'Export Led Growth' x 'Growth Led Exports': What Matters for the Brazilian Growth Experience after Trade Liberalization?

Araujo, Ricardo Azevedo and Soares, Cristiane

University of Brasilia

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‘Export Led Growth’ x ‘Growth Led Exports’: What Matters for the Brazilian Growth Experience after Trade Liberalization?

Ricardo Azevedo Araujo

Department of Economics, University of Brasilia

And

Cristiane Soares

Brazilian Institute of Geography and Statistics

Abstract

In this paper we study the Brazilian growth experience after trade liberalization by testing both the Export Led Growth (ELG) and the Growth Led Exports (GLE) hypotheses through a causality test between exports and gross domestic output (GDP). The paper provides further evidence that after openness both ELG and GLE hypotheses are useful to explain the Brazilian growth experience.

Keywords: Export led growth, Growth Led Exports, Thirlwall’s law, Granger causality test.

JEL Classification: C22, C32, F43, 011

1. Introduction

Despite the fact that the interaction between openness and economic growth is an open question in the literature [see Edwards (1993)], the general view is that an economy exposed to international trade may reap benefits that accrue from the access to new consumer markets [Thirlwall (1997)], to foreign direct investments [Cuadros, Orts and Alguacil (2004)] and, to new technologies [Pasinetti (1993)]. The view that growth of exports may create favorable environments to economic growth has found support in the seminal work of Thirlwall (1979). In short the Thirlwall's law states that the growth rate of output is given by the ratio of the growth rate of exportations to the income elasticity of demand for imports.

While the neoclassical model focuses on the supply side to explain the constraints to economic growth [see Krugman (1989)], Thirlwall departing from the Harrod trade multiplier model, focuses on a demand driven process to explain the long run growth rate of GDP. The idea is that under the constancy of relative international prices, the growth rate of output adjusts in conformity to the growth rate of exports to keep intertemporal balance of payment equilibrium [see Thirlwall (2001)]. In this view, economic growth is a balance of payment constrained process and associated to it a strategy of economy growth became known as Export Led Growth – ELG hereafter.

Other authors such as Awokuse (2007) and Thornton (1996) have tested the ELG hypothesis outside of the context of the Thirlwall's law by analyzing the causality between exports and economic growth. For these authors export expansion and openness to foreign markets are viewed as key determinants of economic growth since openness are to concentrate investment in the most efficient sectors of the economy (those in which the country enjoys a comparative advantage). Stronger specialization in these sectors is shown to increase productivity.

Besides, higher exports growth allows the country to gain from economies of scale due to the access to new foreign markets, by allowing larger scale operations. The stronger exposure to international competition by higher exports is considered to increase the pressure on the export industries to keep costs low and provide incentives for the introduction of technological change. In this vein the growth of exports is seen to have a stimulating influence on productivity of the economy as a whole via externalities of exports on other sectors.

In fact there is a large amount of literature confirming the empirical validity of the outward oriented view[1] but ELG is far from being unanimity. An alternative approach, known in the literature as the growth-led exports view – GLE hereafter – advocates that the causality between TFP and international trade runs in the opposite direction supported by the ELG view. According to Krugman[2] (1989) export expansion is generated by productivity gains from increases in labor skills and technology; in this view a higher growth of TFP implies a higher capacity of production that leads to a higher participation in the international market [see Helpman and Krugman (1985)]. According to this view, fast-growing countries seem to face a high income elasticity of demand for their exports, while having a low income elasticity of demand for imports. The converse is true for slow growing countries. [Krugman (1989, p. 1032)]

This view departs from a neoclassical standpoint that admits that technological progress is the ultimate engine of economic growth [Solow (1956)] and gives little room for the possibility that economic growth may be a demand-driven process subject to structural economic dynamic forces that can affect the direction of causality between

[1] In the next section a brief review of the literature is made in order to present the results concerning the causality between exports and GDP for a number of countries. Although the test has been performed for a number of countries it was not accomplished for the Brazilian economy after trade liberalization.

[2] See Thirlwall (1991) for a rebuttal of Krugman's view.

growth and technological progress as proposed by the Verdoon's law. [See Ocampo (2005)]

It is worth to mention that ELG and LGE are not mutually exclusive views of the process of economic growth. They may be seen as complementary since openness may affect positively productivity growth, which in turn increases the capacity of production that may lead to higher insertion in the international trade[3]. In this vein, a starting point to evaluate the benefits of international trade to economic growth is to better understand the relationship between the former and technological progress. Edwards (1993) has tackled this issue and has found that total factor productivity (TFP) is faster in more open economies.

