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Keywords: Bolivia, Growth; Thirlwall’s Law; Cointegration

Balance of payments constrained growth model: evidence for Bolivia 1953-2002

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Abstract

Theoretical and empirical literature has focused on supply factors when studying economic growth determinants. The present work analyzes demand factors as determinants of the Bolivian economic growth between 1953-2002 using frameworks introduced by Thirlwall (1979). According to cointegration analysis exports were an important determinant in the Bolivian economic growth for the whole period. In addition, real exchange rate presents a negative relationship respect to the long run growth. Further results show that Bolivian imports are more elastic than exports respect to the GDP, determining a negative impact in trade balance. Our hypothesis is that the implemented economic model after 1985 has increased the external constraint of the country causing a process of “deindustrialization”.

Keywords: Bolivia, Growth; Thirlwall’s Law; Cointegration

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Introduction

The Balance of payment constrained growth model is an alternative model to the neoclassical, following the traditional -Solow - or the endogenous growth model -Romer, Lucas among others. It is necessary to highlight that there are few empirical works that analyze the Thirlwall's Law for developing countries - especially Latin American economies- that suffer a structural character of external restriction to the economic growth as we will see later on.

Exports are fundamental for any economy, because not only generate employment but also contribute to collect foreign currencies (dollars) that are necessary to finance the imports and the development projects. There also exist other variables that have influenced in the long-run growth of the economy, like the terms of trade, the interests for the payment of the foreign debt and the exchange rate. The last one had a fundamental paper in controlling the inflation in the period of macroeconomic stabilization.

The objective of the paper is to prove empirically the Thirlwall's Law in its original version as also to the variants to the model -type of change, exchange terms and service of the foreign debt -, for the Bolivian economy during the period 1953-2002. In the first part of the work, we made a literature review of the empirical application to the model to some Latin American economies. In second part, we present some stylized facts of the external vulnerability that has gone suffering the Bolivian economy. Lastly we estimate the Balance of payment constrained growth model in their original version as well as the variations to this model (Elliot and Rhodd, 1999; Ferreira and Canuto, 2001; Moreno-Brid and Pérez, 2000; Moreno-Brid, 2003; López and Cruz, 2000), for this reason we used econometric techniques, like the unit root test, cointegration analysis, causality in the Granger sense. Finally, we make some conclusions and comments about the economic policies implications of the model

The Thirlwall's Model

The Thirlwall's model is based on the Harrod dynamic foreign multiplier which determines long-term economic growth. A version of the Thirlwall's (1979) model can be expressed using the following equations:

$$x = \phi q + \rho z \quad (1)$$

$$m = \alpha q + \pi y \quad (2)$$

$$x + q = m \quad (3)$$

The equation (1) in the export function, equation (2) is the demand for imports and the third equation shows us the current account equilibrium. The variables are the real growth rate of: x (exports), m (imports), q (relative price), y (national income) y z (world income).

Substituting equations (1) and (2) in the equation (3) we obtain:

$$y^* = \frac{(1 + \phi - \alpha)}{\pi} q + \frac{\rho}{\pi} z \quad (4)$$

Taking equations (1) and (4), and bearing in mind the Marshall-Lerner condition, or considering that the relative prices are constant (that is its growth rate is zero, $q=0$) we obtain:

$$y^* = (1/\pi)x \quad (5)$$

That equation is the Thirlwall's law and states that an increase in the income elasticity of demand for imports (π) reduces equilibrium income growth rate respect to the balance of payments.

Empirical Evidence of Thirlwall's Law for Latin American Economies: A Literature Review¹

The economic growth models with foreign currencies restrictions have been developed initially for developed countries. However, in the last few years it has left increasing the interest of the researchers to contrast this hypothesis in developing economies - especially Latin America - among those Mexico and Brazil. (See Moreno-Brid (1998-1999; 1999; 2000); Loría (2001), Loría and Fujii (1997), López and Cruz (2000); Porcile, Higashi, Bittencourt (2000); Bértola, Higashi, and Porcile (2002).

A summary of the different econometric methodologies used to contrast the hypothesis can be found in McCombie (1997). This author begins with the seminal work done by Thirlwall (1979), which been worth his hypothesis by means of the degree of association of the Spearman ranges correlation coefficients. McCombie (1997), after making a methodological recount, he analyzes the

¹ A previous version of this survey is in Arevilca (2004).

case of three developed economies: United States, Japan and the United Kingdom. He concluded that it holds the external constraint for United States as the United Kingdom and that the growth rates were close to the balance of payment equilibrium, but this fails to the case of Japan.

Moreno-Brid (1999), analyzes the case of the Mexican economy and the period embraces from 1950 to 1996. This author divides in two sub-periods that are of 1950-75 and 1976-96, this according to him:

“.. To capture possible differences in the association between the growths rates of exports and of GDP due to shifts in the foreign exchange rate regime”².

The empiric validation for Mexico is centred in the estimate and the association of long -run GDP growth rate and the real exports. Although, Moreno-Brid (1999) highlights that the assumption of the terms of trade and the current account deficit are not perfectly adjusted to the Mexican reality during the period of 1950-96³, he finds by means of Johansen cointegration analysis a significant and positive relationship between the GDP and the exports. For the case of the imports, this author finds an income elasticity of 1.04 for 1950-81 and 2.47 for 1982-86. In this respect he pointed out⁴:

“..Such increased elasticity tightened the balance of payments constraint on Mexico’s economic growth and may likely have been a major reason for the long term fall in the rate of expansion of its domestic activity in the last 15 years”.

In another paper Moreno-Brid (2000), analyzes, what he denominates the "three Balance of Payment Constraint Generation Model", and evaluates the McCombie test for the Mexican economy⁵.

This author pointed out that most of empirical studies for the imports in Mexico have not been able to capture the effects of the commercial protection on the demand of imports. Different authors would have tried to capture this effects, in different ways among which we stand out the inclusion of “dummy ” variable like regressors to capture the hysteresis effect on the change of the demand of imports. Another alternative focus would be to include variables that reflected the incidence of the

² The first subperiod was characterized by a fixed exchange rate regime between the peso and the North American dollar. The second for an administered flotation. (Moreno-Brid, 1999 pp. 153).

