Conciliating Prebisch-Singer and Thirlwall: An assessment of the dynamics of terms-of-trade in a balance-of-payments-constraint growth model

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Abstract
The balance-of-payments-constrained growth models can be used to capture key economic insights of both the Keynesian and structuralist tradition. We suggest that Thirlwall's law corresponds to a mathematical derivation from Prebisch's rule. Given their similarity, we wonder why the Prebisch-Singer hypothesis of deterioration of the terms-of-trade is not included in the model. Thus, this study aims to develop the relationship between Thirlwall's Law and ECLAC's thought adding to the first a component that captures the Prebisch-Singer hypothesis. For such it is employed an alternative definition for the real exchange rate. We call the final expression the *Prebisch-Thirlwall rule*. Further, we endogenize the output and productivity rate of growth through the combination of our version of Thirlwall's law with the Kaldor-Verdoorn's law.

Key words: Economic Growth, Thirlwall's Law, Prebisch-Singer Hypothesis, ECLAC, Post-Keynesian economics

JEL: O11, O41, O47

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1. Introduction

The idea that in the long-term economic growth is limited by the emergence of trade imbalances has a strong tradition in Latin America (Porcile, Curado and Cruz, 2012). The work of the Economic Commission for Latin America and the Caribbean (ECLAC) and especially the argentine economist Raúl Prebisch already indicated the low dynamism of the export sector and the high propensity to import as the main limiting to growth in peripheral economies. The ECLAC's school of economic thought shows in its documents, especially from the 50s, a major concern with the relationship between income elasticity associated with foreign trade, the diffusion of technical progress and economic development in peripheral economies (Prebisch, 1959; Rodríguez, 2009 [2006]).

In turn, the post-Keynesian literature developed a series of growth models demand-side among which stand out so-called balance-of-payments-constrained (BOPC), notably represented by the Thirlwall' law. Its central proposition is that, for most countries, the major constraint to the product's growth rate is in the balance of payments because it determines the limit to demand's growth rate that supply can adapt (Thirlwall, 1979; Alonso and Garcimartín, 1999; Thirlwall, 2011).

Although apparently he built his model independently, Thirlwall (1983) mentions the similarities between his formulation and the Prebisch's one. We suggest that Thirlwall's law can be understood as a mathematical formalization of ECLAC's thinking derived from Prebisch rule. Given their similarity, we wonder why the Prebisch-Singer thesis of deterioration of the terms-of-trade for primary products relative to manufactured goods is not included in the model. Thus, this study aims to develop the relationship between the Thirlwall's law and ECLAC's thought adding to the first a component that captures the Prebisch-Singer hypothesis.

Our interest in combining both theoretical frameworks goes beyond the advantage that the modeling exercise brings itself. Since its initial formulation, BOPC models have evolved to incorporate the other components of the balance of payments. However, to our knowledge, no effort has yet been made towards incorporating the dynamics of prices. Thus, our contribution aims to give greater strength to the theoretical framework in question.

It seems to have been an initial fear of incorporating the terms-of-trade in the model since the balance of payments adjustment through prices could lead to an adjustment not via income, disqualifying the Thirlwall's law. However, contrary to this neoclassical assumption, we consider that it is the deterioration of terms-of-trade of primary products in relation to manufactured goods that can reduce the compatible growth rate with equilibrium in the balance of payments. The empirical evidence does not support the neoclassical view, as shown by Alonso e Garcimartin (1999).

The post-Keynesian analytical models assume that the long-term growth is essentially endogenous to the operation of the economic system. This means that the growth of output and labor productivity cannot be treated as exogenous variables in growth models (Oreiro, 2011). Further, we endogenize the output and productivity growth rate through the combination of our version of Thirlwall's law with the Kaldor-Verdoorn's law.

This work is divided into four sections besides this introduction. In section 2 we review the main concepts behind the ECLAC's thinking of economic growth with particular emphasis on the ideas developed by Prebisch and the Prebisch-Singer hypothesis of deterioration of the terms-of-trade. The next section presents the main versions of Thirlwall's law relating it to the ECLAC's thinking. In Section 4 we present our proposal to add a component that captures the Prebisch-Singer thesis of

deterioration in terms-of-trade, employing an alternative definition for the real exchange rate. We call the final expression obtained the *Prebisch-Thirlwall rule*. Finally, in section 5, we endogenize the output and productivity's growth rate by combining our version of Thirlwall's law with the Kaldor-Verdoorn's law. The last section contains the concluding remarks.

2. Latin-American structuralism and the external trade restrictions

The idea that in the long-term economic growth is limited by the emergence of trade imbalances has a strong tradition in Latin America (Porcile, Curado and Cruz, 2012). Within the ECLAC's school of economic thought, the names of Raúl Prebisch, Juan Noyola and Celso Furtado stand for working the implications of the external constraint on growth. Although there are important differences between their formulations, a common element is that both share the structuralist approach to development (Boianovsky and Solis, 2014). In this section we will try to summarize the main elements of the structuralist approach and the considerations made by Prebisch regarding restrictions on foreign trade.

2.1.1 The latin american structuralism

The studies included under the common name of "structuralists" share certain methodological positions that operate as essential basis of their analytical contributions (Rodríguez 2009 [2006]). Its method takes particular account of the real characteristics of the analyzed situations and their dependence on structural factors historically determined (Bielschowsky, 2009). The starting point of our analysis and to guide the description of this school of thought lies in its understanding of the process of economic development.

Development is understood, from a strictly economic perspective, as the continued and sustained output's growth and capital endowment per worker expressed in the increase of the material well-fare. This process in turn is driven by technical progress and must necessarily be accompanied by changes in the production and demand structure (Furtado, 2009 [1961]; Rodríguez, 2009 [2006]). We can represent the above definition as follows. The average productivity of the economy $\bar{q}$ is given by:

$$\bar{q} = \sum_{1}^{n} \theta_i q_i \qquad (2.1)$$

Where θ_i corresponds to the weight of each sector of the economy and q_i defines sectoral productivity. Differentiating this expression respect to time we obtain:

$$\dot{\bar{q}} = \sum_{1}^{n} \theta_i \dot{q}_i + \sum_{1}^{n} \dot{\theta}_i q_i \qquad (2.2)$$

The expression above captures the two key components of the structuralist approach. The first puts variations of the average productivity as a result of changes in sectoral productivities. Changes in q_i lead to changes in $\bar{q}$ for a constant θ_i. The second component however shows that changes in the sectoral composition (θ_i) also lead to changes in average productivity ($\bar{q}$). The transfer of workers from low productivity sectors to high productivity sectors can increase *ceteris paribus* the average productivity of the economy. Thus, the multi-sectoral structural component has great importance in contrast to the neoclassical models with only 1 sector.

Underdevelopment, in turn, is seen as a specific way of being for certain economies which cannot be studied as a single stage of the development process. It is considered that both correspond to different aspects of the same historical process connected to the creation and diffusion of technology in post-industrial revolution (Furtado, 2009 [1961]; Rodríguez, 2009 [2006]). It is characterized by a profound

structural heterogeneity in production and distribution. Thus, in countries in this condition is observed the combination of a very unequal distribution of income and the coexistence of high and low productivity sectors.

The definitions above allow us to introduce a last element of vital importance in structuralist thought: the center-periphery system. According to Cimoli and Porcile (2013), the ECLAC's thinking is based on the perception that the international system is formed by two poles, the center (north) and the periphery (south), whose economies are structurally different. Although authors such as Celso Furtado prefer to avoid this terminology its clear the contrast between the developed countries, situated as central, and underdeveloped, occupying a peripheral position. The centers identify themselves as possessing the most advanced production techniques thereby achieving higher levels of labor productivity and greater homogenization of its production and demand structure. The periphery on the other hand is formed by economies technologically and organizationally backward beyond a deep structural heterogeneity.

