have supported associations between exports and output but time series data studies have failed to provide strong evidence in favour of either ELG or GLE hypothesis. The main criticism to cross-country studies is that they assume common and identical economic structure and levels of development to all the considered countries which can derive in misleading results. Because of this problem, time series analysis has became very popular in the empirical literature.

Another important methodological limitation in the ELG literature (both, in time series analysis or cross country studies) derives from the fact that exports are built into output and spurious results can be achieve because of the bias in favour of correlation (Sheehey, 1990, Greenaway and Sapsford, 1994). Trying to avoid this bias two strands in the empirical literature has emerged including additional variables and, then, moving to either a multivariate correlation or causality aprroach. One of them estimates production functions augmented with exports (for instance, Ghatak et al. 1997 and Awokuse, 2003) or augmented with exports and imports (Herzer et al. 2006 and Awokuse, 2007). The other one has included other variables to take into account for indirect effects such as imports (Tang, 2006) or imports and openness (Kónya, 2006). In general, this strand has failed in providing a consistent theoretical model.

Our point in this study is to provide a theoretical model supporting a balance of payments framework in the analysis of ELG hypothesis in the spirit of Thirwall´s model (1979)

The kinship between external sector and growth path for Cuba has been econometrically verified. In fact, there exist three internal contributions tying up exports and output in keeping with the balance of payments constrained model but while Mendoza and Roberts (2000) and Triana (2005) find support of a positive association only making allowance for goods in the export variable, Fundora and Vidal(2006) reckoned services together with terms of trade and current account deficit. Regarding our major causality concern in this paper and, as far as we know, there is no research including the case of Cuba in a cross country study dealing with the ELG hypothesis. Only Mañalich (2007) is dealing with this pattern but in the most basic two-variable case and this is precisely our starting point in this paper.

B. Empirical model.

Assuming that a country's output growth is external influenced, Thirlwall (*1979*) developed a seminal hypothesis assessing that a country's economic growth rate can be approximated by the inverse of import income elasticity (π) times the rate of growth of exports. This balance of payments constrained growth model has been applied to developed and developing countries, showing that the actual growth rates are very close of the predicted ones and, therefore, that the economic growth is balance of payments influenced (see, among many others: Atesoglu (1995), Hieke (1997), McCombie and Thirlwall (1994), Moreno-Brid and Pérez (1999) López and Cruz (2000), Perraton (2003), Fugarolas and Matesanz (2007)

For this purpose, Thirlwall assumes, on one hand, that current account equilibrium will be mantained over time if the currency values of imports and exports spread at the same rate and, on the other hand, that the demand of import (*M*) and

exports (X) are stable functions of income and their relative prices, i.e., $M_t = f(Y_t, P_t, P_t^*)$ and $X_t = h(Y_t*, P_t, P_t^*)$ being Y* and Y, international and domestic values of output and P*and P are index prices of imports and exports, respectively.

Following recent empirical contributions for other Latin American countries (among others, Lopez and Cruz (2000), Moreno-Brid and Pérez (1999), Fugarolas and Matesanz (2007), it is essential to consider the impact of terms of trade on the output path in any developing country context. In this scenario, the balance of payments equilibrium income (Y_{BP}) level performance results on the following log-linear output growth

$$\ln Y_{BPt} = \beta_o + \beta_1 \ln X_t + \beta_2 \ln(P/P^*)_t + \varepsilon_t \quad (1)$$

where ε_t is a white noise term.

The subsequent analysis on those casual relationships discussed above is firstly built upon the augmented VAR levels framework that can be associated to equation (1). We should remark that Fugarolas et al. (2008) do have found support for Thirwall's Law as an explanation for growth in Cuba over the same periods we will analyse. Over and above, extremely high correlation of 96.79%, 99.06%, 98.23% and 80.75% is estimated between actual and predicted income levels for the periods 1960-2004, 1960-1989, 1970-1989 and 1990-2004 respectively. Turning to demand side ELG testing itself, all these estimates empower us to assume that the variable Y_{BP} can be drafted in equation(1) by the actual output Y performance.

Into the bargain, two main reasons lead us to enlarge the basis information set by considering the essential effect of imports: firstly, they are at the centre of the spirit of

Thirlwall's hypothesis and, in fact, the analysis rely on the calculation for income elasticity demand for imports; secondly, imports have represented the main channel of capital goods incorporation in Cuban economy. Henceforth, causality analysis finally runs over the expanded model (2) defined by

$$\ln Y_t = m\left[\ln X_t, \ln(P/P^*), \ln M_t\right] + u_t \qquad (2)$$

where u_t is an independent random error.