³ During the period 1950-91 to 1995-96 the terms of trade measured by the export price export/import ratio registered an accumulated fall of 16%.

⁴ This result is similar to the one that found Atesoglu (1995) for the case of the economy of United States.

⁵ This test is based on the methodology developed by McCombie (1997), and it is known as the test for BPC model of third generation, which captures the potential effects of capital flows in the long-run economic growth and the accumulated foreign debt. Moreno-Brid, 2000, pp.2

non-tariff restrictions on the commercial flows⁶. Following this logic Moreno-Brid (2000) includes in his demand of imports estimation an index of licenses to the imports⁷.

The lack of statistical significance of the effects of long-run relative prices to the opposing demand of imports in their estimate for the period 1967-99, been worth the hypothesis of the BPC, just as it points out it McCombie and Thirlwall (1999, pp. 49):

".. For to country to be potentially balance of payments constrained, the change in relative prices cannot have to significant effect on the growth of exports or imports"

The author concludes that during the period 1967-99, the balance of payments has restricted the long-run economic growth of the Mexican economy. He also points out that during these years the terms of trade did not play a significant role in the determination of the Mexican economic growth.

Another work to highlight is López and Cruz (2000), which incorporates the exchange rate in the model, according to the authors:

".. in order to analyze if and how the real exchange rate affects domestic output in the long run, we estimated to VAR with domestic output and the real exchange rate" (López and Cruz, 2001, pp. 486)

Their model's results are presented in the next table:

Table 1. Equilibrium growth rates with balance of payment for Latin American economies

Countries	W	\hat{h}	h'
Argentina (1965-96)	0.41	2.4	2.8
Brazil (1965-95)	0.59	1.6	1.03
Colombia (1968-96)	1.7	0.56	1.8
México (1965-96)	2.2	0.45	1.3

⁶ Among other observations made by Moreno-Brid to other studies on the demand of imports, is that most of them does not consider stationarity properties of the series, which are subject to the critical of spurious regression done by Granger and Newbold (1974)

⁷ The demand of imports that estimates is:

$$\ln(m_t) = \beta_0 + \beta_y \ln(y_t) + \beta_p \ln(p_t) + \beta_q q_t + v_t$$

Where q is the index of tariff protection, which would be between 0 and 1, being for the first one when all the requirements of licenses have been eliminated and 1 when it is apply to all goods and/or importable services.

Note: The vectors are normalized with respect to the domestic GDP ($Y = 1$); w is export elasticity, \hat{h} y h' are the long-run equilibrium elasticities and estimated of imports with respect to domestic income, respectively. \hat{h} is the inverse of long-run export elasticities of exports with respect to the GDP, while h' is the cointegration vector in the VAR for the GDP and the imports.

Source: López y Cruz (2000 pp. 485)

Lastly the authors conclude that the real exchange rate is significant for the growth of the GDP with external balance. This would bring that :

“..Those countries where the Marshall-Lerner condition is fulfilled could achieve a faster rate of growth of output if they pursued a policy whereby their real exchange rate is kept at competitive level”

“..our results also suggest that a higher real exchange rate, by itself, is no guarantee that output will be higher” (López y Cruz (2000), pp. 491)

Finally, we can point out the paper done by Loría (2002), which analyzes the external restriction to the economic growth for the case of Mexico, embracing the period of 1980-1999. It is necessary to stand out that the econometric methodology used is, - panel data for 59 sectors of tradable goods - novel, since generally the empirical studies that validate the Thirlwall's Law have been based on time series models.

Loría (2002) analyzes the Mexican economy in three divisions⁸; this according to the author to detect which sector is the one that restricts the economic growth. The hypothesis that manages is that the manufacturing sector has not generated the economic development and transfer of resources to the rest of the economy.

The econometric results that found are that the real exchange rate as the United States GDP is factors that correct the Mexican trade balance. Last of all, he concludes that sectors like the automobile has increased their exports, but at the same time also their imports, this has not generated the spillover effects.

Some other empirical findings are Bertola, Higashi, and Porcile (2002), for the case of Brazil. This paper embraces great part of the economic history of this country, not only for the primary-export growth period but also the industrialization based on the import substitution process.

⁸ The sectors are agriculture, mining and manufacturing.

In author's words :

"We decided to end the study in 1973 because the 1970's represented a new particular phase from the perspective foreign capital inflows and qualitative change in the degree of external indebtedness" (Bertola, Higachi y Porcile (2002, pp. 126).

After revising the statistical series of the GDP, TT, y Z⁹, they are integrated processes of first order (that is to say they are I(1)), they apply the cointegration analysis using the Johansen procedure. They find at least two cointegration vectors. Parallel of the obtaining the relationship of long term, these authors estimate an error correction model with the purpose of seeing the dynamics that follows the process in the short term. Finally they conclude that when a relationship is finding among the GDP, the exchange terms and the world entrance, this would predict Thirlwall's Law.

The External Vulnerability: Past and Present

Bolivia implemented a series of structural reforms starting from 1985. The change of the economic development model from then on has been characterized by the deregulation, privatization and commercial liberalization that influence not only in the exports and imports of goods and services, but also on other balance of payment variables.

The new commercial policy also looked for to expand the exports; since 1985 the obstacles to the exports were eliminated and it was instituted a neutrality-taxation later, being also created institutions to facilitate and to promote those ones. The external openness was not only focused to trade balance but also in the capital account when being eliminated the restrictions to the entrance and exit of capitals of the country, to settle down the exchange freedom and of convertibility and also to instituted economic-institutional environments to favor the reception of external investment

In spite of the external constraint, Bolivia has not changed its productive structure characterized to be primary – exporter¹⁰ (Arevilca, 2003). The understanding of the Bolivian economic performance had during the last two centuries is to go back to the past of the mining crises in a process of dialectical synthesis. (Jordan, 1993).

⁹ These represent the Gross Domestic Product, terms of trade and world income. In this last point, they take the most representative markets for Brazil among those: Argentina, Belgium, France, Germany, Holland, Italy, the United Kingdom and the United States.