2.1 The external trade restrictions and the Prebisch-Singer hypothesis

Prebisch's initial interest in studying the dynamics of Latin American foreign trade was to explain the mechanism behind the economic cycles in those economies (Boianovsky and Solis, 2014). Indeed, the concept of Harrod trade multiplier is used to distinguish their effects in the center and the periphery. However, his analysis is not limited to business cycles and he also studied the impact of international trade on the long-term growth and price behavior (Rodríguez 2009 [2006]).

It is observed that the world trade reflects the position of an economy in the center-periphery dynamic. The countries of the center, being leaders in R&D, would export manufactured products with higher added value and technological intensity. The periphery countries that turn to occupy marginal position in terms of innovation, would export primary products with low added value (Prebisch, 1959; Prebisch, 1963; Sai Wing-Ho, 2012). The specialization in the periphery implies that the rate of expansion of its production is limited by margins that if exceeded would lead to the deterioration of the terms-of-trade (Rodríguez 2009 [2006]).

It is considered that domestic income growth in the periphery is constrained by the income elasticity of imports since there is a limited supply of foreign exchange with which a country can rely to satisfy its needs for imports. Prebisch (1949, 1959) defines the structural imbalance[1] as the result of an increase in income that leads to an increase in imports above those permitted by exports. According to Rodríguez (2009 [2006]) in his analysis of the structuralist thought, the trade imbalance is thus the key to the external imbalance problems, marked by the alternation of boom and scarcity phases of foreign exchange.

But what does differentiate the industrial from the primary products? Two explanations are given to this question. The first one is related to differences in their income elasticities. Primary products have elasticity less than unity due to that technical progress reduces the demand for raw materials by replacing them with synthetic. It's observed in addition and according to Engel's law a saturation of demand for basic foods. These factors are exacerbated by a lower rate of increase in population centers. In contrast, the income elasticity of manufactured products would be greater than unity since these products are at the technological frontier.

Prebisch (1959, p.4) constructs a numerical example illustrating the effects of external constraint on economic growth. As a simplifying hypothesis it is assumed that

[1]The term "structural imbalance" was introduced the first time by Noyola and Furtado in an ECLAC's document in the 50s and was not initially used by Prebisch. He employed it only in the 60s (Boianovsky and Solis, 2014).

there is only 1 country in the center and in the periphery. If in the central economy the output growth rate is 3% and the income elasticity of imports is 0.80, then imports in the center could grow at a rate of 2.4% (3 x 0.80). On the other hand, assuming the elasticity of demand for industrial products in the periphery equal to 1.3, periphery's growth rate to maintain balance in BP it cannot exceed 1.84% (2.4 : 1.3). If the peripheral economy grows at the same rate of the center, its exports would have to grow at 3.9% to keep the BP balanced, well above the demand center for their exports. In mathematical terms we have:

$$\hat{y} = \frac{\hat{x}}{\pi} \qquad (2.3)$$

where $\hat{y}$ is the output growth rate, π is the income elasticity of imports and $\hat{x}$ corresponds to the exports growth rate.

To maintain the equilibrium in the balance of payments, imports cannot growth more than $\hat{x}$. As noted by Cimoli and Porcile (2013), Boianovsky and Solis (2014) and by Thirlwall (1983) himself the final expression is precisely equivalent to Thirlwall's law. The empirical evidence that brings support to this argument is intertwined with the support found to Thirlwall's law, and will be further explored in the next section.

The second explanation for the differentiation between primary and industrial products became known in the literature as the Prebisch-Singer hypothesis of deterioration of the terms-of-trade. It is argued that there is a secular trend of deterioration in terms-of-trade in favor of industrial goods and against primary goods. Traditionally four factors are appointed as responsible for this phenomenon: (i) the existence of market power in the industrial sector in contrast to competitive markets in the commodities sector (Singer, 1950; Mollic et al, 2008), (ii) pressure from the difference in income elasticities of manufactured and primary products, (iii) unequal distribution of human capital and knowledge and (iv) labor market asymmetries between center and periphery (Prebisch, 1963; Ocampo e Parra, 2010).

Singer (1950) was the main defender of the first argument while the work of Prebisch focused on the last one. This especially distinguished from others as it would apply to all goods produced by the periphery and not just the primary ones. The central idea contained in the work of Singer is quite intuitive. Assuming that technical progress is concentrated in industrial activity, this would allow firms in the center to have monopoly power for a period of time, which would not occur in the primary activity. Prebisch in turn considers that the relative slowness in world's demand growth for commodities, associated with the existence of a large surplus population in the periphery, would generate a downward pressure on wages which in turn would result in such deterioration.

Although it's a controversial issue, there is a wide range of studies supporting the Prebisch-Singer thesis. As one of the first efforts in this direction, Thirlwall and Bergevin (1985) examined the behavior of commodity prices relative to manufactured for the period 1954-1982. The authors not only confirmed the deterioration but also shown that price fluctuations are greater for primary products. Anyway, Grilli and Yang (1988) are noted as the first most solid references on the subject and their time series is used as a standard in most subsequent work in the area. The authors constructed price indices covering the years 1900-1986 and found a trend of deterioration of 0.6% per year.

Reinhart and Wickham (1994) using quarterly data for the period comprising the years of 1957 to 1993 indicate that the weakness in commodity prices is secular and suggest the need for primary exporting to focus on diversification of export countries. The authors also found evidence of greater price volatility of these products.

Ocampo and Parra (2003) analyzed the evolution of the terms-of-trade of primary products during the twentieth century and found that although not continuous, there is a deterioration of up to 60% in the period. Ocampo and Parra (2010) extend the previous exercise and examine the evolution of prices of commodities and manufactured goods since 1860. The authors show that there was an improvement in terms of trade in favor of primary goods between the late nineteenth and early twentieth century. However, during the remainder of the twentieth century there has been a deterioration tendency, especially from the 1970s. In the first decade of this century it's observed an improvement in terms-of-trade, however, by far it does not reverse the secular trend.

Using database for the period 1900-1998, Zanias (2005) shows that the relative price of primary products fell to about 1/3 with structural shocks and not gradually. Two structural breaks, the first in 1920 and the second in 1984 are identified, leading to the decline in the relative prices of primary products. This suggests that the Prebisch-Singer thesis about the direction of movement in terms-of-trade in the long run cannot be rejected. In the same direction, Bunzel and Vogelsang (2005) found empirical support for the hypothesis of deteriorating of terms-of-trade using an index of net terms-of-trade for the period 1900-1995.

Serrano and Pinilla (2011) analyzed the evolution of the terms-of-trade of agricultural products and food for 56 internationally tradable in the second half of the twentieth century. Using a new method for econometric time series, structural breaks were analyzed in non-stationary series. It is found that in general, the less processed products suffered a sharp fall in real prices, much more than recorded in aggregated indices. Only products with high income elasticity or difficulty to be replaced by synthetic had an improvement in terms-of-trade. The evidence presented also supports a deterioration in stages rather than continuous.

Mollic et al (2008) evaluated the relative prices of primary products in the U.S. economy and observed a significant negative trend between 1947-1998. The authors do not only find that the international evidence supports the Prebisch-Singer hypothesis, but also that, assuming globalization makes economies more similar to the U.S., the deterioration persists and it is not likely to be reversed by economic integration.

In an ambitious effort Harvey et al (2010) constructed a panel formed by 25 primary commodity prices since 1650 to test the presence of a linear trend and trend with structural break. Prices of eleven products showed robust evidence of a deterioration in relation to manufacturing. Commodities such as coffee showed deterioration of 0.77% per annum for approximately 300 years. The authors' conclusion is that the empirical evidence supports the Prebisch-Singer hypothesis. Finally, Arezki et al (2013) re-examined the behavior of prices of 25 primary commodities in relation to manufactured using series from the seventeenth century. The results pointed to the existence of a negative trend in the terms-of-trade against primary commodities. Furthermore, it is found that primary prices are more volatile and that its volatility has increased in recent years.

This section was dedicated to the presentation of the main guidelines of ECLAC's structuralist thought and central points of the work of Raúl Prebisch. As shown, there is a clear concern about the relationship between economic growth and the trade balance performance through income elasticities and prices. Special attention was given to the empirical evidence that supports the Prebisch-Singer's views of deterioration in terms-of-trade since it seems to have been ignored by much of the growth literature. This marginalization seems a misnomer considering the abundant empirical support existent in its favor, though not in its original terms.