Therefore in Section 5, causality on the ELG hypothesis is based on those two models (1) and (2) which both are built in the spirit of a Thirlwall´s balance of payments framework. Precisely, this demand approach have demonstrated especially accurate in Latin American countries and in Cuban economy (Fugarolas et al. 2008)

III. DATA AND DESCRIPTIVE ANALYSIS

The database consists of annual time series covering the period 1960-2004 from Oficina Nacional de Estadística (ONE), Comité Estatal de Estadísticas (CEE), Instituto Nacional de Investigaciones Económicas (INIE) and Ministerio de Economía y Planificación. The variables considered in our modelling are real gross domestic product (GDP), exports of goods and services (X), imports of goods and services (M) and the terms of trade (TOT) which are defined by the ratio price index (1997=100) of imports and price index of exports. All the variables are expressed in logarithmic terms. As long as the beginning of the seventies and the nineties steer two exogenous cutt-off points in

the Cuban policy-making, three different sub-periods- 1960-1989, 1970-1989 and 1990-2004- are also examined from now on.

Figure 1 depicts the evolution of real GDP, imports and exports in Cuba during 1960-2004 (Table 1 shows their corresponding average annual rates of growth for the whole and selected periods). All variables followed upwards trends, but with different rhythm. The long term slope of GDP severely dropped after the collapse of communism system in East Europe in 1989 (real GDP dropped 35% between 1990 and 1993); in fact, it is in 2005 when the Cuban economy retrieved real GDP levels of 1989, implying fifteen years of stagnation in this period. During 1970-1989 the economy rate of growth was relatively high based on the COMECON arrangements which specified exports and imports goods, volumes and prices. After Berlin Wall fallen, Cuban economy enters in a stage of sector, institutional and openness reforms trying to face up the negative effects of soviet collapse; agrarian reform to increase output, tourism openness to foreign investment, biotechnology sector recommendations and exports financial support were policies implemented to improve economic performance in this difficult period (González, 1993). Since 1994, the economy recovered a positive path not only in its economic growth and but also in its export and import performance, but absolute levels in 2004 do not reach 1989 levels.

We note that exports have shown a more volatile path with a long period of rapid growth in 1970-1989, an intense dropped in the rate of growth from 1990 to 1995 and a quite fast recover of the slope of growth after 1995. 1972-1985 was the golden period of Cuban exports and imports: the annual rate of growth was of around 16% and 15%, respectively and economic growth reached almost 7% annual rate of growth. In this period, Cuban economy was integrated in the COMECON with preferential prices for

Cuban most important exported products, especial access to soviet markets and other facilities such as import credits and others. From 1960 until 1989 more than around 80% of exports were sugar, nickel, fish products, citrus fruits and tobacco and COMECON countries received almost three quarters of the global Cuban exports. Later on, after the disintegration in 1991 of socialist area and Soviet Union and subsequently the end of the COMECON commercial agreements, Cuban exports had to be diversify in terms of exports products and commercial partners: medicaments and tourism were the principal exports hereafter and Canada and Latin America the regions of destination.

(table 1 around here)

Also imports followed a rapid rate of growth during the COMECON period, a collapse in the first years of the nineties and a slow recuperation after 1994. During the COMECON period just about the 90% of imports were composed by capital and intermediate goods: one third of the capital goods were necessary for industrialization process of the Cuban economy and petrol was the most important intermediate goods for production arriving from the Soviet block. After 1989, imports pattern was diversified in terms of products. Capital goods and fuel imports were substantially reduced due to the economic crises and consumption imports were elevated in order to complete the basic food basket of Cuban population, attaining more than 20% of imports during these years. On the other hand, traditional East commercial partners began to be substituted for Latin America, Asian and European countries.

Finally, terms of trade have shown a slightly improvement during COMECON period, coinciding with those faster periods of exports and imports expansion[1]. Hereafter, the collapse of the Soviet Union implied a continuous deterioration of terms of trade moving away from administer prices of the previous rules and adjusting Cuban external sector prices to more realistic international market conditions.