¹⁰ A clear example gives us Morales, Espejo and Chávez (1992), when pointing out that between 1950 and 1990 the exports of three primary natural resources (RNP): tin, zinc and natural gas have constituted 65% of the value of the exports of goods of Bolivia on the average. Another study of recent publication is Loza (2002), which points out that in real values, the exports diminished 5.7% in 10 years and its deterioration registered in two opportunities: between 1990 and 1992, with a fall of 27% as consequence of the smallest exports of gas to the Argentina, and in 1998 and 1999, due to the international crisis, with an accumulated fall of 16%.

The reflection of these crises was given in the shortage of foreign currencies, for the side of the exports, and its impact in the balance of payments. Moreover, comparing with other sectors of the economy this was losing force in their contribution to the GDP. As example we could indicate that the exports of natural gas duplicated the value to the exports of minerals between 1985 and 1986.

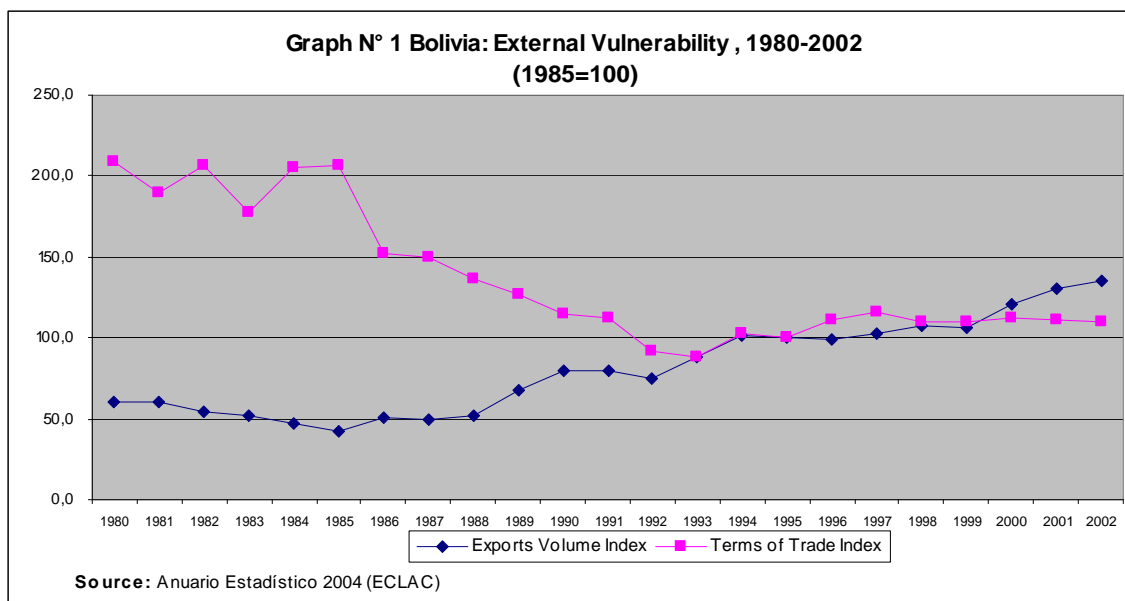
During 1986 the hydrocarbons continued being the biggest taxpayers in the General Treasury of the Nation (TGN). (Montes de Oca, 1993). Therefore we have that two sectors of primary products regarding the total level of the exports explain the evolution of revenues of foreign currencies to the country. During the first half of the decade of the eighty, the participation arrived to 92.2% annual average, while for 2000-2003 the average fluctuated in 47%, being evident the change in the structure; hydrocarbons pass from 9% to 22% with regard to the total exports. (See Table 2)

Table 2. Participation of primary goods in the total exports (percentages)

Year	Hydrocarbons	Minerals	Total
Average			
1980-1985	43.2	49	92.2
1986-1990	36.9	41.4	78.3
1991-1995	16.5	45.3	61.9
1996-1999	9	39.2	48.2
2000-2003	22.1	25.3	47.4

Source: Owner elaboration based on Nina and Brooks (2001), INE (2004)

Although it is certain, as many analysts point out, the exports have gone growing after the liberalization process; however these did not change significantly in their structural content; since basically we are continued exporting *commodities*. It is so that the Prebisch-Singer thesis -a permanent deterioration of the terms of trade - holds effective for our economy (Larrazabal et.al, 2000; Arevilca, 2003). (See graph 1)

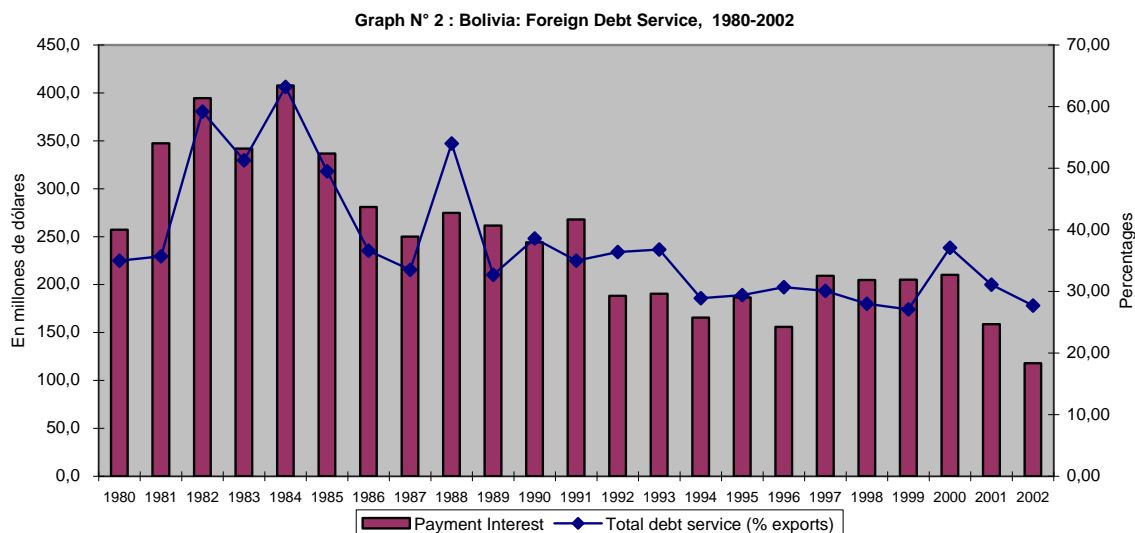


The foreign debt has been a restriction to the growth of long term of the Bolivian economy. As well Larrazabal points out et.al. (2000) this has been a concern of State, after the crisis of the decade of the eighty. It is so for example in 1984, there was an agreement with the Central Obrera Boliviana (COB)¹¹ to dedicate 25% of the exports for the payment of the foreign debt. (Cariaga, 1994).