As we show in the present paper these hypotheses have been tested for a number of countries but there are few results for the Brazilian economy. A possible reason for this fact is that although Brazil has the ninth largest economy in the world at PPP[4], it was one the latest countries in the Latin America to proceed towards trade liberalization. After a long period in which the import substitution and protection of infant industries were the springboards of the Brazilian strategy of economic growth, in 1988 a trade-liberalization process began with the removal of all the relevant non-tariff barriers. This was rather timid at first, but after 1990 the pace of reform has accelerated.

Some studies that are worthy of mention are mainly related to the impact of the openness on productivity. Hay (2001), for instance, has analyzed the effects of openness on the total factor productivity, market share and profits of a sample of large manufacturing firms. He has found very large total factor productivity gains in the

[3] Some could say that the process starts with productivity growth that increases production capacity and yields a higher participation in the international trade.

[4] Sources: IMF and the World Bank

period, which were accompanied by large falls in market shares and profits. The explanation is that the shock of trade liberalization to profits was so great that firms were stimulated to improve their efficiency dramatically.

Moreira and Najberg (2000) by studying the impact of trade liberalization on the Brazilian labor market have found that after an initial difficult phase of transition in which growth of imports challenged the sustainability of the openness process these negative effects were outweighed in the long run by an increase in productivity carried out by a vigorous process of modernization and specialization in more productive activities.

All these studies point to a positive effect of the openness to economic growth but to the best of our knowledge no further inquiries of the effects of trade liberalization on economic growth were performed to Brazil, which is the aim of the present paper. This paper is organized as follows: the next section presents an overview of the literature focusing on the validity of the ELG hypothesis. Section 3 presents the empirical results for the Brazilian economy, performing a test to determine the causality between exports and GDP. Section 4 concludes.

2. A Review of the Literature

2.1. The Export Led Growth Hypothesis

After the seminal work of Thirlwall (1979) a number of papers assessing the empirical validity of Thirlwall's law for a number of advanced [see McCombie (1997), Atesoglu (1993, 1997), Hieke (1997), León-Ledesma (1999)] and developing countries [see Bairam and Dempester (1991), Lopez and Cruz (2000), Moreno (1999) and Hussain

(1999)] have been published[5] since then and the results are quite favorable to the non rejection of the balance-of-payment constrained growth hypothesis. The Thirlwall's law may be derived as follows:

$$X = \left(\frac{P_d}{EP_f}\right)^{\tau} Z^{\zeta} \tag{1}$$

$$M = \left(\frac{EP_f}{P_d}\right)^{\psi} Y^{\varphi} \tag{2}$$

Where X stands for exports, Z is the international income, M is imports and Y is domestic income. P_d stands for domestic prices, P_f means foreign prices and E is the nominal exchange rate. The prices elasticities of demand for exports and imports are denoted respectively by τ and ψ, respectively, and the income elasticities for exports and imports are denoted by ζ and φ, respectively. In equilibrium:

$$P_d X = EP_f M \tag{3}$$

Taking logs and differentiating expressions (1), (2) and (3) we conclude respectively that:

$$\hat{x} = \tau(\hat{p}_d - \hat{p}_f - \hat{e}) + \zeta\hat{z} \tag{4}$$

$$\hat{m} = \psi(\hat{p}_f + \hat{e} - \hat{p}_d) + \varphi\hat{y} \tag{5}$$

$$\hat{p}_d + \hat{x} = \hat{p}_f + \hat{e} + \hat{m} \tag{3a}$$

Where the hats denote growth rates. By substituting (4) and (5) into expression (3a) one obtains:

[5] Our aim is not to cover the literature on the Thirlwall's law that is extensive and well known. Here we focus on the causality between exports and GDP to determine the validity of the ELG hypothesis. The Journal of Post Keynesian Economics, vol. 19, No.3, Spring 1997, provides a "Minisymposium on Thirlwall's Law and Economic Growth in an Open-Economy Context".

$$(1+\tau+\psi)(\hat{p}_d - \hat{p}_f - \hat{e}) + \zeta\hat{z} = \varphi\hat{y} \tag{6}$$