3. Thirlwall's model and its main developments

The emphasis in demand as an engine of economic system while differences in growth rates between countries would be the result of differences in its pace of growth is not new in the literature, being crafted by renowned economists such as Kaldor, Prebisch, McCombie and Thirlwall. The Keynesian tradition believes that the demand side matters in determining the growth trajectory of the economy both short-term and long-term (Libânio, 2009).

The fundamental hypothesis of the BOPC growth models is that the balance of payments in the long run should be balanced. Faced with the impossibility of continually funding the imbalances in the balance of payments, an adjustment in aggregate demand occurs that restricts its expansion and consequently its growth as well (Setterfield, 2011; McCombie 2011 Romero, Silveira and Jayme Jr., 2011). Growth is demand-led in the sense that any effect of the supply side is necessarily mediated by a specific effect on income elasticity of the demand (Cimoli and Porcile 2013).

As an economy grows the demand for imports also accompanies this expansion. This increase in imports is financed by an increase of exports or by capital inflows. If the exports growth rate, which depends on foreign income, cannot follow the imports growth rate, their difference must be filled via external financing. However, the inability to finance such deficits indefinitely causes an adjustment in the real economy by restricting the output growth rate. The balance of payments sets a limit to the pace of demand limiting consequently the growth of the economy.

In this study we assume that, for most countries, a major constraint to growth is in the balance of payments because it determines the limit of growth in demand that supply can adapt (Thirlwall and Hussain, 1982; Alonso and Garcimartín, 1999; Thirlwall, 2011). However, following the heterodox tradition of the post-Keynesian and ECLAC's thought, we recognize that the performance of BP and the pattern of foreign trade specialization depend on structural factors historically determined (Bielschowsky, 2009).

The canonical model of Thirlwall (1979) assumes that the performance of the balance of payments equals the trade balance. Thus we can summarize it in three equations:

$$\begin{cases} X = (1/E)^{\varphi} Z^{\Phi} & (3.1a) \\ M = (E)^{\beta} Y^{\pi} & (3.1b) \\ X = EM & (3.1c) \end{cases}$$

Where X is exports, M imports, Z world income, Y is the domestic income and E is the real exchange rate. Finally φ, $\beta < 0$ and Φ, $\pi > 0$ correspond to the price-demand elasticity and income-demand elasticity for exports and imports respectively. Equation (3.1c) gives us the condition of equilibrium in BP. Taking logarithms and deriving in time:

$$\begin{cases} \hat{x} = -\varphi(\hat{e}) + \Phi\hat{z} & (3.2a) \\ \widehat{m} = \beta(\hat{e}) + \pi\hat{y} & (3.2b) \\ \hat{x} = \hat{e} + \widehat{m} & (3.2c) \end{cases}$$

Where ^ characterizes the variation rate of each variable.

Substituting (3.2a) and (3.2b) into (3.2) and isolating $\hat{y}$ we obtain the growth rate compatible with equilibrium in the balance of payments:

$$\hat{y} = \frac{-(1 + \varphi + \beta)\hat{e} + \Phi\hat{z}}{\pi} \qquad (3.3)$$

Then taking as true the purchasing power parity (PPP), we obtain the simple rule of Thirlwall:

$$\hat{y} = \frac{\Phi}{\pi}\hat{z} \qquad (3.4)$$

Considering equation (3.4), the long-term growth is directly proportional to the variation of foreign income and the ratio between income elasticity of exports and imports. The growth of domestic income is restricted by the income elasticity of imports to the extent that there is a limit supply of foreign exchange with which this economy can count on to satisfy their needs of imports. This means that the higher the ratio of income elasticity of foreign trade is, the smaller the constraint growth will be. In primary-exporting economies, the growth trend is smaller than in industrialized countries to the extent that this ratio is lower for the first (Gouvêa and Lima, 2010). The income gap between developed and underdeveloped countries derives from this restriction.

Looking to incorporate the "structural change" element to the original model, Araujo and Lima (2007) derived from a passinettian multi-sectoral approach the growth rate compatible with equilibrium in BP. The final expression obtained, and that was known as Thirlwall's multi-sectoral law, indicates that the income growth rate is directly proportional to the growth rate of foreing income weighted by the ratio between the income-sectoral demand elasticities of exports and imports. Mathematically we have:

$$\hat{y} = \frac{\sum_{i=1}^{n} \theta_{x,n} \Phi_n}{\sum_{i=1}^{n} \theta_{m,n} \pi_n}\hat{z} \qquad (3.5)$$

Where $\theta_{x,p}$ and $\theta_{m,p}$ correspond to each sector's share in total exports and imports, respectively. Even though the growth of the rest of the world is near zero, the transfer of workers from lower income elasticity sectors to greater elasticity sectors helps to increase the rate of growth compatible with BP equilibrium. Changes in demand components alter sectors' share in foreign trade and has significant impact on growth.

The formulation originally developed by Thirlwall also evolved to incorporate other elements of the balance of payments. Thirlwall and Hussain (1982) and Moreno-Brid (2003) added capital flows while Alleyne and Francis (2008) added the account transfers. While recognizing the importance of their work, for the sake of simplicity we will limit ourselves in our modeling exercise to the equivalence between the trade balance and balance of payments.

In terms of empirical support, Thirlwall's law has found wide acceptance, which has allowed it to be consolidated in the post-Keynesian literature growth. Thilrwall (1979) tested his formulation for the period 1953-1976 in a sample of 18 countries. The author found estimates for the growth rates consistent with the actual growth rates.

Thirlwall and Hussain (1982), knowing the importance that financial flows have on developing economies, extended the original exercise incorporating financial flows. They used a sample of 15 countries to 1951 to 1969. The conclusion of their analysis indicates that the movement of capital was significant in determining the rate of growth compatible with equilibrium in BP. Moreover, it is found that changes in relative prices were statistically significant for some countries in the sample.

On the other hand, Alonso and Garcimartín (1999), using data for a group of 10 OECD countries between 1965 to 1994, showed that the law of Thirlwall is supported empirically although relative prices have no significant role in terms of economic growth. The results corroborate the Keynesian position with no significant evidence of adjustment in prices.

Romero, Silveira and Jayme Jr. (2011) find that the Thirlwall's model in its simple and multi-sectoral version successfully explains Brazil's economic growth over the past fifty years. The authors employ three distinct estimation methods for the years

1962-2007. Gouvea and Lima (2010) tested the Thirlwall's multi-sectoral law for a sample of 8 countries, four Asian and four Latin American between 1962 and 2006, finding that we cannot reject the hypothesis that growth in this countries is constrained by the balance of payments.

Using larger samples Cimoli, Porcile and Rovira (2010) conducted an econometric exercise verifying the applicability of Thirlwall's law to 29 countries, 8 Latin Americans, 15 OECD members and 6 Asians. The reporting period covers the years 1961 to 2004. Besides the support found in favor of Thirlwall's formulation, it is shown that the evolution of imports and exports elasticities in Latin American and Asian countries are able to explain the divergent trajectory of their per capita incomes.

Finally, Gouvea and Lima (2013) tested the multi-sectoral version of Thirlwall's law for a sample of 90 economies between 1965 and 1999. The predictive power of the model is tested by comparing the expected growth rate with the actual growth rate. Although, as expected, not all countries are restricted by the balance of payments, "Curve 45" cannot be rejected at a significance level of 5%, which supports the law.

Even though apparently he developed his model independently, Thirlwall (1983) mentions the similarities between his formulation and the Prebisch's one. However, unlike Thirwall's generalization, Prebisch argued that BP constraints on growth were imposed only for the most peripheral and not to the center countries (Boianovsky and Solís, 2014). McCombie (2011) recognizes that the less developed countries are more likely to have their growth constrained by the balance of payments, however this condition is not exclusive.