Although the Highly Indebted Poor Countries (HIPC) program has helped to reduce the debt service (see graph N° 2), these are conditioned to the application of counteractive policies as being the application of structural reforms. Also the use of this funds was dedicated to a bigger social expenditure and the fight against the poverty; with this we don't mean to be bad such an end, but on the contrary one could make use for more productive ends with more multipliers effects in the economy.

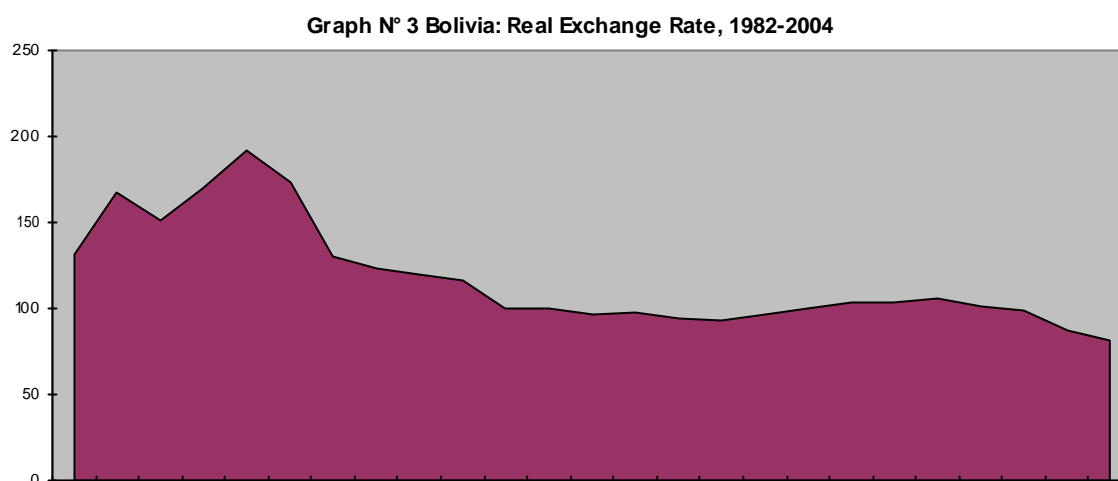
Great part of these resources - 62, 8% of the relief - comes from bilateral sources, while the remaining 31, 2% is derived of the participation from the international cooperation to multilateral level.

¹¹ The principal labour union in Bolivia



Source: Anuario Estadístico, 2004 (CEPAL) y World Development Indicators, 2004 (CD-Rom)

Another relevant aspect has been the handling of the exchange rate. Schweickert points out (2001) that this instrument has two objectives in economies like ours: a) to help to generate expectations against the inflation and b) to preserve the external competitiveness. One of the author's conclusions is that although the exchange rate helped to reduce the inflationary expectations this didn't help and on the contrary it was a negative factor in the performing of the exports. (Schweickert, 2001 pp. 31).



Source: Economist Intelligence Unit Database

Nota: Trade-weighted basket of currencies converted to an index (1997=100) and adjusted for relative price movements

Following Loría (2003) and Elliot and Rhodd (1999), the high service of the foreign debt, the "misalignment" of the exchange rate (overvaluation) and the influence of the terms of trade are factors that have influenced the performance of long term of economies like the Bolivian.

Next we present a table where we summary of the Balance of Payment constraint growth model besides the graphic representation applied to the Bolivian economy, this in order to understand with more accuracy the changes in the path of growth of long term of the Bolivian economy and as the readiness of foreign currencies it influenced in their performance. For this, we divide the period analyzed in six periods that were crucial for the economic history and Bolivian politics.

Table 3. Bolivia: Real GDP, Exports and Imports 1953-2002

	1953-62	1963-71	1972-82	1983-88	1989-95	1996-2002
GDP Growth Rates (Y)	1.86	5.6	2.29	0.88	4,08	1.51
Exports (X)	-1.44	10.39	16.84	0.44	8	5.53
Imports (M)	5.11	7.09	13.7	7.93	9.98	2.9
Income Elasticity of imports $X'=(M/Y)$	2.75	1.27	5.98	9.01	2.44	1.92
Balance of Payment with external Equilibrium $(Yca)=X'/X$	-0.52	8.21	2.81	0.05	3.28	2.88
Growth Gap (Y-Yca)	1.34	-2.61	-0.52	0.83	0.81	-1.37
Terms of Trade (2000=100)	10.51	15.88	161.12	200.58	156.65	97.25
Current Account (% PIB)	-2.94(*)	-5.48(**)	-9.73	-7.89	-5.57	-5.58

Source: Own elaboration based on World Bank, *World Development Indicators*, CD 2004, OXLAD, Oxford University y CEPAL, *Anuario Estadístico*, On line, 2004. Nota: *) Solo para el año 1976 y **) solo para el año 1977.