(figure 1 around here)

As Figure 1 is suggesting, there exists a closer association among exports, imports and output showing upward trends in the same periods and an evident and deep break in their long run expansion in the end of the eighties. Our task needs to econometrically validate such connexion and, what is most important in our work, to test for causal influence among trade and economic growth. In looking for the ELG or GLE hypothesis, we investigate the possibility of Granger causality between the export expansion and economic growth pace by means of a sequential procedure. In so doing, we are concerned with the Granger casual inference biases that can emerge when cointegration must be pre-tested so looking for a genuine and complete model and on the basis of the advantages of the TYDL procedure, the effect of terms of trade and imports are introduced and tested in the causal relationship.

[1] Following common practice, terms of trade are constructed as the ratio of imports prices to exports prices so, a negative rate of growth implies an improvement of terms of trade and, vice versa, a positive rate of growth implies deterioration.

IV. MODEL SPECIFICATION. CAUSALITY AND METHODOLOGY.

Granger (1969) introduced a popular causality concept which has been used in the context of rational expectations, definition of super exogeneity and econometric modelling strategy. He defines a variable x_t to be casual for a time series variable y_t if including the former variable in the information set helps to improve the forecasts of the latter. More precisely, let Ω_t stand for the set of all the relevant information in the universe and $y_{t+h|\Omega_t}$ for the optimal *h*-step forecast of y_t at origin *t* based on Ω_t. We may define x_t to be Granger-non causal of y_t if and only if

$$y_{t+h|\Omega_t} = y_{t+h|\Omega \propto \{x_s | s \leq t\}}, \qquad h = 1,2,\ldots \qquad (1)$$

Where the symbol $A \propto B$ denotes the set of all elements of a set *A* not contained in the set *B* and *h* is a positive integer that can be infinite. Hence, x_t is said to be not causal for y_t if removing the past of x_t from the information set does not change the likelihood to help predict y_t at any forecast horizon. In turn, x_t is Granger-causal for y_t if (1) does not hold for at least one *h*, and thus a better forecast of y_t is obtained for some period ahead by including the past of x_t in the information set.

The simplest and most common framework assumes that Ω_t only contains past values of x_t and y_t, that is, $\Omega_t = \{(y_s, x_s)' | s \leq t\}$ and $(y_s, x_s)'$ is generated by a bivariate *p*th-order VAR process given by

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \sum_{i=1}^{p} \begin{bmatrix} \alpha_{11,i} & \alpha_{12,i} \\ \alpha_{21,i} & \alpha_{22,i} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-i} \end{bmatrix} + \varepsilon_t \qquad (2)$$

and non-causality condition (1) of x_t for y_t is equivalent to test if the lags of the first variable do not enter in the first equation[2], that is,

$$H_o : \alpha_{12,i} = 0, i = 1,2,\ldots, p \qquad (3)$$

Granger causality is dealing with precedence and, precisely, the procedure defined by (3) which tests the significance of the coefficient of the lagged independent variable is commonly used in practice though many other testing procedures have been proposed in the related literature.

Causal results are quite sensitive to the model selection and henceforth to the considered variables. In Mañalich (2007) causal relationships between exports of good and services expansion an economic growth were firstly analized for Cuba in the framework of a vector correction model for the same periods analyzed in this paper. In this study, the trace and the maximal-eigenvalue statistis in the Johansen (1991) and Johansen and Juselius (1990) procedure confirm the existence of at most one equilibrium relationship among the logarithms of GDP and exports at the 95% confidence level in 1960-2004 and 1960-1989 showing, on the contrary, evidence of negatively cointegration in the long-run is found for the sample periods, 1990-2004 and 1970-1989., At the 5 percent significance level, Granger causality proofs show in the

whole period the rejection of the null hypothesis that exports of goods and services does not Granger-cause GDP but not vice versa. However, the ELG hypothesis that can be addressed for 1960-2004 turns into reverse causality from GDP growth to the exports growth during the 1960-1989 samples.

It is worth mentioning an essential issue regarding the Granger Causality approach itself. Following common practice, in the bivariate model the sequential testing procedure based on likelihood ratio tests to a dynamic VAR structure introduced by Johansen (1991) and Johansen and Juselius (1990) is implemented. Once the existence of long-run relationships is accepted, their direction is checked on the basis of an error correction representation by means of a joint significance test of the coefficients. Nevertheless, it turns out that weakness is characterizing this two-step causality approach. As Giles and Mirza (1999) brought to mind, this methodology is calling for pre-testing unit roots and cointegration before causality testing and the results may suffer from size distortions and inference biases leading to an over rejection of the non-causal null hypothesis.