In order to obtain the Thirlwall's law two hypothesis may be evoked here. The first one is the Purchasing Power Parity hypothesis: under it the nominal exchange rate equilibrates domestic and foreign inflation and hence $\hat{p}_d - \hat{p}_f - \hat{e} = 0$. Another hypothesis that is adopted to obtain the thirlwall's law is the Marshall Lerner condition. According to it $\tau + \psi = -1$ which also gives rise to the Thirwall's Law expressed as:

$$\hat{y} = \frac{\zeta}{\varphi}\hat{z} \tag{6a}$$

Perraton (2003) terms the strong form of the Balance of Payment Constrained Growth hypothesis. By considering that PPP holds Thirlwall's Law may be rewritten as:

$$\hat{y} = \frac{1}{\varphi}\hat{x} \tag{6b}$$

which Perraton (2003) terms the weak form of the BPCG hypothesis. Given our focus on the Brazilian economy it is worthy to mention that it was tested by the first time by Thirwall and Hussain (1982) taking into consideration the effects of the capital flows on the external constraint. They have tested the law for a number of countries and have concluded that the inclusion of capital flows on the balance of payment play a decisive role in the explanation of growth experience of a number of underdeveloped countries including Brazil. Another study worthy of special attention is the one performed by Bertola et. al. (2002). These authors have tested the Thirlwall's law for Brazil from 1890 to 1973 and confirmed the existence of a long run relationship between GDP, terms of trade and world income as predicted by the law. This is a first hint that points to the non rejection of the ELG hypothesis for Brazil. But some could say that the validity of the law is not a sufficient condition to guarantee that the ELG hypothesis holds since the original aim of the test is only to verify the cointegration between the growth rates of GDP and exportation without establishing the relation of causality between them.

Krugman (1989) for instance suggests a direction of causation different from the Thirlwall's Law: according to him it is fast growth, caused by the growth of the labour force in efficiency units, which leads to a high export and/or low import elasticity. The derivation of the 45-degree rule is shown below under the label of The Growth Led Exports Hypothesis.

2.2. The Growth Led Exports Hypothesis

A possible theoretical background for the GLE may be found in the work of Krugman (1989) and employs tools analogous to the derivation of the Thirlwall's law but with completely different view on the growth process. He considers that exports X is also a function of the real exchange rate, $R=EP_f/P_d$, and international income Z. Hence:

$$X = X(R, Z) \tag{7}$$

Accordingly nominal exchange rate is a function of domestic income, Y, and relative price of imports R

$$M = M(R, Y) \tag{8}$$

The trade balance in domestic currency may be written as:

$$B = P_d X - EP_f M = P_d\,[X - RM] \tag{9}$$

By differentiating this expression in relation to time it yields:

$$\dot{B} = X\left[\zeta\hat{z} + \tau\hat{r}\right] - RM\left[\varphi\hat{y} + (1-\psi)\hat{r}\right] \tag{10}$$

Where $\hat{z}$ stands for the growth rate of foreign income, $\hat{r}$ is the rate of real depreciation and $\hat{y}$ is the growth rate of the national income. If it is assumed that in time zero, $B = 0$ namely $X = RM$, then the intertemporal equilibrium in the balance of payment requires that $\dot{B} = 0$. In this case:

$$\hat{r} = \frac{\zeta\hat{z} - \varphi\hat{y}}{\tau + \psi - 1} \tag{11}$$

From the expression above it is possible to conclude that the lack of a trend in the rate of real depreciation requires that:

$$\frac{\zeta}{\varphi} = \frac{\hat{y}}{\hat{z}} \tag{12}$$

Note that the expression above is in fact expression (6a) rewritten to express the ratio of the elasticities as a function of the ratio of the growth rate of national and foreign income. According to Krugman, countries with high growth rates face high income elasticities of demand for their exports while having low income elasticities of import demand. In this vein the growth rate of exports is determined by the growth rate of income and not the reverse as claimed by the Thirlwall's Law.

In order to tackle this issue a number of authors started to test the causality between these two variables. Hutchinson and Singh (1992) have found a bicausal relationship for 18 of 34 countries in their sample, including Brazil. Following these lines, Thornton (1996) have tested the causal relationship between exports and economic growth using data on Mexico's real exports and real GDP over the period 1895-1992 in a VAR model. The results of the tests suggest that there has been a significant and positive Granger-causal relationship running from exports to economic growth in Mexico over the long term, which is a strong evidence for the ELG.