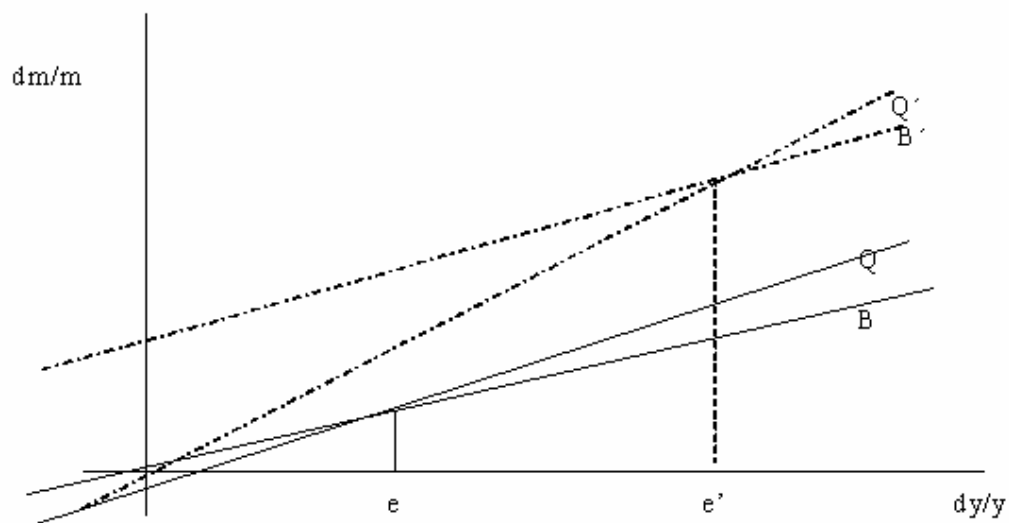
The first period goes from 1953 to 1962, time in which is given the process of the national revolution and later macroeconomic stabilization; the boom export will show during 1963 at 1971, period in which we have high prices of the main export products. For instance, the growth rate of the exports that arrives to 10.39% compared with 1953-62 that shows a clear decreasing.

The following sub-period is one of the most important in the contemporary life of the country not only in the economic but also in politics issues. It was starting from 1972 when begins the dictatorship of Colonel Banzer, furthermore this period it characterizes for a positive shock in the terms of trade, as the international financial help thanks to the support of the United States that this government endorsed. The favorable situation would not last so much time, and so, it begins a recession that will affect the already important load of the debt and the international private

creditors. This period is well-known as the lost decade that affected most of the Latin American countries. Another important date is 1985, year in which the Decreto Supremo (D.S) 21060 enters in validity, changing the economic model from the state capitalism to the pro-market paradigm. The period goes from 1989 to 1995 and is given by important events as being the wave of the first generation policies of structural reforms. This has not been modified during the later years, the pro-market reforms have been deepened so much in the economic context as institutional also.

Following Moreno-Brid (1998-99) we exemplify the pattern, in a graphic representation for the period 1953-62 and 1963-71, where as we already explain is a process of social revolution and it was given at the beginning of the 50's and later a boom export process for the later period.

Figure 4. Bolivia: Economic Balance according to Balance of payments movements 1953-62 y 1963-71



The movement up of the line B toward B' reflects the quick expansion of the exports. The entrance of foreign currencies for exports makes him to improve the economic situation and that the rate of growth is quick. On the other side the line Q toward Q' reflects the increment in the elasticity income of the imports, and their movement up it captures the effect of the improvement of the terms of trade.

Empirical Evidence for Bolivia (1953-2002): A Thirlwall's Model application

Econometric specification

This chapter aims to test the Thirlwall's model for the Bolivian economy. Considering fundamental equation (5) given in section II, an econometric specification is proposed:

$$\text{Ln}(GDP)_t = \alpha_0 + \alpha_1 \text{Ln}(X)_t + \varepsilon_t \quad (6)$$

Equation (6) is known as the econometric specification of the Thirlwall's law and tells us that GDP is determined by exports plus an error term. Where coefficient α_1 is the inverse of the income elasticity of the imports.

Afterwards some modifications are made to estimate the real exchange rate (RER) effect over the economic growth as shown in equation (7).

$$\text{Ln}(GDP)_t = \beta_0 + \beta_1 \text{Ln}(RER)_t + u_t \quad (7)$$

Equation (7) tries to test variables considered as insignificant in the Thirlwall model. RER has been important variable in development economies when applying stabilization policies, therefore significance of coefficient β_1 will be tested.

Even more Trade Balance (TB), Imports (M), and Exports (X) equations will be estimated to analyze the level of external constraint (see equations (8), (9), and (10)).

$$TB_t = \delta_0 + \delta_1 \text{Ln}(GDPUSA)_t + \delta_2 \text{Ln}(GDP)_t + \delta_3 \text{Ln}(RER)_t + v_t \quad (8)$$

Note that in equation (8) is important to test the Marshall-Lerner condition checking if RER is significative in the model, otherwise Thirlwall assumption would fail.

$$\text{Ln}(X)_t = \gamma_0 + \gamma_1 \text{Ln}(GDP)_t + \gamma_2 \text{Ln}(TOT)_t + z_t \quad (9)$$

$$\ln(M)_t = \varphi_0 + \varphi_1 \ln(GDP)_t + \varphi_2 \ln(TOT)_t + h_t \quad (10)$$

The GDP impact in Exports and Imports is checked using equations (9) y (10). In addition these equations permit to test the equality between the ratio of income elasticity of imports and exports, and the average domestic and foreign growth ratio as in equation (11). (see Moreno-Brid 2003).

$$\frac{\gamma_1}{\varphi_1} = \frac{y}{y_{rm}} \quad (11)$$

Where y is the domestic average growth and y_{rm} the foreign growth.

Data Set

We will begin the empirical analysis with the revision of the statistical series that will be used as being the Gross Domestic Product of Bolivia in constant prices of 1970, the United State product in billion of dollars, the nominal exchange rate, the service of the foreign debt and lastly the terms of trade. The data of the series to calculate the import and export functions come from the International Monetary Fund (International Financial Statistics), World Development Indicators, 2004 of the World Bank (CD-Rom), the database of the OXLAD (Oxford University)¹², besides the Annual Statistics Yearbook 2004, ECLAC.

Note that graph 5 shows us that the series are not stationary, that is they follow a tendency in the time¹³. Moreover, the series of the Bolivian GDP follows a continuous process of stop-go cycles primarily influenced by external factors as being the terms of trade.

¹² <http://oxlad.qeh.ox.ac.uk/>. More than one hundred year of statistical data are found in this website for many Latin-American countries.

¹³It is well worth to highlight the discussion existent respect to the nature of economic time series. Are they trend stationary (TS) or difference stationary (DS)? See Nelson and Plosser (1982).