Investigating the interrelationships in greater detail usually requires taking into account the possible indirect effect of other relevant variables in the economic system. Therefore, indirect causal links must be analyzed in higher dimensional dynamic structures. On one hand, and as we have already pointed out, three sub-periods are discerned in the whole analyzed sample in keeping with Cuba's commercial policy-making; in so doing, to go into the real effects of the country's trade decisions, the classical formulation defined in Mañalich (2007) is firstly extended to a trivariate structure by introducing the terms of trade variable. On the other hand, following

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[2] In the same way, y_t does not Granger-causes x_t whenever $\alpha_{21,i} = 0$ for $i = 1,2,\ldots, p$

Riezman et al (1996) and the very recent empirical contributions of Tang (2006) and Awokuse (2007), the validity of any Export-Led Growth or a Growth-Driven Export phenomenon should take into account the key role of imports not only as intermediate inputs in exports but also for its influence in recovering global and stable positions from possible external disequilibria. Hence, the information set is once again extended by adding the imports of goods and services.

In those more suitable multivariate frameworks, we employ the augmented level VAR technique with integrated and cointegrated process. The TYDL procedure consists on over-fit a levels VAR specification with a total of $p=(k+dmax)$ lags being k the lag-length chosen by using some information criteria and $dmax$ the maximal order of integration for the time series data involved in the system. The asymptotic chi-squared distributed MWald test proposed is applied to the first k VAR coefficient matrix while the coefficient matrices of the last $dmax$ lagged vectors in the model are ignored. More precisely, the underling intuition of this approach to Granger Causality is that whenever the elements in at least one of the coefficient matrices A_i are not restricted at all under the null hypothesis (for instance, the non causality restriction (3) which involves in a VAR modelling elements from all A_i, $i=1,\ldots,k$) it is enough to add extra and redundant lags in estimating the parameters of the structure to ensure the standard asymptotic properties of the Wald statistic which maintains its usual limiting χ^2 distribution. Therefore, the TYDL enables the proposed MWALD statistic to test linear or nonlinear restrictions on these k coefficient matrices using the standard asymptotic theory.

To sum up, the conclusive specification tested is defined by the following four variable (*k+dmax*) order VAR structural modelling linking exports, economic growth, terms of trade and imports[3]

$$\begin{bmatrix} \ln X_t \\ \ln GDP_t \\ \ln TOT_t \\ \ln M_t \end{bmatrix} = \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \\ \alpha_{30} \\ \alpha_{40} \end{bmatrix} + \sum_{i=1}^{k} \begin{bmatrix} \alpha_{11,i} & \alpha_{12,i} & \alpha_{13,i} & \alpha_{14,i} \\ \alpha_{21,i} & \alpha_{22,i} & \alpha_{23,i} & \alpha_{24,i} \\ \alpha_{31,i} & \alpha_{32,i} & \alpha_{33,i} & \alpha_{34,i} \\ \alpha_{41,i} & \alpha_{42,i} & \alpha_{43,i} & \alpha_{44,i} \end{bmatrix} \begin{bmatrix} \ln X_{t-i} \\ \ln GDP_{t-i} \\ \ln TOT_{t-i} \\ \ln M_{t-i} \end{bmatrix} + \tag{6}$$

$$+ \sum_{j=k+1}^{k+1+d\max} \begin{bmatrix} \alpha_{11,j} & \alpha_{12,j} & \alpha_{13,j} & \alpha_{14,j} \\ \alpha_{21,j} & \alpha_{22,j} & \alpha_{23,j} & \alpha_{24,j} \\ \alpha_{31,j} & \alpha_{32,j} & \alpha_{33,j} & \alpha_{34,j} \\ \alpha_{41,j} & \alpha_{42,j} & \alpha_{43,j} & \alpha_{44,j} \end{bmatrix} \begin{bmatrix} \ln X_{t-j} \\ \ln GDP_{t-j} \\ \ln TOT_{t-j} \\ \ln M_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{X_t} \\ \varepsilon_{GDP_t} \\ \varepsilon_{TOT_t} \\ \varepsilon_{M_t} \end{bmatrix}$$

V. ECONOMETRIC ANALYSIS AND RESULTS

This section presents the corresponding empirical results for Cuba's exports-growth connection. Prior to run the described Granger Causality tests methodology for two multivariate dimensional versions, we start by investigating the unit roots in order to examine the stationary and univariate time series properties of each of the time series data involved in modelling.