Yamada (1998) has re-examined the export-led growth hypothesis through testing the Granger causality from exports to labor productivity for six developed nations – United States, United Kingdom, Italy, France, Canada and Japan. They have used a four-variable VAR(k) model to find the existence of causality from exports to productivity growth for Italy at 5% level. However, in most cases, the null hypothesis of noncausality cannot be rejected even at the 40% level, and he cannot found robust empirical evidence for the hypothesis for developed countries.

Awokuse (2007) have adopted a neoclassical growth framework and multivariate cointegrated VAR methods to investigate the contribution of both exports and imports to economic growth in Bulgaria, Czech Republic, and Poland. In the case of Bulgaria, the results suggest that empirical evidence exists for both ELG and GLE hypothesis, indicating a bi-directional causal relationship between exports and growth. In the Czech Republic, Granger causality flows from both exports and imports to economic growth, whereas in Poland the Granger causality flows from import to economic growth.

Kunst and Marin (1989) have examined causality between exports and productivity using a four-variable vector autoregressive (VAR) model comprised of export, labor productivity, terms of trade, and GDP for the Austrian Economy. Using Granger's (1969) causality test, they have found no causality from exports to productivity growth whereas it holds in the opposite direction, giving support to the GLE view. Finally, the estimated absence of any causal link from terms of trade to productivity growth suggests that disturbances caused by a devaluation of the exchange rate and/or by an import tariff do not seem to be capable of boosting productivity in Austria as implied by the ELG view.

Ahmad and Harnhirun (1996) have investigated the causal relationship between exports and economic growth for five of the members of the Association of South East Asian Nations, ASEAN hereafter. They have concluded that there is no statistical evidence of a long-term relationship from exports to economic growth for Indonesia, Malaysia, the Philippines, Singapore and Thailand. The findings based on the Granger's (1969) causality test support the GLE hypothesis since domestic economic growth was found to cause exports to grow in all five countries.

However, this result may be disputed by the findings of Ansari and Xi (2000), who have studied a sample of four ASEAN countries and found that the Thailand is the only one that admits the rejection of the balance-of-payment constrained growth hypothesis. As pointed out by these authors there are strong evidence for supporting that ELG was a successful strategy in Indonesia, Malaysia and Philippines[6].

To close this section it is worth to focus on the finding of Abu-Qarn and Abu-Bader (2006) who have examined the ELG hypothesis for nine Middle East and North Africa, MENA countries hereafter. By using a three-variable vector autoregressive model with error correction mechanism they have rejected the ELG hypothesis for almost all of the countries when considering total exports. However, when desegregation was performed to consider only manufactured exports two kinds of results were found: (i) no causality for countries with relatively low shares of manufactured exports in total merchandise exports and (ii) a bidirectional causality for countries with relatively high shares. Their findings suggest that promoting exports may contribute to economic growth only after a certain threshold of manufactured exports has been reached. This is a key evidence since it shows that the composition of exports may play an important role in establish exports as a promoting of economic growth.

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[6] These evidences show that economic growth in the ASEAN region appears to be consistent with different hypotheses, which points both to an important role for the "internally generated" mechanisms such as the reallocation of the labor force to more productive activities and the export promotion. [see Young (1995)]

This view is supported by the finding of Araujo and Lima (2007) who have shown that a disaggregated version of the Thirlwall's law predicts that a country which has low income elasticities of import and high income elasticities of export weighted by coefficients that measure the share of each sector in total volume of exportation and importation can experience higher rates of growth. In this vein a country that exports goods with higher elasticity of demand are supposed to have a better performance in international trade.

Based on the Abu-Qarn and Abu-Bader (2006) and considering the implication of the multi-sectoral Thirlwall's law it is possible to say that the above mentioned studies that found no causality between exportations and economic growth could present a different result if exports are disaggregated. This may overcome some of the doubts on the premise that trade openness is a necessary component of successful strategy of economic growth. In the next section we intend to focus on this issue by addressing the Brazil's experience of trade liberalization.

3. Methodological Issues

3.1 Unit Root Tests

The modified augmented Dickey-Fuller's ($MADF^{GLS}$) and modified Phillips-Perron's (MZ^{GLS}) test have been proposed by Elliot, Rottemberg, and Stock (1996) and Ng and Perron (2001) considering the problems of low static power and size distortion of the Dickey-Fuller's (1979, 1981) and Phillips-Perron's (1988) tests. They are based on two main aspects: (a) ordinary least square (OLS) is inefficient when the series are detrended; and (b) the importance of an adequate lag selection (k), in order to obtain a better approximation to the truth data generated process.