<i>Model without constant and without trend</i>							
ADF-test :	1.13	0.59	1.81	-0.56	-1.97	0.80	-1.24
PP-test :	2.94	8.74	1.78	-0.41	-1.80	0.59	-1.34
<i>Model with constant and without trend</i>							
ADF-test :	-1.09	-1.24	-0.46	-0.54	-0.82	-1.32	-0.60
PP-test :	-0.92	-0.42	-0.48	-0.28	-0.93	-1.33	-0.45
<i>Model with constant and trend</i>							
ADF-test :	-2.24	-0.13	-1.87	-2.17	-1.65	-0.24	-2.21
PP-test :	-1.51	-1.26	-1.98	-1.91	-1.98	-0.48	-1.85
Source: Based on obtained results.							
* Augmented Dickey-Fuller and Phillips-Perron tests. (a) Null Hypothesis rejection at 1%.							
(b) Null Hypothesis rejection at 5% or 10%. Based on obtained results.							

Table 4. Unit Root Tests* (First Difference of the Variables in Logarithms)							
Variable :	$\Delta\text{Ln}(\text{GDP})$	$\Delta\text{Ln}(\text{GDPUSA})$	$\Delta\text{Ln}(X)$	$\Delta\text{Ln}(M)$	$\Delta\text{Ln}(\text{RER})$	$\Delta\text{Ln}(\text{TOT})$	ΔTB
<i>Model without constant and without trend</i>							
ADF-test :	-1.86	-0.63	-6.16(a)	-3.53(a)	-5.32(a)	-5.89(a)	-3.64(a)
PP-test :	-2.90	-0.89	-6.17(a)	-3.48(a)	-5.33	-5.96(a)	-3.60(a)
<i>Model with constant and without trend</i>							
ADF-test :	-2.18	-4.87 (a)	-6.60 (a)	-3.90 (a)	-5.54 (a)	-6.00 (a)	-3.83 (a)
PP-test :	-3.88 (a)	-5.15 (a)	-6.60 (a)	-3.92 (a)	-5.53 (a)	-6.07 (a)	-3.82 (a)
<i>Model with constant and trend</i>							
ADF-test :	-2.20	-4.93 (a)	-6.52 (a)	-3.86 (b)	-5.47 (a)	-6.21 (a)	-3.81 (b)
PP-test :	-3.88 (b)	-5.16 (a)	-6.52 (a)	-3.88 (b)	-5.47 (a)	-6.20 (a)	-3.80 (b)
Source: Based on obtained results.							
* Augmented Dickey-Fuller and Phillips-Perron tests. (a) Null Hypothesis rejection at 1%.							
(b) Null Hypothesis rejection at 5% or 10%. Based on obtained results.							

Estimation of the Thirlwall's Law

According to Espasa and Cancelo (1993), from a strict economic point of view, studying the existence of cointegration relationships among the analyzed variables is a fundamental result of the modelling process. Studying cointegration permits to analyze the long run behaviour of the variable to be explained, through the considered explicative variables.

Following Jayme (2001) at first a cointegration study between Bolivian GDP and the Exports is made for the period 1953-2002. That is a first step to discover whether is possible the existence of at least one long run relationship such as proposed by Thirlwall.

Table 5 shows the cointegration relationships for the whole period and for different sub-periods. Johansen cointegration test was applied (Johansen, 1988). This test is better than the Engle-Granger test due to an advantage, Johansen procedure estimates every vector in case of the existence of more than one relation.

Table 5. Cointegration equations between			
The log of Bolivian GDP and the Exports			
	Intercept	Log of the Exports	Lags
<i>Period 1953-2002</i>			
coefficient	6.66442	0.464067	1
t-statistic	[-52.3226]	[-22.2709]	
<i>Period 1953-1971</i>			
Coefficient	-2.384026	-1.497793	2
t-statistic	[-2.57979]	[-7.32917]	
<i>Period 1971-1990</i>			
Coefficient	7.70214	0.302836	3
t-statistic	[-79.4384]	[-20.1245]	
<i>Period 1953-1989</i>			
coefficient	6.745292	0.449918	2
t-statistic	[-72.5334]	[-28.2449]	
<i>Period 1953-1982</i>			
coefficient	6.647231	0.471281	2
t-statistic	[-55.0970]	[-20.5892]	
<i>Period 1982-2002</i>			

coefficient	5.351271	0.662718	1
t-statistic	[-13.9863]	[-11.6540]	
<i>Period 1966-1985</i>			
coefficient	6.052821	0.568114	5
t-statistic	[-21.3182]	[-11.4750]	
<i>Period 1985-2002</i>			
coefficient	5.63427	0.625675	1
t-statistic	[-23.9750]	[-17.9058]	
Source: Elaborated based on the obtained results. Econometric program Eviews 4.1 was used.			

The results show the existence of a cointegration vector for every period. This is a necessary condition to support the Thirlwall's law in the Bolivian economy.

However in order to analyze the period it is precise that the explicative variable (Exports) be weakly exogenous in the model. As suggested by Espasa and Cancelo (1993) a variable is exogenous to the analysis if it is allowed to do the analysis without the need of modeling the explicative equation of the presumed exogenous variable. Therefore Table 6 shows the obtained cointegration relations after testing weakly exogeneity on exports.

Table 6. Cointegration after Weakly Exogeneity of the Exports			
	Intercept	Log of the Exports	Lags
<i>Period 1953-2002</i>			
coefficient	6.249349	0.517585	1
t-statistic	[-21.4557]	[-10.8623]	
<i>Period 1953-1971</i>			
Coefficient	5.942119	0.63402	2
t-statistic	[-19.6591]	[-9.48537]	
<i>Period 1971-1990</i>			
coefficient	8.157586	0.233790	3
t-statistic	[-27.6481]	[-5.10539]	
<i>Period 1953-1989</i>			
coefficient	6.655979	0.463577	2

t-statistic	[-61.2632]	[-24.9103]	
<i>Period 1953-1982</i>			
Coefficient	6.538935	0.490452	2
t-statistic	[-18.5210]	[-46.8493]	
<i>Period 1982-2002</i>			
Coefficient	-9.380896	2.68332	1
t-statistic	[0.37940]	[-0.73018]	
<i>Period 1966-1985</i>			
Coefficient	5.929265	0.588508	5
t-statistic	[-18.8801]	[-10.7468]	
<i>Periodo 1985-2002</i>			
Coefficient	5.985599	0.578888	1
t-statistic	[-13.0633]	[-8.49697]	
Source: Elaborated based on the obtained results. Econometric program Eviews 4.1 was used.			