[3] Note the trivariate specification is identical to the (6) by omitting in the variable and estimator matrices the last row corresponding to the imports field.

V.1.Integration properties of the data series

In terms of a distribution moments, a time series generated by a stationary stochastic process must fluctuate around a constant mean, its variance is time-invariant and does not show any trend. However, most of the economic time series are *nonstationary* and its use can falsely imply the existence of a meaningful economic relationship. Hence determining whether a variable follows a trend –stationary or a difference-stationary process, and therefore whether to detrend or to diferenciate it in order to result in a stationary series, is of great importance for any analysis.

In this paper the data univariate characteristics are examined using the Dickey-Fuller (DF) and the Augmented Dickey Fuller (ADF) unit root approaches. On the basis of independently not serial correlated and identical distributed errors, this parametric procedure is assuming a stochastic part modelled by an autorregressive representation testing the null hypothesis of a unit root against the alternative of stationary. Lag-length is selected to ensure non-autocorrelated error terms and the decision tree proposed by Charemza and Deadman (1992) is implemented to check the significance of time trend and drift terms together with non-stationary.

Table 2 summarizes the ADF test over the period 1960-2004[4]. Based on the results neither a trend nor a drift can be accepted; in addition, the null hypothesis of non stationary of the variables cannot be rejected. Hence, at 5% or even 1% levels of significance, all four variables are integrated of order one, I(1), so they are not-stationary in levels but stationary after differencing.

[4] Not reported here but available on Fugarolas el at (2008), we note that all the variables are found to be integrated of order one in each of the analyzed sub-periods.

(table 2 around here)

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V.2 Terms of trade and imports of goods and services. The multivariate analysis

In this section we test those higher dimensional systems by including relevant economic variables in the balance of payments constrained framework we have specified: first we introduce the terms of trade (equation 1) and later on the imports of goods and services (equation 2). Let Model (*i*) and Model (*ii*) stand for the three and four variable respectively.

The causal analysis for these two modellings is carried out by means of the augmented VAR procedure proposed by Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) which allows for causal inference (by testing general restrictions on the parameter matrices) on the basis of an augmented level VAR with integrated and cointegrated vectors.

Before testing for causality an essential issue is to specify the lag-length in each of the considered periods. The general approach is to fit VAR(*m*) models with orders $m = 0,\ldots, j_{\max}$ and to choose an estimator of the order j that minimizes the criterion. In so doing, the distance between the "true" model and the Kullback-Leiber quantity of information contained in a proposed model is measured by the log-likelihood function with *h* parameters given by

$$l = -\frac{TR}{2}(1+\ln 2\pi) - \frac{T}{2}\ln\det(\hat{\Omega}(m))$$

where $\det(\cdot)$ denotes the determinant, *R* is the number of equations and $\hat{\Omega}(m) = T^{-1}\sum_{t=1}^{T}\hat{e}_t\hat{e}_t'$ is the residual covariance matrix estimator for a VAR of order *m*. In

measuring the goodness of fit and parsimonious of a model specification, the information criteria of Akaike (AIC), Schwartz (BIC) and Hannah-Quinn (HQ) are defined on the basis of -2 times the average log-likehood function adjusted by a penalty function.

(table 3 around here)

Table A1 in the appendix shows the optimal lag selection in both three and four vector autoregressive structures estimated by OLS over each of the considered periods. In this fashion we prefer lag structures which are the more parsimonious but still long enough to whiten the residuals. For model *(i)*, we can see that AIC and SC choose a lag length of one for all the terms with the exception of two years for the sub-period 1990-2004. Once the imports variable is included, lag selection is based on the AIC and HQ criteria which indicate two lag for those long periods starting in the sixties and one for the shorter ones -1990-2004 and 1970-1989.

Given that VAR(k) has been selected for each three and four variable autoregressive modelling in each of the considered periods, the last point is to determine the maximal order of integration that might occur in the process. As long as all the variables have been found to be at most I(1), an extra lag may be added in each of the periods so $dmax=1$ in both three and four variable modelling.

To conclude, and overfitting the true VAR order, we estimate a levels VAR with a total of $p=(k+dmax)$ lags. For the Granger-Causality tests, we apply standard Wald test to the first k VAR coefficient matrix excluding the extra parameters in testing for Granger causality. Table 3 and Table 4 report all the results of the MWALD test for the augmented VAR models (*i*) and (*ii*) respectively.