By assuming PPP, Thirlwall disregards the effects of prices on income in the long run. Whereas Thirlwall in Thirlwall and Bergevin (1985) finds evidence for a deterioration of terms-of-trade of primary products relative to manufactured goods, remains our questioning why it has not been included yet in the model. In the next section we will present a proposal for reconciling the Prebisch-Singer thesis and Thirlwall's law.

4. Conciliating Prebisch-Singer and Thirlwall

As anticipated in the general introduction, the considerations in this section deal with our proposal to deepen the relationship between the ECLAC school and post-Keynesian approach through the work of Prebisch and Thirlwall. As argued by Cimoli, Porcile and Rivera (2010), the BOPC growth models can be used to capture key economic insights of both Keynesian and structuralist traditions.

Our interest in reconciling Thirlwall's law with the Prebisch-Singer hypothesis of deteriorating in terms-of-trade goes beyond the advantage that modeling exercise brings itself. Since its initial formulation, BOPC models have evolved to incorporate the other components of the balance of payments. However, to our knowledge, no significant effort has been made toward incorporating the dynamics of prices[2]. Thus, our contribution aims to give greater strength to this theoretical framework.

It seems to have been an initial fear of incorporating the terms-of-trade in the model since the balance of payments adjustment through prices could lead to an adjustment not via income, disqualifying the Thirlwall's law. The neoclassical version of the causality in equation (3.3) is given by $\hat{e} = \frac{\Phi\hat{z}+\pi\hat{y}}{(1+\varphi+\beta)}$, where, assuming flexible prices in the long term, $\hat{e}$ would adjust any imbalances in BP. However, Alonso and Garcimartín (1999) show that that it is not possible. Unlike the neoclassical assumption, we consider that it is the deterioration of terms-of-trade of primary products in relation

[2] In the post-Keynesian literature, Block and Sapsford (2000) and Sarkar (2001) developed models compatible with the Prebisch-Singer hypothesis, but independent of BOPC literature.

to manufactured goods that can reduce the compatible growth rate with equilibrium in the balance of payments.

In his original work, Thirlwall uses a function for the real exchange rate compatible with the PPP such that while $(1 + \varphi + \beta)$ captures the so called Marshall-Lerner condition, $\hat{e}$ corresponds to changes in the real exchange rate and would be zero in the long term. In fact both, Thirlwall and the authors that succeed him, define the real exchange rate as:

$$E = \frac{P_f \varepsilon}{P_d} \tag{4.1}$$

Where P_d corresponds to the domestic price level, P_f is the level of foreign prices and ε is the nominal exchange rate.

Araújo (2013) argues that the PPP would not be the most convenient setting to study the effect of changes in relative prices on growth. According to Rogoff (1996), even if we accept the parity of purchasing power, it seems to hold only in the very long-term at a rate of extremely slow convergence. Apart from occurring only in very long periods - over 50 years - the relationship between the Kaldor-Verdoorn and Thirlwall's law only has validity if we do not accept PPP. Moreover and for the purposes of this study, the adoption of purchasing power parity cannot capture the Prebisch-Singer thesis of deteriorating of terms-of-trade. In this direction, the definition proposed by Rodrik (2008) seems to be more appropriate. Be:

$$E = \frac{P_T}{P_N} \tag{4.2}$$

where E is the real exchange rate, P_T is given by the prices of tradable goods and P_N for non-tradable goods. As shown by Rodrik (2008) this definition is consistent with the Balassa-Samuelson effect and will be used in the modeling approach presented[3].

We consider then an economy consisting of three sectors corresponding to the production of primary goods (sector 1, tradable), industrial goods (sector 2, tradable) and services (sector 3, non-tradable). The real exchange rate can be represented as follows:

$$E = \frac{P_{T,1}^{\theta_1} P_{T,2}^{\theta_2}}{P_N} \tag{4.3}$$

Where $P_{T,1}$ corresponds to prices in the primary sector, $P_{T,2}$ is given by prices in the industrial sector and P_N in the services sector. In turn, $\theta_1 + \theta_2 = 1$ determine the weight of each sector in total tradable production and are taken at the beginning as constants. Gains of productivity in the tradable sector lead to lower prices, which in turn, are reflected in a more appreciated exchange rate. In turn, gains of productivity in the service sector have the opposite effect, devaluing the real exchange rate. The validity of Balassa-Samuelson effect implies that the increase in productivity levels of tradable sectors is higher than in the non-tradable. The rate of change of the exchange rate is given by:

$$\hat{e} = \theta_1 \widehat{p_{T,1}} + \theta_2 \widehat{p_{T,2}} - \widehat{p_N} \tag{4.4}$$

Following Porcile and Lima (2006), be prices determined in industrial sector by a mark-up that captures the market power of firms. The other sectors operate in a competitive market. Then:

[3] The Balassa-Samuelson effect postulates that productivity gains are larger in the tradable sector than in the non-tradable. A related effect of this prediction is that countries with higher growth rates will experience greater exchange appreciation. As we show below, this is not necessarily true.

$$\begin{cases} P_{T,1} = wq_{T,1}^{-1} & (4.5a) \\ P_{T,2} = \tau wq_{T,2}^{-1} & (4.5b) \\ P_N = wq_N^{-1} & (4.5c) \end{cases}$$

Market power in the manufacturing sector is represented by $\tau > 0$, and we consider that it is intrinsic to the very structure of this market, regardless if it is operating in monopolistic or oligopolistic competition. We observed that the mark-up is derived from the presence of a greater bargaining power by workers and the concentration of innovation in the industrial sector. Workers of the industrial sector seem to be organized in trade unions and are in a better position to seek wage improvements as described by Prebisch. Moreover, as shown by Singer, when a company innovates, it gains the right to charge a mark-up on prices. Finally, w corresponds to the nominal wage and q to labor productivity.

Taking logarithms of equations (4.5a), (4.5b) and (4.5c) and deriving in time:

$$\begin{cases} \widehat{p_{T,1}} = \hat{w} - \widehat{q_{T,1}} & (4.6a) \\ \widehat{p_{T,2}} = \hat{\tau} + \hat{w} - \widehat{q_{T,2}} & (4.6b) \\ \widehat{p_N} = \hat{w} - \widehat{q_N} & (4.6c) \end{cases}$$

Thus, we obtain the prices change rate function of our economy. Increases of productivity lead to reductions in prices while wage increases have the opposite effect. In the industrial sector, a higher rate of innovation or bargaining power of workers causes an increase in $\hat{\tau}$ resulting in higher prices. The rate of change of the mark-up can be modeled by a unit step function where:

$$\hat{\tau} = \begin{cases} h\widehat{q_{T,2}}, \text{higher inovation rate or increase in workers bargainig power} \\ 0, \text{otherwise} \end{cases}$$

Following Ferrari, Freitas and Barbosa Filho (2013), we reconstruct the original system of Thirlwall's model for our economy as follows:

$$\begin{cases} X_{T,i} = (1/E)^{\varphi_{T,i}} Z^{\Phi_{T,i}} & (4.7a) \\ M_{T,i} = (E)^{\beta_{T,i}} Y^{\pi_{T,i}} & (4.7b) \\ \sum_{i=1}^{2} X_{T,i} = E \sum_{i=1}^{2} M_{T,i} & (4.7c) \end{cases}$$

In which the export and import function and the equilibrium condition were disaggregated in two sectors so $X = X_{T,1} + X_{T,2}$ and $M = M_{T,1} + M_{T,2}$ with i = 1, 2.

With the same tools used up to here we obtain:

$$\begin{cases} \hat{x}_{T,i} = -\varphi_{T,i}\hat{e} + \Phi_{T,i}\hat{z} & (4.8a) \\ \hat{m}_{T,i} = \beta_{T,i}\hat{e} + \pi_{T,i}\hat{y} & (4.8b) \\ \alpha_1\hat{x}_{T,1} + \alpha_2\hat{x}_{T,2} = \hat{e} + \gamma_1\hat{m}_{T,1} + \gamma_2\hat{m}_{T,2} & (4.8c) \end{cases}$$

Where parameters α and γ correspond to the weight of each sector in total exports and imports, respectively ($\alpha_1 + \alpha_2 = 1$ and $\gamma_1 + \gamma_2 = 1$).