Note that Table 6 permits to analyze the long run implicit elasticity of the imports (\square) of each period. For the period 1953-2002 the income elasticity of imports is 1.92 (represented by a coefficient of 0.52). During period 1953-1971 the income elasticity of imports is 1.59 (represented by a coefficient of 0.63). Comparing with period 1985-2002 where the coefficient is 0.58 and then the income elasticity of the imports is 1.72, it is possible to appreciate an increment of 8.18% in that elasticity. This suggests us that the actual economic model (implemented after 1985) has been harmful for the Bolivian economy and that it has increased the external constraint to the economic growth.

Effects of the RER over the Bolivian GDP

López and Cruz (2000) suggest that the exchange rate has played a determinant role in the long run growth of the Bolivian economy. It is well worth to highlight that after trade and financial liberalization according to the Washington Consensus (WC), the exchange rate had an essential role not only fomenting exports but also controlling inflation generating a trade-off in terms of economic policy. That means violating the Tinberger's rule -an instrument and two objectives, see Tinberger (1952), Fernández et.al. (2002), Martner (2000), and Arevilca (2004).

Table 7 shows the cointegration vector supplied by Johansen test at 5% of significance. This vector is a stable long run relation between product and exchange rate as in López and Cruz (2000).

Table 7. Cointegration relationship between GDP and the Real Exchange		
Sample(adjusted): 1957-2000		
Lags interval (in first differences): 1 a 3		
1 cointegrating equation found		
Ln(GDP) = 10.48197 -0.051540.Ln(RER)		
t-statistic	[-39.2248]	[3.47680]
Source: Elaborated based on the obtained results.		
Eviews 4.1 program was used.		

In order to do an inference analysis during the period, it is necessary to check if the RER is an exogenous variable. Table 8 shows obtained cointegration relationship assuming that RER is weakly exogenous. Note that exogeneity test does not reject exogeneity hypothesis, being the coefficients similar in both specifications.

Table 8. Test of Weakly Exogeneity over the RER		
Cointegration relationship		
H ₀) RER is weakly exogenous		
LR-statistic:	0.085231	
Probability :	0.77033	
New cointegration relationship considering exogeneity		
Ln(GDP) = 10.45345 -0.053275.Ln(TCR)		
t-statistic	[-41.1528]	[3.78077]
Source: Elaborated based on obtained results		
EViews 4.1 program was used.		

An inference analysis for the whole period is possible since null hypothesis about exogeneity of RER is not rejected.

In all the cases the signs are the expected and it is possible to assert that an increment in the RER has reduced the long run rate of growth for the product in the whole period. In order to confirm such hypothesis a cointegration relationship for the trade balance is estimated checking if the Marshall-Lerner condition is fulfilled.

Cointegration relationship for the Bolivian Trade Balance

Including the Trade Balance (in constant dollars), the world product (taking as reference the GDP of USA, in constant dollars), the domestic product (in constant units), and the real exchange rate (in logarithms) a cointegration vector is found at 5%.

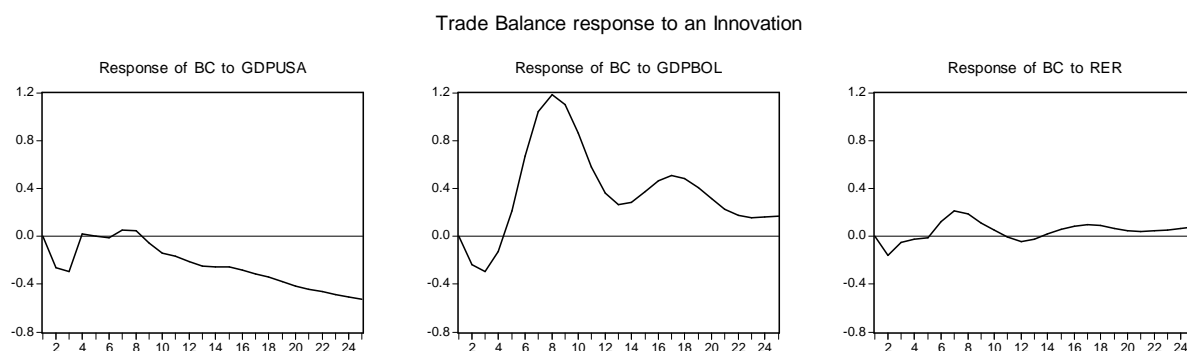
According to Tables 9 and 10, the trade balance is positively related with the Bolivian GDP and negatively with the GDP of USA and the RER.

Table 9. Cointegration relationship among TB, GDP of USA, domestic GDP, and the RER				
Sample(adjusted): 1962-2000				
Lags interval (in first differences): 1 a 3				
1 Cointegrating Equation found				
TB=	-45	- 11.45.Ln(GDPUSA)	+14.5821.Ln(GDP)	- 0.008.Ln(RER)
t-statistic	[3.99255]	[10.4689]	[-6.75939]	[0.14616]
Source: Elaborated based on the obtained results.				
EViews 4.1 program was used.				

Table 10. Weakly Exogeneity over GDP of USA, Domestic Product, and the RER				
Sample(adjusted): 1962-2000				
Lags interval (in first differences): 1 a 3				
1 Cointegrating Equation found				
TB=	-47	- 11.18.Ln(GDPUSA)	+14.45.Ln(GDP)	- 0.004.Ln(RER)
t-statistic	[3.98338]	[9.95095]	[-6.51935]	[-0.67647]
Source: Elaborated based on the obtained results				
EViews 4.1 program was used.				