From the application of the TYDL methodology in the three-dimensional analysis (see Table 4), we note that in 1960-2004 exports of goods and services "Granger-cause" GDP at the 95% confidence level then supporting the ELG hypothesis; for the same sample, the export equation results indicate that the null hypothesis that exports are not caused in the Granger sense by GDP can also not be rejected at the 5% significance level, showing the existence of the positive influence of GDP on their dynamic. Hence, we observe that the causal link between exports and economic growth in Cuba is bidirectional in the whole period 1960-2004. However, no causal relationship can be addressed in any of the analyzed sub-periods.

(table 4 around here)

As long as export expansion and openness to foreign markets are considered as key determinants of economic growth, our point is to take into account the effect of imports. In the Cuban case, though in the short-run some mismatches can be observed, exports co-moved with imports of goods and services in the long-term. This joint movement is reflected by high correlation coefficients over 0.95 for all the periods expect for the period 1990-2004 that drops up to 0.86. Turning to model *(ii)* causality results (see Table 5), we can conclude that, at least in the Granger sense, either the ELG hypothesis or the GLE phenomenon can be strongly rejected at the 5% and even 10% significance level. Interestingly, the GDP equation results show a positive casual relationship going from imports of goods and services to the Cuban growth path in all the periods but 1990-2004.

This finding is implying that imports are causing growth in Cuba suggesting Import-led Growth (ILG) causality and therefore, imports are more important for Cuban

economy to grow than exports. In 1990-2004, period we do not find a ILG causality pattern but a direct causality flowing from output to exports (GLE) and, interestingly, causality from imports to exports.

VI. CONCLUSIONS.

This paper, reports on new empirical developments in international trade literature and, more precisely, to the crucial role of a country's external sector position on its growth performance and the so-called export-led growth phenomenon. We have introduced for the first time a formalization of the indirect effects in the ELG hypothesis based on the balance of payments constrained framework exposed by Thirlwall (1979) in the tradition of Verdoon and Hicks, among others. The most relevant contribution of this paper is the formalization of the external sector indirect effects in the ELG empirical literature. Some of these works have included different variables to test for these indirect effects trying to avoid the typical bias in support of the ELG found in bivariate literature (for instance, Tang (2006) includes imports and Kónya, (2006) includes imports and openness).

Our approach is different but complementary with the traditional approach through the production function framework used in works such as (Awokuse, 2003, Ghatak et al. 1997, Herzer et al. 2006 and Awokuse, 2007). In so doing, the paper includes the impact of both terms of trade and imports of good and services in the relationship between exports and output. We have applied our model to the appealing example of the Cuban economy during 1960-2004.

Arising from this analysis, there are two essential conclusions that crops up from this paper. First, comparing our model specification (*i*) and (*ii*) we show that causality reverses by including imports in the analysis. In (*i*), the ELG casual relationship is accepted in the whole period where causality flows from exports to growth. However, the inclusion of imports in model (*ii*) shows that the causality link, at least in Granger's sense, between export expansion and growth fades away and whenever exports and imports of goods and services show high correlated movements, economic growth in Cuba is responsive to import expansion. Therefore, imports seem to be more important for Cuban economic growth than exports suggesting an Import Led Growth (ILG) hypothesis. Awokuse (2007) found the same ILG causality but in this case in a production function framework.

Second, our analysis has been applied to test the effects of different commercial arrangements periods in the Cuban economy in the ELG approach. When including different periods we observe that in the whole sample and in the COMECON analysed periods (that is, 1960-2004, 1960-1989 and 1970-1979) ILG causality is verified and only in the 1990-2004 period; though a long-run match can still be observed, correlation disappears and imports appear to not Granger cause growth. These results are suggesting that during the socialist regulation of international trade period the Cuban economy was able to get imports, principally of capital and intermediate goods and, in general, of more technological advance inputs for Cuban production, from the soviet block and these were the base of the Cuban output expansion. At the same time, primary exports to the soviet block financed Cuban imports at preferential prices. At this point, our results for Cuba tend to support the hypothesis exposed by Krugman (1984) and, in general, for the technological approaches of international trade and development and

endogenous models (Dosi and Soete, 1988 and Coe and Helpman, 1995). When the *administered* international trade period ended for Cuban economy in 1990, ILG hypothesis is rejected. In this last period, 1990-2004, we obtain that growth causes exports and that imports causes exports, reflecting again the importance of imports in the economic growth path in this case directly linked to exports growth. These results clearly complement those obtained in Fugarolas et al. (2008) where the application of the Thirlwall model for Cuban economy in the same periods suggest that the economic growth in the Island has been balance of payments constraint, but during the COMECON period the economy could overcome this limitation due, we as we have empirically verified now, to the ability of importing capital and intermediate goods that causes growth.