Substituting (4.8a) and (4.8b) in (4.8c) and isolating $\hat{y}$ we obtain the growth rate compatible with equilibrium in the balance of payments:

$$\hat{y} = -\left(\frac{1 + \sum_{i=1}^{2} \alpha_i \varphi_{T,i} + \sum_{i=1}^{2} \gamma_i \beta_{T,i}}{\sum_{i=1}^{2} \gamma_i \, \pi_{T,i}}\right)\hat{e} + \left(\frac{\sum_{i=1}^{2} \alpha_i \Phi_{T,i}}{\sum_{i=1}^{2} \gamma_i \, \pi_{T,i}}\right)\hat{z} \qquad (4.9)$$

Looking for the reconciling ECLAC's vision with the propositions made by Setterfield (2011) and Araujo (2013), we replace the definition of real exchange adopted by Thirlwall (1979) by the one adopted by Rodrik (2008) and previously modified (see equations 4.3 and 4.4). Thus we have:

$$\hat{y} = \frac{-\left(1 + \sum_{i=1}^{2} \alpha_i \varphi_{T,i} + \sum_{i=1}^{2} \gamma_i \beta_{T,i}\right)\left(\theta_1 \widehat{p_{T,1}} + \theta_2 \widehat{p_{T,2}} - \widehat{p_N}\right)}{\sum_{i=1}^{2} \gamma_i \, \pi_{T,i}} + \left(\frac{\sum_{i=1}^{2} \alpha_i \Phi_{T,i}}{\sum_{i=1}^{2} \gamma_i \, \pi_{T,i}}\right) \hat{z} \quad (4.10)$$

However, we know from system (4.6) which is the behavior of prices in each sector. Making the appropriate substitutions and after some algebraic manipulations:

$$\hat{y} = \frac{-\left(1 + \sum_{i=1}^{2} \alpha_i \varphi_{T,i} + \sum_{i=1}^{2} \gamma_i \beta_{T,i}\right)\left[-\theta_1 \widehat{q_{T,1}} + \theta_2 (\hat{\tau} - \widehat{q_{T,2}}) + \widehat{q_N}\right]}{\sum_{i=1}^{2} \gamma_i \, \pi_{T,i}} + \left(\frac{\sum_{i=1}^{2} \alpha_i \Phi_{T,i}}{\sum_{i=1}^{2} \gamma_i \, \pi_{T,i}}\right) \hat{z} \quad (4.11)$$

We obtain a version of Thirlwall's law compatible with the structural change and the possibility of deterioration in terms-of-trade. Similarly to the original model, the growth rate that leads to the equilibrium of the balance of payments is directly proportional to the growth rate of foreign income and the ratio between exports and imports elasticities. Thus, the more the international product grows the bigger the domestic potential growth will be. Moreover, countries specialized in the production of industrial goods present higher growth than the rest of the world due to the higher income elasticity of exports to the detriment of imports. On the other hand, primary exporting countries tend to grow more slowly than the rest of the world since the elasticity of exports is lower than that of imports.

The model also does not exclude the possibility of structural change. In fact we have as in equation (2.1):

$$\begin{cases} \overline{\Phi} = \sum_{1}^{2} \alpha_i \Phi_{T,i} & (4.12a) \\ \overline{\pi} = \sum_{1}^{2} \gamma_i \pi_{T,i} & (4.12b) \end{cases}$$

Where $\overline{\Phi}$ and $\overline{\pi}$ correspond to averages elasticities of exports and imports respectively. Differentiating both equations with respect to time:

$$\begin{cases} \dot{\overline{\Phi}} = \sum_{1}^{2} \dot{\alpha_i} \Phi_{T,i} + \sum_{1}^{2} \alpha_i \dot{\Phi_{T,i}} & (4.13a) \\ \dot{\overline{\pi}} = \sum_{1}^{2} \dot{\gamma_i} \pi_{T,i} + \sum_{1}^{2} \gamma_i \dot{\pi_{T,i}} & (4.13b) \end{cases}$$

Technical progress is able to modify the income elasticities, process captured by the second component of the system above. In turn, the transfer of workers from sectors with lower to higher income elasticity also can contribute to modify the potential growth rate, as shown by the first component. Even in an adverse external environment, changes in the proportion of each sector in the economy allow to achieve different growth rates.

Not assuming PPP and taking the Marshall-Lerner condition as valid, our formulation is compatible with the ample evidence presented in favor of the Prebisch-Singer hypothesis of deterioration of terms-of-trade. Productivity gains resulting from the process of economic growth naturally lead to an appreciation of the exchange rate, via Balassa-Samuelson effect, which reduces the growth rate consistent with equilibrium in the balance of payments. However, technical progress and market structure in the industrial sector can simultaneously reduce the intensity of the

appreciation via mark-up. As the R&D is concentrated in sector 2, countries specialized in the production of sector 1 present a greater constraint to growth due to the appreciation of the real exchange rate. Note, however, as we modeled $\hat{\tau}$ as a scalar unit function, the variation does not occur continuously.

As an example, consider the extreme cases of a central and a peripheral economy fully specialized in the production of industrialized and primary goods, respectively. In the first case, the sector 2 is responsible for the entire production of tradable goods ($\theta_2 = 1$). Thus, the growth rate consistent with balance of payments constraint is equal to:

$$\hat{y} = \frac{-\left(1 + \varphi_{T,2} + \beta_{T,1}\right)[(\hat{\tau} - \widehat{q_{T,2}}) + \widehat{q_N}]}{\pi_{T,1}} + \left(\frac{\Phi_{T,2}}{\pi_{T,1}}\right)\hat{z} \qquad (3.14a)$$

Technical progress and/or changes in the bargaining power of workers, who by definition are concentrated in the industrial sector, allow to offset the effects of the appreciation of the real exchange rate through a variation in the rate of mark-up. Although the Balassa-Samuelson effect prevails, in the long run it will be less intense.

In the case of an economy totally specialized in the production of primary goods ($\theta_1 = 1$), the long term growth rate is given by:

$$\hat{y} = \frac{-\left(1 + \varphi_{T,1} + \beta_{T,2}\right)[-\widehat{q_{T,1}} + \widehat{q_N}]}{\pi_{T,2}} + \left(\frac{\Phi_{T,1}}{\pi_{T,2}}\right)\hat{z} \qquad (3.14b)$$

As the market for primary goods operates in perfect competition, we can consider that there is a deterioration of the terms-of-trade of primary products in relation to industrial products, determined by the differences in sectoral market structures.

Productivity gains in the tradable sector lead, through prices, to a reduction in the potential growth rate of the economy in both cases. The existence of oligopolized structures in the center countries reduces this effect via the mark-up that innovation itself allows firms to possess. As the primary commodity market approaches a competitive structure, productivity gains necessarily translate into a reduction in prices, featuring the deterioration described by Prebisch.

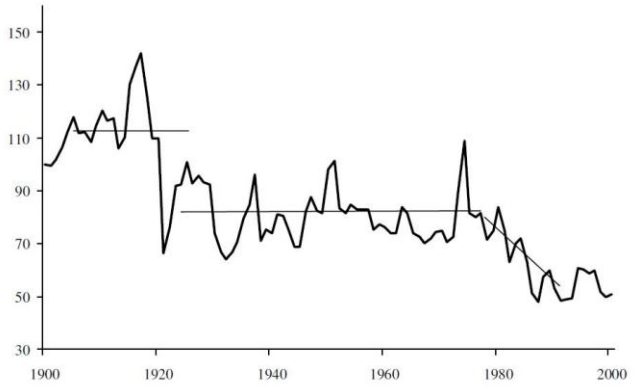
The empirical evidence supporting the Prebisch-Singer hypothesis suggests that the deterioration did not occur continuously, being characterized by structural breaks. The model developed in this study is also consistent with this observation. Indeed the deterioration of terms-of-trade would be continuous only if the rate of mark-up also growed continuously, which is clearly not possible. However, technical progress, from which the market power of firms derives, is discontinuous and to some extent the great innovations are unpredictable.