In the first case, (a), Elliot, Rottemberg e Stock (1996) and Ng and Perron (2001) proposed generalized least square (GLS) for the detrended data, which delivers substantial power gains for the tests and allows for a more precise autoregressive spectral density estimate. Standard procedure to estimate MADF^{GLS} is used as the t-statistic for testing the null hypothesis $H_0 : \beta_0 = 0$, which indicates unit root presence from the following regression estimated by OLS:

$$\Delta\tilde{y}_t = \beta_0\tilde{y}_{t-1} + \sum_{j=1}^{k}\beta_j\Delta\tilde{y}_{t-j} + e_{tk} \tag{13}$$

Against the alternative hypothesis: $H_A : \beta_0 < 0$, in which the series is stationary. $\tilde{y}_t$ is the GLS detrended series; Δ is lag operator of first differences; e_t is a white noise, $\{e_t\} \sim i.i.d.\left(0, \sigma_e^2\right)$; and $\beta_j \; (j = 1, \ldots, k)$ are coefficients.

In the second case, Ng and Perron (2001) have shown that when there are errors with a moving-average root close to -1, a high order augmented autoregression is necessary for unit root tests to have good size, but that information criteria such as AIC and the BIC tend to select a truncation lag (k) that is very small. Ng and Perron (2001) suggest the Modified Akaike Information Criteria (MAIC) for an adequate lag selection (*k*) in equation (1).

Ng and Perron (2001) have proposed the same modifications in the *M* tests developed by Phillips and Perron (1988) and Perron and Ng (1996), resulting the MZ^{GLS} tests. According to Ng and Perron (2001), the MAIC along with GLS detrended data yield a set of tests with desirable size and power properties. However, Perron (1989) has pointed out that if there are structural breaks, the standard unit root tests are biased towards the non rejection of a unit root. Structural change also affects all the inferential procedures, such as cointegration and causality [Maddala and Kim, 2003].

Perron (1989) has proposed a modified Dickey-Fuller test for a unit root in the presence of structural break with different types of deterministic trend function. Let τ be a time period prior to structural break, and the structural change occurrs at time period $t = \tau + 1$. Consider the null hypothesis of a one-time jump in the level of a unit root process against the alternative of a one-time change in the intercept of a trend stationary process. Consider the regression equation known as model (A)[7]:

$$y_t = a_0 + a_1 y_{t-1} + a_2 t + \mu_2 D_L + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + \varepsilon_t \qquad (14)$$

where D_L represents a level dummy variable such that $D_L = 1$ if $t > \tau$ and zero otherwise; the error term ε_t is assumed to be Gaussian white noise with zero mean and a constant variance. Under the null hypothesis, $\{y_t\}$ is a unit root process with a one-time jump in the level of the sequence in period $t = \tau + 1$. Under the alternative hypothesis, $\{y_t\}$ is trend stationary with a one-time jump in the intercept.

The error term in equation (2) is used to estimate the following regression by ordinary least squares (OLS):

$$\hat{\varepsilon}_t = a_1 \hat{\varepsilon}_{t-1} + v_t \qquad (15)$$

Under the null hypothesis of a unit root, the theoretical value of a_1 is unity. Perron (1989) shows that when the residuals are identically and independently distributed, the distribution of a_1 depends on the proportion of observations occurring prior to the break. Denote this proportion by $\lambda = \tau / T$ where T is the total number of observations. If there is serial correlation, use the augmented form of equation (3), with

[7] According to Perron (1989), the methodology allows to analyze two other cases: model (B), which test the null hypothesis of a permanent change in the drift term versus the alternative of a change in the slope of the trend; and model (C) which test the null hypothesis of a change in both the level and drift of a unit root process.

an appropriated selection of lags. The t-statistic for the null hypothesis $a_1 = 1$ can be compared to the critical values calculated by Perron (1989).

Despite these considerations, in this study we use ADF and Phillips-Perron test to verify the stationary of series. We regress y_t against x_t or the reverse using a vector autoregressive model (VAR) model. Considering cointegration the residuals are I(0). The Durbin-Watson test around 2 indicates no autocorrelation. The MADF^{GLS} test for Brazilian series does not change the results.