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APPENDIX

Table A1. VAR model. Lag selection and Information Criteria

VAR Model (*i*): $\ln GDP, \ln X, \ln TOT$

Period	*Lags(k)*	*l*	*AIC*	*SC*	*HQ*
1960-2004	1	130.11	-5.36*	-4.88*	-5.18*
1960-1989	1	92.66	-5.55*	-4.99*	-5.38*
1990-2004	2	78.86	-7.71*	-6.72*	-7.72*
1970-1989	1	70.20	-5.82*	-5.22*	-5.70*

VAR Model (*ii*): $\ln GDP, \ln X, \ln TOT, \ln M$

Period	*Lags(k)*	*l*	*AIC*	*SC*	*HQ*
1960-2004	2	194.03	-7.35*	-5.87*	-6.80*
1960-1989	2	143.31	-7.66*	-5.95	-7.14*
1990-2004	1	82.55	-8.34*	-7.39*	-8.35*
1970-1989	1	97.31	-7.73*	-6.73*	-7.53*

Notes: * indicates lag-order selected by the criterion; *l* is the log of the likelihood function with *h* parameters estimated using *T* observations and the information criteria of Akaike, Schwarz and Hannah-Quinn are defined by

$$AIC = -2(l/T) + 2(h/T)$$
$$BIC = -2(l/T) + h\log(T)/T$$
$$HQ = -2(l/T) + 2h\log(T)/T$$

Table 1. Cuba: GDP, exports and imports (1960-2004 and selected periods)

Period	$\dot{gdp}$ (1)	$\dot{x}$ (1)	$\dot{m}$ (1)	$\dot{tot}$ (1)
1960-2004	3.03	4.87	5.00	0.26
1960-1989	4.91	7.71	9.14	-0.81
1970-1989	5.47	8.53	9.74	-0.82
1972-1985	6.93	16.13	15.20	-1.5
1990-2004	-0,.1	-0.38	-2.24	2.83
1994-2004	3.52	8.27	8.93	-0.5

Notes: (1) Denotes average annual rates of growth of real GDP, exports and imports, respectively.

Source: Own calculations based on data from CEE and ONE

Table 2. Augmented Dickey-Fuller test (ADF). Cuba 1960-2004.

$$H_0 : \delta = 0$$

$$H_1 : \delta < 0$$

(i) $\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum_{i=1}^{m} (\alpha_i \Delta y_{t-i}) + \varepsilon_t$

(ii) $\Delta y_t = \beta_1 + \delta y_{t-1} + \sum_{i=1}^{m} (\alpha_i \Delta y_{t-i}) + \varepsilon_t$

(iii) $\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{m} (\alpha_i \Delta y_{t-i}) + \varepsilon_t$

variable	**k**	**Model (i)**			**Model (ii)**			**Model (iii)**
		Φ_3	$\tau_{\beta\delta}$	t_{tc}	Φ_1	$\tau_{\alpha\mu}$	t_c	t_{nc}
$\ln GDP$	1	0.240	0.481	-1.423	4.180	1.996	-1.909	1.715
$\Delta \ln GDP$	1	n.a.	n.a	n.a	n.a.	n.a	n.a.	-2.550*
$\ln X$	1	1.34	1.571	-1.946	2.50	1.257	-1.131	1.193
$\Delta \ln X$	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-4.324* **
$\ln TOT$	1	0.928	1.128	-2.035	1.001	-1.005	-1.787	-1.484
$\Delta \ln TOT$	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-5.504* **
$\ln M$	1	0.362	0.562	-1.737	3.210	1.970	-1.911	0.603
$\Delta \ln M$	1	n.a.	n.a	n.a	n.a.	n.a	n.a.	-4.097* **

Notes: *k i*s the lag structure order chosen to guarantee white noise residuals and Δ is the first differenced lag operator*;* subscripts *tc*, *c* and *nc* indicate if trend and intercept. intercept or none is included in test equation (iii), (ii) and (i). Φ_3, $\tau_{\beta\delta}$, Φ_1, $\tau_{\alpha\mu}$ denote statistics for individual or joint significance of trend and intercept assuming unit root. * and ** show 5% and 1% significance level in accordance to MacKinnon (1996) critical values; n.a is non available. Results implemented using Eviews 4.1.