At the moment that a major innovation arises or there is a shock in the bargaining power of workers, it is observed an increase in $\hat{\tau}$ that causes a sharp deterioration in the terms-of-trade of primary products, featuring the observed structural breaks. A period of relative price stability follows for both sectors. Ocampo and Parra (2003), Zanias (2005) and Ocampo and Parra (2010) identify two major structural breaks during the twentieth century, the first around 1920 and the second during the 1980s, as can be seen in figure 4.1. In the light of the presented model, there were effectively two shocks on mark-up rate.

We suggest that the first shock is related not only to the end of the 1st World War, but also to the rise of the Soviet bloc. At that time it rose the terms of bargaining for workers in the center countries. The Russian Revolution of 1917 granted to Western Europe workers a significant increase in bargaining power taking in consideration that it raised entrepreneurs' fears of a revolution in their own countries. The second and more recent structural break would be linked to the beginning of the computer revolution, a

true technology shock. The leading economies of this industry remained an important market power in the years that followed its dissemination.

Gráfico 4.1: Evolution of terms-of-trade of primary commodities in relation to manufactured products between 1900 and 2003



Source: Ocampo e Parra (2003)

The two main variables behind the long-term growth rate remain the international growth and the ratio of the income elasticity of exports and imports. They are in fact the determinants of long-term growth and override the effect of prices. The approach presented, however, adds a new element in this framework by allowing the capture of the effect of prices on growth from the Prebisch-Singer hypothesis of deterioration of terms-of-trade for primary products in relation to manufactured goods. We call the final expression denoted by equation (4.11) the *Prebisch-Thirlwall rule*.

5. Cumulative causation and the Prebisch-Thirlwall rule

The post-Keynesian literature has developed two different models of long-term growth for open economies, namely the cumulative causation model originally designed by Nicholas Kaldor (Kaldor, 1966) and the balance-of-payments-constrained already presented in the third section. Although both approaches differ significantly in some of its hypotheses (Blecker, 2009), important insights can be extracted from their combination[4].

Returning to equation (4.11) and rewriting it in terms of average elasticities defined in (4.12a) and (4.12b) we find:

$$\hat{y} = \frac{-\left(1 + \sum_{i=1}^{2} \alpha_i \varphi_{T,i} + \sum_{i=1}^{2} \gamma_i \beta_{T,i}\right)(\theta_2 \hat{\tau} - \widehat{q_T} + \widehat{q_N})}{\overline{\pi_T}} + \left(\frac{\overline{\Phi_T}}{\overline{\pi_T}}\right)\hat{z} \quad (5.1)$$

Where $\widehat{q_T} = \theta_1 \widehat{q_{T,1}} + \theta_2 \widehat{q_{T,2}}$. Being valid the Marshall-Lerner condition $-\left(1 + i{=}12\alpha i \varphi T,i + i{=}12\gamma i \beta T,i > 0\right.$.

As argued by Araújo (2013) and Romero, Silveira and Jayme Jr. (2011), income elasticities are determined by technological intensity of domestic production. Thus, technologically leading industries would present a greater income elasticity of demand. Then, following Setterfield (2011), let's consider the average elasticities as a function of the productivity growth of the tradable sector so that:

$$\frac{\overline{\Phi_T}}{\overline{\pi_T}} = k\widehat{q_T} \quad (5.2a)$$

Where $k > 0$ is a linear parameter that captures the sensitivity of elasticities to changes in productivity growth rate. Countries specialized in the production of industrial goods of high technological intensity tend to have a high *k*. That contrasts with technologically

[4]The Dixon-Thirlwall model corresponds to a formalization of the Kaldorian vision applied to a regional economy context.

backward countries which present a lower *k*. The pattern of specialization in world trade determines how the fruits of technical progress shall be divided between countries.

The mark-up growth rate has been previously modeled by a unit step function linearly dependent on the industrial productivity growth rate. For the sake of simplicity, in this representation it will depend only on the tradable productivity growth rate. Being productivity gains concentrated in this sector we can also write the non-tradable productivity growth rate in a similar way. So, we have:

$\hat{\tau} = h\widehat{q_T}$ (5.2b)

$\widehat{q_N} = l\widehat{q_T}$ (5.2c)

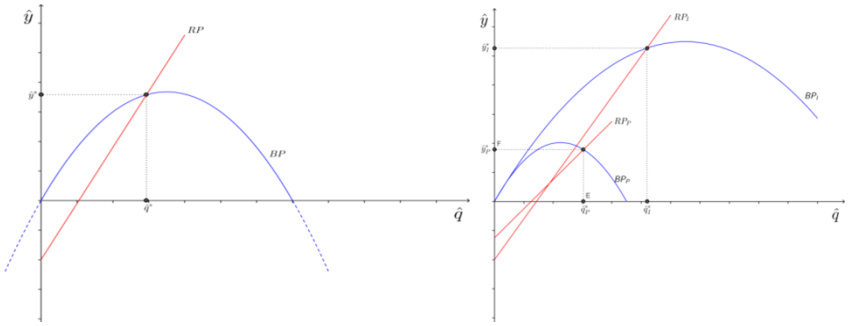
With $h > 0$ corresponds to the sensitivity of the mark-up to variations in productivity and $0 < l < 1$ is the ratio of innovation of the non-tradable sector in relation to the tradable one.

Replacing the system formed by equations (5.2) in (5.1) and after some algebraic manipulations we get our growth rate compatible with equilibrium in the balance of payments. Joining this result with the Kaldor-Verdoorn law we have our system of cumulative causation:

$$\begin{cases} \hat{y} = \Omega_1 \widehat{q_T} + \Omega_2 \widehat{q_T}^2 & (5.3a) \\ \widehat{q_T} = \zeta_0 + \zeta_1 \hat{y} & (5.3b) \end{cases}$$

Where $\Omega_1 = k\hat{z}$ corresponds to the income effect and captures the output growth rate sensibility to variations in productivity growth rate, $\Omega_2 = -\frac{\left(1+\sum_{i=1}^{2} \alpha_i \varphi_{T,i} + \sum_{i=1}^{2} \gamma_i \beta_{T,i}\right)(\theta_2 h + l - 1)}{\Phi_T} < 0$ corresponds to the price effect, $\zeta_0 > 0$ is a constant and $\zeta_1 > 0$ captures the productivity growth rate sensibility in relation to the output growth rate. Equation (5.3a) corresponds to the balance of payments regime while (5.3b) to the productivity regime. The graphic 5.1a allows us to visualize the behavior of both expressions:

Gráfico 5.1:*Cumulative causation* and the Prebisch-Thirlwall rule



(a) (b)

Elaborate by the authors

Some important insights can be extracted from the model presented. The first suggests that the output growth rate depends quadratically on the productivity growth rate. BP curve is formed by all combinations of $\widehat{q_T}$ and $\hat{y}$ that maintain the balance of payments in equilibrium. Economies whose equilibrium is found before the parabola's vertex of the BP regime show a positive relation between the endogenous variables. Productivity shocks that move RP to the right raise the growth rate that balances BP. Moreover, economies whose equilibrium is after BP vertex have a negative relation between the endogenous variables. Thus, positive productivity shocks have a negative effect on growth rate, since the price effect begins to overlap the income effect.

In turn, the productivity growth rate depends directly on the output growth rate through Kaldor-Verdoorn mechanism. In other words, the external constraint determines the changes in productivity. We argue that countries with high *k* and ζ_1 are

the most likely to get into virtuous circles of growth. Analogously, the combination of a low *k* and ζ_1 implies a greater propensity to indulge in vicious circles of growth.

The two main variables behind the long-term growth rate remain the international growth and the ratio between the income elasticity of exports and imports. Those are in fact the determinants of long-term growth, which means that the income effect overlaps extensively the price effect. The model remains compatible with the structural change since both, technical progress and the transfer of workers from sectors with lower to higher income elasticity, are able to change the average elasticity of foreign trade and therefore modify the growth rate. The approach presented is still compatible with the Prebisch-Singer hypothesis of deterioration of terms-of-trade of primary products in relation to manufactured goods.