Note that the RER coefficient is less significative, almost equal to 0. Since *Marshall-Lerner* condition is satisfied in order to obtain larger growth rates of products, it is necessary to maintain the RER in competitive levels. Finally an impulse-response function is made to study the innovation effects on the mentioned variables over the Trade Balance.

Figure 6. Impulse-Response: Effects of one innovation in the US GDP, Domestic GDP, and the RER in the Trade Balance



Source: Elaborated based on the obtained results.

A final comment is due to TB model starting from the graph 6: The signs confirm, note that US GDP has a negative effect. In addition Bolivian GDP has a positive effect in the long run on the trade balance, while the RER has an insignificant effect. Therefore, depreciation could have a negative effect in the domestic demand in the long run but an almost null effect in the trade balance.

Following Moreno-Brid and Pérez (2000; 2003) Table 11 analyzes the effect of the TOT in the long run growth. Therefore imports and exports functions are estimated.

Table 11. Cointegration Vectors for the Imports and Exports					
Imports Equation			Exports Equation		
<i>Period 1953-2002</i>			<i>Period 1953-2002</i>		
$\text{Ln}(M) = -193.21 + 21.32\text{Ln}(\text{GDP}) - 1.38\text{Ln}(\text{TOT})$			$\text{Ln}(X) = -10.81 + 1.69\text{Ln}(\text{GDP}) + 0.18\text{Ln}(\text{TOT})$		
(5.10)	(-4.62)	(5.11)	(14.46)	(-18.53)	(-5.50)
<i>Period 1953-1985</i>			<i>Period 1953-1985</i>		
$\text{Ln}(M) = -30.25 + 2.64\text{Ln}(\text{GDP}) + 0.15\text{Ln}(\text{TOT})$			$\text{Ln}(X) = -10.20 + 1.61\text{Ln}(\text{GDP}) + 0.22\text{Ln}(\text{TOT})$		
(30.25)	(4.21)	(0.75)	(6.53)	(3.70)	(8.41)
<i>Period 1985-2002</i>			<i>Period 1985-2002</i>		
$\text{Ln}(M) = -125.55 + 11.23\text{Ln}(\text{GDP}) + 4.91\text{Ln}(\text{TOT})$			$\text{Ln}(X) = -17.47 + 2.26\text{Ln}(\text{GDP}) + 0.39\text{Ln}(\text{TOT})$		
(21.71)	(-24.43)	(-18.70)	(9.78)	(-15.76)	(-4.92)
Source: Elaborated based on the obtained results.					

The results indicate the existence of at least a cointegration vector at the level of 5% in all cases. It calls our attention the high elasticity income of the imports for the whole period of study, which represents the magnitude of 21.32.

If the two traced periods are compared results that the income elasticity of the imports has increased in an important way during the period 1953-1985 and 1985-2002 from 2.64 to 11.23 respectively. In the case of the exports, the results show us an income elasticity of the exports of 1.69 for the whole period. Presenting a variation for the periods 1953-1985 and 1985-2002 that goes correspondingly from 1.61 to 2.26.

The above-mentioned explains the negative elasticity that presents the Bolivian GDP in the trade balance. This arises to the fact that imports react in a stronger way in the face of a change of the GDP than the exports. In this way an increment of 1 point in the GDP would increase the imports in 21.3 points and only 1.69 points in the exports, the net balance is negative pointing out a fall in the trade balance.

Table 12. Income Elasticity of the Imports, Exports, and the Growth ratio¹⁴

	Income Elasticity of Imports	Income Elasticity of Exports	Elasticity Ratio	Growth Ratio
1953-2002	21.32	1.69	0.08	0.40
1953-1985	2.64	1.61	0.61	0.35
1985-2002	11.23	2.26	0.20	0.47

Source: Elaborated based on obtained results.

Empirical validity of the model is verified by means of the comparison between the ratio of elasticities that arise from the cointegration equations with the ratio between the average growth of the national GDP and the GDP of USA. Note that income elasticity of the imports in period 1953-2002 affects the estimation of the elasticities and the growth ratio. An explanation is that in the seventies Bolivia received not only a positive input of capitals but also foreign support. See Arevilca (2003).

Conclusions

Most of the studies about economic growth have focused on input factors (physical and human capital) and technology as determinants. Thirlwall (1979) from a post-Keynesian point of view proposed a growth model focused on external demand (exports, imports and rest of the world demand).

Present work intends to contribute to the empirical study of the Bolivian economy. Then statistical and econometric analysis was made not rejecting validity of Thirlwall's law for the Bolivian economy in the period 1953-2002. In addition, this approach suggests the existence of a situation of constraint on the balance of payment associated to a slow evolution of the export growth rate in

¹⁴ This Table follows the applied methodology by Moreno-Brid and Perez (2003).

relation to the income elasticity of the imports, indicating the importance of the restriction explaining the small effective rate of long run product growth.

In the present study some variations to the original model were introduced such as the suggested by Moreno-Brid and Pérez (2000; 2003), and by López and Cruz (2000). The real exchange rate effect was also analyzed, this is fundamental to understand the long run growth of the Bolivian economy since it has been an important variable when applying stabilization policies. It has had a negative effect on the long run growth of the product. On the other hand it had a null effect in the trade balance coinciding with the Thirlwall model's assumptions. A curious result is that Bolivian GDP has a negative effect on the trade balance. Studying the exports and imports functions it is possible to deduce two things. At first the imports are more elastic to the GDP than the exports explaining the negative sign in the trade balance. It means an increment of the Bolivian GDP makes the imports growth over the export growth giving as result a negative effect in the trade balance. In second place income elasticities of the imports and exports present a tight relationship with the growth ratio between domestic income and foreign income verifying the Thirlwall assumption.

Considering that Bolivia specialized exporting principally raw materials while importing basically manufactured products. Moreover the imports increased more than the exports as reaction of the domestic product growth, the model applied since 1985 increased the income elasticity of the import augmenting the external constraint of the country. A hypothesis could be that Bolivian economy has followed and "deindustrialization" process (importing manufactured product from the rest of the world more and more) while it was losing competitiveness. Then strategy used by the country since 1985 did not contribute to a modification of the productive conditions, stressing even more the foreign constraint.

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