Table 3. GDP. exports and TOT Granger causality Test. Augmented VAR model

Period	Dependent variables	MWALD-Statistics *Source of causation*		
1960-2004		$\ln GDP$	$\ln X$	$\ln TOT$
	$\ln GDP$	n.a.	4.9033 (0.0267)	1.5908 (0.2078)
	$\ln X$	4.631 (0.0314)	n.a.	0.3725 (0.515)
	$\ln TOT$	3.181 (0.0745)	21.74 (0.0000)	n.a.
1960-1989				
	$\ln GDP$	n.a.	0.1121 (0.7377)	0.7855 (0.7699)
	$\ln X$	0.6266 (0.4289)	n.a.	1.6068(0.7699)
	$\ln TOT$	1.842 (0.1747)	0.2532(0.0124)	n.a.
1990-2004				
	$\ln GDP$	n.a.	0.3663 (0.5450)	0.4140 (0.5483)
	$\ln X$	0.04744 (0.9451)	n.a.	0.0134(0.9020)
	$\ln TOT$	5.002 (0.0253)	16.35483(0.01)	n.a.
1970-1989				
	$\ln GDP$	n.a.	0.34096(0.5593)	0.6274 (0.4279)
	$\ln X$	0.1910 (0.6620)	n.a.	13.606(0.002)
	$\ln TOT$	3.7504 (0.0528)	4.0533(0.00441)	n.a.

Notes : The $\lfloor k + d(\max) \rfloor$th order level VAR has been estimated with $d(\max) = 1$. Lag length selection follows Table 6 results Values in parentheses are p-values

Table 4. GDP. Exports, TOT, Imports. Granger causality Test. Augmented VAR model

Period		MWALD-Statistics			
	Dependent variables	*Source of causation*			
1960-2004		$\ln GDP$	$\ln X$	$\ln TOT$	$\ln M$
	$\ln GDP$	n.a.	0.3200 (0.5073)	0.093(0.793)	4.1304 (0.0421)
	$\ln X$	0.095 (0.7575)	n.a.	4.6063(0.0319)	0.5981(0.4393)
	$\ln TOT$	7.3428 (0.0067)	3.8247 (0.0505)	n.a.	0.0012(0.9719)
	$\ln M$	0.005938(0.9399)	1.491(0.2220)	0.04285(0.8359)	n.a.
1960-1989					
	$\ln GDP$	n.a.	0.0192 (0.8997)	0.0849 (0.770)	4.6991(0.032)
	$\ln X$	0.8679 (0.3515)	n.a.	4.906(0.0259)	1.971(0.1603)
	$\ln TOT$	5.905 (0.0151)	1.98(0.1593)	n.a.	2.744(0.097)
	$\ln M$	0.051(0.813)	0.05375(0,8166)	0.048(0.9442)	n.a.
1990-2004					
	$\ln GDP$	n.a.	1.0297 (0.3120)	0.5634 (0.4529)	0.1147 (0.748)
	$\ln X$	4.343 (0.0372)	n.a.	0.9808(0.3220)	3.3632(0.060)
	$\ln TOT$	23.050 (0.000)	20.56(0.0000)	n.a.	3.70(0.0544)
	$\ln M$	0.0809(0.7760)	0.1022(0.7492)	5.3095(0.025)	n.a.
1970-1989					
	$\ln GDP$	n.a.	7.69e-05(0.9930)	0.7702 (0.380)	3,8444(0.0499)
	$\ln X$	0.8058 (0.399)	n.a.	0.0606(0.1013)	0,3125(0.5761)
	$\ln TOT$	8.363 (0.0038)	8.8001(0.030)	n.a.	6,2252(0,0126)
	$\ln M$	0,387(0,5336)	0.327 (0,5071)	0.0603(0.8060)	n.a.

Notes : The $\lfloor k + d(\max) \rfloor$th order level VAR has been estimated with $d(\max) = 1$. Lag length selection follows Table 6 results. Values in parentheses are p-values

Figure 1. Cuba 1960-2004: real GDP (left scale), TOT (right scale) and exports and imports of goods and services (right scale). All data in log except TOT. Source: CEE and ONE.