As an example, let us consider the extreme cases of a central and a peripheral economy, fully specialized in the production of industrial and primary goods, respectively. In the first case there is a combination of a high Ω_1 and ζ_1 and a low Ω_2. The high Ω_1 occurs because the center countries are exporters of technologically advanced products with high income elasticity and import primary inputs of lower income elasticity. The high ζ_1 is also guaranteed by the technological leadership of the center which gives them more advanced educational and research systems as well as major consumer markets. Finally, the low Ω_2 comes not only from high income elasticity of exports (see denominator of the expression) but also for the presence of market power in the industrial sector.

The periphery presents, in turn, a combination of low Ω_1 and $\zeta_1$and high Ω_2.The low Ω_1 occurs because a primary export economy is an importer of manufactured goods with high income elasticity and whose exports have low income elasticity. The reduced ζ_1 comes from its technological backwardness, giving them fragile educational and research systems and smaller consumer markets. Finally, the highest Ω_2 comes not only from low income elasticity of exports (see denominator of the expression) but also for the absence of market power in the industrial sector.

Comparing the curves of the productivity regime and the BP regime between the center and the periphery allows us to notice that the growth rate that balances the balance of payments is higher in the first than in the latter. It can be seen in graphic 5.2b. The RP_I and BP_I curves correspond to the productivity and the balance of payments regimes, respectively, in the central country. Similarly, the RP_P and BP_P curves correspond to the productivity and the balance of payments regimes, respectively, in the peripheral country. The growth rate in the center will be higher via prices, due to the presence of the mark-up factor, and mainly due to differences in income elasticities whose effect is captured by the $\Omega_1(k)$ parameter. As explained above, in industrialized countries, *k* is greater than in the primary exporting countries.

As described by Prebisch (1959), positive productivity shocks in peripheral economies are not reflected in increases in the growth rate and only generate a transfer of the fruits of technical progress to the center. In fact, for a shift to the right of the RP_p curve there is a reduction in the output growth rate. In terms of economic policy, it would be advisable to increase the slope of RP and shift the BP curve up, thus relieving the external constraint.

If a developing country promotes its industry with an export focus, it not only will be able to raise its output growth rate but also increase the growth rate of productivity. This can be seen through the BP curve shifts vertically and helps to explains the differences in growth patterns between Southeast Asia and Latin America. While the first focused on the rise of income elasticities and made the defense of prices a secondary effort, the latter devoted greater attention to the protection of prices via

customs protectionism. As the income effect outweighs the price effect our model can explain the lower growth of output and productivity in the Latin America. Intermediate situations can be described from different combinations of Ω_1, ζ_1 and Ω_2 and likewise also be used to explain the behavior of some exceptions to the classic center-periphery dynamic described by ECLAC authors.

6. Conclusion

This paper reviewed the basic BOPC growth model and its main developments suggesting that Thirlwall's law can be understood as a mathematical formalization of ECLAC's thinking derived from Prebisch rule. We also seek to make a first draft of what would be the introduction of the Prebisch-Singer hypothesis of deterioration of the terms-of-trade in Thirlwall's law.

Assuming an economy consisting of three sectors - manufactured goods, primary goods and services – we derive Thirlwall's law using a distinct definition for the real exchange rate, inconsistent with PPP and compatible with the Balassa-Samuelson effect. We call the final expression obtained the *Prebisch-Thirlwall rule*.

Technical progress - that by definition focuses on the industrial sector - and shocks in the bargaining power of workers decrease the effects of the appreciation of the real exchange rate through the market power that innovation gives to innovating firms. Although the Balassa-Samuelson effect prevails, in the long run it will be less intense in the central than in the peripheral economy.

As the primary goods market operates in perfect competition, we can consider that there is a deterioration in the terms-of-trade of primary products in relation to industrial products, determined by the difference in sectoral market structures. This deterioration has negative repercussions on the growth rate compatible with equilibrium in the balance of payments of the primary-exporting economies, reinforcing its peripheral position.

Our model is also consistent with the conclusions of Thirlwall's multi-sectoral law. In fact, the two main variables behind the long-term growth rate remain the international growth and the ratio between the income elasticity of exports and imports. Thus, industrial economies will potentially grow above the rest of the world since the elasticity of exports is superior to the imports. On the other hand, it is expected the opposite effect on primary-exporting economies. In terms of structural change, the transfer of workers from the primary sector to the industrial one contributes positively to growth via changes in the composition of the foreign trade elasticities.

The presented approach adds a third element in this framework by allowing the capture of the effect of prices on growth via the Prebisch-Singer hypothesis of deterioration of the terms-of-trade of primary products in relation to manufactured goods. Empirical evidence suggests that this deterioration does not occur continuously but staggered through structural breaks. The constructed model is consistent with this observation. Deteriorating terms of trade would only be continued if the rate of mark up also grows continuously. However, technical progress - from which the market power of firms derive - and changes in the pattern of distributive conflict are discontinuous. At the moment that a major innovation appears there is an increase in $\hat{\tau}$ that causes a sharp deterioration in terms-of-trade, characterizing the observed structural breaks. A period of relative price stability follows for both sectors.

We also present a proposal for a joint between BOPC growth model and the post-Keynesian tradition of cumulative causation. It is found that the output growth rate depends quadratically on the productivity growth rate. In turn, productivity growth rate depends directly on output growth rate through Kaldor-Verdoorn mechanism. In terms of economic policy, if a developing country promotes its industry with an export focus,

it is not only able to raise its growth rate but also to increase the growth rate of productivity. Our findings reinforce the settings originally made by ECLAC authors.

ReferênciasBibliográficas

ALLEYNE, D. e FRANCIS, A. A. "Balance of payments-constrained growth in developing countries: a theoretical perspective", *Metroeconomica,* vol.59, n. 2, p. 189-202, 2008.

ALONSO, J.A. E GARCIMARTÍN, C. "A new approach to balance-of-payments constraint: some empirical evidence", *Journal of Post Keynesian Economics,* vol. 21, n. 2, p. 259-281, 1999.

ARAÚJO, R. "Cumulative causation in a structural economic dynamic approach to economic growth", *Structural Change and Economic Dynamics*, vol. 24, p. 130-140, 2013.

ARAÚJO, R.A. e LIMA, G.T. "A structural economic dynamics approach to balance-of-payments-constrained growth", *Cambridge Journal of Economics*, vol. 31, p. 755-774, 2007.

AREZKI, R., HADRI, K., LOUNGANI, P. e RAO, Y. "Testing the Prebisch-Singer Hypothesis since 1650: Evidence from Panel Techniques that allow for multiple breaks" *IMF Working Paper*, n. 180, p. 1-35, 2013.

BIELSCHOWSKY, R. "Sesenta años de la Cepal: estructuralismo y neoestructuralismo", *Revista Cepal,* n. 97, p. 173-194, 2009.

BLECKER, R.A. " Long-Run Growth in Open Economies: Export-Led Cumulative Causation or a Balance-of-Payments Constraint?" *American University Working Papers,* n.23, p. 1-36, 2009.

BLOCK, H. e SAPSFORD, D. "Whither the Terms of Trade? An Elaboration of the Prebisch-Singer Hypothesis, *Cambridge Journal of Economics,* vol. 24, p. 461-481, 2000.

BOIANOVSKY, M. "A View from the Tropics: Celso Furtado and the Theory of Economic Development in the 1950s", *History of Political Economy*, v. 42, p. 221-266, 2010.

BOIANOVSKY, M. e SOLÍS, R. "The origins and Development of the Latin American Structuralist Approach to the Balance of Payments", *Review of Political Economy*, 2014.

BUNZEL, H. e VOGELSANG, T. "Powerful trend function tests that are robust to strong serial correlation with an application to the Prebisch-Singer hypothesis", *Journal of Business & Economic Statistics*, vol. 23, n. 4, 2005.