3.2 Granger Causality Test

According to Granger (1969), given a universe including the two series x_t and y_t, x is said to cause y if the forecast for y from the history of the universe excluding x can be improved by taking the history of x into account. Consider x_t and y_t are I(0), in order that the bivariate autoregressive distributed lag model (ARDL) is given by:

$$y_t = \alpha_1 + \sum_{i=1}^{p} \alpha_{11}(i) y_{t-i} + \sum_{i=1}^{q} \alpha_{12}(i) x_{t-i} + \varepsilon_{yt} \tag{16}$$

$$x_t = \alpha_2 + \sum_{i=1}^{l} \alpha_{21}(i) y_{t-i} + \sum_{i=1}^{m} \alpha_{22}(i) x_{t-i} + \varepsilon_{xt} \tag{17}$$

where $\alpha_{11}(i), \alpha_{12}(i), \alpha_{21}(i), \alpha_{22}(i), \alpha_1, \alpha_2$ are all parameters; the error terms ε_{yt} and ε_{zt} are Gaussian white noise disturbances with zero mean and a constant covariance matrix, and which may be correlated with each other.

In equations (4) e (5), the null hypothesis $H_0 : \alpha_{12}(i) = 0$ means x_t does not Granger-cause y_t, whereas the alternative hypothesis $H_A : \alpha_{12}(i) \neq 0$ means x_t does Granger-cause y_t. On the other hand, the null hypothesis $H_0 : \alpha_{21}(i) = 0$ means y_t does not Granger-cause x_t, whereas the alternative hypothesis $H_A : \alpha_{21}(i) \neq 0$ means y_t does Granger-cause x_t. There are four possible results for each pair of variables.

4. Empirical Analysis and Results

The data set consists of quarterly observations for real GDP (y_t) and real exports (x_t), obtained from the Brazilian Institute of Applied Research Economics (IPEA) database, which covers the periods from 1991.q1 to 2010.q1[8]. All variables are in natural logarithms.

The ADF and Phillips-Perron tests suggest that Brazilian GDP and export series are both integrated I(1). However, the results for the first difference indicate all the variables are I(0). Table 1 provides the results of unit root tests:

Table 1. Tests for unit root

Variable	ADF			Phillips-Perron		
	C	NC	T	C	NC	T
y_t	-1.765	1.725	-4.004	-2.501	0.079	-22.933
Δy_t	-11.755	-11.317	-11.688	-81.614	-82.864	-81.655
x_t	-1.551	0.896	-2.773	-2.114	0.099	-11.815
Δx_t	-9.015	-8.983	-8.975	-56.537	-57.120	-56.411

"C" denotes model with constant; "NC" denotes model without constant and "T" denotes deterministic trend. (*) denotes levels of significance at 1%; (**) denotes levels of significance at 5%; (***) denotes levels of significance at 10%. Critical values for ADF test are: (i) Model with constant: -3,54 (1%); -2,91 (5%); -2,59 (10%); (ii) Model without constant: -2,61 (1%); -1,95 (5%); -1,61 (10%) e (iii) Model with trend: -4,09 (1%); -3,47 (5%); -3,16 (10%) . Critical values for Phillips-Perron test are: (i) Model with constant: - 19,37 (1%), -13,51 (5%), -10,86 (10%); (ii) Model without constant: -13,11 (1%), -7,80(5%), -5,55 (10%) and Model with trend: -26,58 (1%), -20,27(5%), -17,16 (10%).

In order to choose the optimal lag length, an autoregressive model was estimated by Vector Autoregression (VAR) in which the optimal lag was chosen by Akaike Information Criterion (AIC). With this information the Granger (1969) test was performed as follows: Table 2 reports the results of Granger Causality tests based on

[8] The values were actualized using INPC (Brazilian price index) for prices at 2010.q1.

VAR model. In the case of Brazil, both the ELG and Thirlwall's Law are supported by the data at the 1% level of significance. There is Granger causality from GDP to exports $(p = 0{,}0000)$ and the reverse short-run causation from GDP to exports is also supported $(p = 0{,}0000)$.

Table 2. Granger causality test results

Null Hypothesis	Obs	Chi	df	p-value
y_t does not Granger cause x_t	75	1.5e+03	3	0.0000 (*)
x_t does not Granger cause y_t	75	1.0e+03	3	0.0000 (*)

(*) denotes levels of significance at 1%; (**) denotes levels of significance at 5%; (***) denotes levels of significance at 10%. Chi values obtained using Wald test.