CIMOLI, M. e PORCILE, G., "Technology, structural change and BOP-constrained growth: a structuralist toolbox", *Cambridge Journal of Economics*, p. 1-23, 2013.

CIMOLI, M., PORCILE, G. e ROVIRA, S. "Structural change and the BOP-constraint: why did Latin America fail to converge?" *Cambridge Journal of Economics*, vol. 34, p. 389-411, 2010.

DI FILIPPO, A. "Latin American structuralism and economic theory", *RevistaCepal,* n. 98, p.175-196, 2009.

FERRARI, M.A.R, FREITAS, F.N.P e BARBOSA FILHO, N. "A taxa de câmbio real e a restrição externa: uma proposta de releitura com elasticidades endógenas", *Revista de Economia Política,* vol. 33, n. 1, p. 60-81, 2013.

FURTADO, C. (1961) "Desenvolvimento e Subdesenvolvimento", Rio de Janeiro: Contraponto Editora, 2009.

GOUVEA, R.R e LIMA, G. "Structural change, balance-of-payments constraint, and economic growth: evidence from the multisectoralThirlwall's law", *Journal of Post Keynesian Economics*, vol. 33, n. 1, p. 169-204, 2010.

GOUVEA, R.R e LIMA, G. “Balance of payments constrained growth in a multisectoral framework: a panel data investigation”, *Journal of Economic Studies*, vol. 40, n. 2, p. 240-254, 2013.
GRILLI, E.R. e YANG, M.C. “Primary Commodity Prices, Manufactured Goods Prices, and the Terms of Trade of Developing Countries: What the Long Run Shows”, *The World Bank Economic Review*, vol. 2, n. 1, p. 1-47, 1988.
HARVEY, D. I., KELLARD, N. M., MADSEN, J. B. e WOHAR, M. E. “The Prebisch-Singer Hypothesis: four centuries of evidence” *The Review of Economics and Statistics*, vol. 92, n. 2, p. 367-377, 2010.
KALDOR, N. “Causes for the Slow Rate of Growth in the United Kingdom”, *Cambridge University Press*. Cambridge, 1966
KRUGMAN, P. “Differences in income elasticities and trends in real Exchange rates”, *European Economic Review,* vol. 33, p. 1031-1054, 1989.
LIBÂNIO, G.A “Aggregate demand and the endogeneity of the natural rate of growth: evidence from Latin American economies”, *Cambridge Journal of Economics*, vol. 33, p. 967-984, 2009.
McCOMBIE, J.S.L. “Criticism and defences of the balance-of-payments constrained growth model: some old, some new”, *PSL Quarterly Review,* vol. 64, p. 353-392, 2011
McMILLAN, M. e RODRIK, D. “Globalization, structural change and productivity growth”, Publicadoem: *Making globalization socially sustainable*, ILO e WTO publications, Suiça, 2011.
MOLLIC, A.V., FARIA, J.R., ALBURQUERQUE, P.H. e LEÓN-LEDESMA M.A. “Can globalization stop the decline in commodities terms of trade?”, *Cambridge Journal of economics,* vol. 32, p. 683-701, 2008.
MORENO-BRID, J.C. “Capital flows, interest payments and the balance-of-payments constrained growth model: a theoretical and empirical analysis”, *Metroeconomica,* vol. 54, n. 2, p. 356-365, 2003.
OCAMPO, J.A. e PARRA, M. “Los términos de intercambio de los productos básicos en el siglo XX”, *Revista Cepal,* n. 79, p. 7-37, 2003.
OCAMPO, J.A. e PARRA, M. “The terms of trade for commodities since the mid 19th century”, *Journal of Iberian and Latin America Economic history*, p. 11-43, 2010.
OREIRO, J.L. “Economia Pós-Keynesiana: origem, programa de pesquisa, questões resolvidas e desenvolvimentos futuros”, *Ensaios FEE,* vol. 32, n. 2, p. 283-312, 2011.
PORCILE, G., CURADO, M. e CRUZ, M. “Restrição externa e crescimento da economia brasileira”, Publicado em *Macroeconomia do desenvolvimento: Ensaios sobre restrição externa, financiamento e política macroeconômica,* Organizadores: Oreiro, J.L., Paula, L.F. e Basílio, F.,Editora UFPE, Brasil, 2012.
PORCILE, G. e LIMA, G.T. “Tipo de cambio, empleo y crecimiento en un modelo con restricción externa”, *Investigación Económica,* vol. 65, p. 63-89, 2006.
PREBISCH, R. “El desarrollo económico de la América Latina y algunos de sus principales problemas”, *Desarrollo Económico,* vol. 26, n. 103, p. 479-502, 1949.
PREBISCH, R. “Commercial Policy in the Underdeveloped Countries”, *The American Economic Review*, vol. 49, n. 2, p. 251-273, 1959.
PREBISCH, R. “Hacia una dinámica del desarrollo latinoamericano”, Cidade do México: Fondo de Cultura Económica, 1963, p. 28-36 e 81-106.
PREBISCH, R. (1951) “Problemas teóricos y prácticos del crecimiento económico”, *Serie Conmemorativa del vigésimo quinto aniversario de la Cepal*, Santiago do Chile: Comisión Económica para América Latina y el Caribe (Cepal), 1973.
REINHART, C. e WICKHAM, P. “Commodity prices: cyclical weakness or Secular decline?”,*IMF Staff papers,* vol. 41, n. 2, 1994.

RODRÍGUEZ, O. (2006) "O estruturalismo latino-americano", Rio de Janeiro: Civilização Brasileira, 2009, p. 61-165.
RODRIK, D. "The real Exchange rate and economic growth", *Brookings Papers on Economic Activity*, p. 365-412, 2008.
ROGOFF, K. "The Purchasing Power Parity Puzzle" *Journal of Economic Literature*, vol. 34, n. 2, p. 647-668, 1996.
ROMERO, J.P., SILVEIRA, F. e JAYME JR, F.G. "Brasil: Cambio estructural y crecimiento con restricción de balanza de pagos", *Revista Cepal*, n. 105, 2011.
SAI-WING HO, P. "Revisiting Prebisch and Singer: beyond the declining terms of trade thesis and on to technological capability development", *Cambridge Journal of Economics*, v. 36, p. 869-893, 2012.
SARKAR, P. "Technical Progress and the North-South Terms of Trade", *Review of Development Economics*, vol. 5, n. 3, p. 433-443, 2001.
SERRANO, R. e PINILLA, V. "The terms of trade for agricultural and food products, 1951-2000", *Journal of Iberian and Latin American Economic History*, vol. 29, n. 2, 2011.
SETTERFIELD, M. "The remarkable durability of Thirlwall's Law", *PSL Quarterly Review*, v. 64, n. 2, p. 393-427, 2011.
SINGER, H.W. "The Distribution of Gains between Investing and Borrowing Countries", *The American Economic Review*, vol. 40, n. 2, p. 473-485, 1950.
THIRLWALL, A.P. "The balance of payments constraint as an explanation of international growth rate differences", *BNL Quarterly Review*, vol. 32, pp.45-53, 1979
THIRLWALL, A.P. "Foreing trade elasticities in centre-periphery models of grosth and development", *BNL Quarterly Review*, vol. 36, p. 249-261, 1983.
THIRLWALL, A.P. "Balance of payments constrained growth models: history and overview", *PSL Quarterly Review*, vol. 64, n. 259, p. 307-351, 2011.
THIRLWALL, A.P. e HUSSAIN, M.N. "The Balance of Payments Constraint, Capital Flows and Growth Rate differences between Developing Countries", *Oxford Economic Papers*, New Series, vol. 34, n 3, p. 498-510, 1982.
THIRLWALL, A.P. e BERGEVIN, J. "Trends, Cycles and Asymmetries in the Terms of Trade of Primary Commodities from Developed and Less Developed Countries", *World Development*, vol. 13, n. 7, p. 805-817, 1985.
ZANIAS, G.P. "Testing for trends in the terms of trade between primary commodities and manufactured goods", *Journal of Development Economics*, vol. 78, n.1, 2005.