In this vein we also have performed the unit roots test to verify whether the results of table 1 still hold with a structural change in 1994 when the Real Plan was implemented. A level dummy variable was introduced considering that $D_L = 0$ for $t \leq \tau : 1991.q1 - 1994.q1$ and $D_L = 1$ for $t > \tau : 1994.q2 - 2010.q1$. The results are presented in tables 4 and 5. For the two regressions using dummy the residuals are I (0), i. e., the null hypothesis can be rejected at the 1% level of significance. But, in regression 4, according to t statistics the dummy variable is not significant.

Table 3. Results for VAR regression

Regression 1: y_t	Coef.	SE	t	p-value
L_{1t}	0.6635971	0.1065949	6.23	0.000
L_{2t}	0.2297089	0.1055051	2.18	0.029
x_t	0.0530832	0.0256589	2.07	0.039
constant	0.841393	0.3933735	2.14	0.032
R^2 = 0.9512; AIC = -2.6328073; DW= 2.010766				
Regression 2: x_t	Coef.	SE	t	p-value
L_{1t}	0.8708246	0.1143851	7.61	0.000
L_{2t}	-0.0095433	0.1123987	-0.08	0.932
y_t	0.2029474	0.094976	2.14	0.033
constant	-1.14763	.8325502	-1.38	0.168
R^2 = 0.9323; AIC = -1.177287; DW= 1.856914				

Table 4. Results for VAR regression (using dummy variable)

Regression 3: y_t	Coef.	SE	t	p-value
L_{1t}	0.5710387	0.0954202	5.98	0.000
L_{2t}	0.1644471	0.0934736	1.76	0.079
x_t	0.0843222	0.0234252	3.60	0.000
Dummy	0.1248066	0.0262235	4.76	0.000
constant	2.47556	0.4865638	5.09	0.000
R^2 = 0.9625; AIC = 2.8700559; DW= 2.033736				
Regression 4: x_t	Coef.	SE	t	p-value
L_{1t}	0.8542117	0.1152478	7.41	0.000
L_{2t}	-.0156002	0.1119942	-0.14	0.889
y_t	0.2969061	0.1405644	2.11	0.035
Dummy	-0.0631549	0.0699651	-0.90	0.367
constant	-2.087386	1.330249	-1.57	0.117
R^2 = 0.9330; AIC = -1.1614257; DW= 1.832303				

Table 5. Unit Roots Tests for Residuals

Regression	ADF			Phillips-Perron		
	C	NC	T	C	NC	T
1	-8.554	-8.613	-8.510	-67.157	-67.154	-67.344
2	-8.119	-8.173	-8.054	-56.928	-56.944	-56.919
3	-8.854	-8.913	-8.863	-73.061	-73.129	-73.029
4	-8.085	-8.137	-8.019	-56.903	-56.937	-56.883

"C" denotes model with constant; "NC" denotes model without constant and "T" denotes deterministic trend. (*) denotes levels of significance at 1%; (**) denotes levels of significance at 5%; (***) denotes levels of significance at 10%. Critical values for ADF test are: (i) Model with constant: -3,54 (1%); -2,91 (5%); -2,59 (10%); (ii) Model without constant: -2,61 (1%); -1,95 (5%); -1,61 (10%) e (iii) Model with trend: -4,09 (1%); -3,47 (5%); -3,16 (10%) . Critical values for Phillips-Perron test are: (i) Model with constant: - 19,37 (1%), -13,51 (5%), -10,86 (10%); (ii) Model without constant: -13,11 (1%), -7,80(5%), -5,55 (10%) and Model with trend: -26,58 (1%), -20,27(5%), -17,16 (10%).

These results show that both the ELG and GLE hypothesis hold for Brazil after trade liberalization. They show that after an initial phase of disappointment with trade liberalization due to a strict adherence to the Washington Consensus' prescriptions the openness has positively impacted economic growth in Brazil.

4. Concluding Remarks

In the recent years, there has been much attention devoted to the role of foreign trade as an engine of growth [see Edwards (1993)]. However, the direction of causality between exports and economic growth in Brazil after trade liberalization has not been subjected to empirical tests of this sort. This paper contributes to this literature by using the Granger causality test to investigate the nature of causality of both exports and GDP. The empirical evidence is favorable for both ELG and GLE hypotheses, confirming earlier findings of Hutchinson and Singh (1992). Besides it confirms the validity of the balance-of-payment constrained growth hypothesis for the Brazilian economy as supported by Bertola et. al. (2002).

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