REAL EXCHANGE RATE AND ECONOMIC COMPLEXITY IN A NORTH-SOUTH STRUCTURALIST BoPG MODEL

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Abstract:

The main objective of this work is to analyze theoretically and empirically the interrelationships between the real exchange rate (RER) and the economic complexity level in a *Balance of Payment Constrained Growth* (BoPG) framework with two regions, the North (developed) and the South (developing). For such, it is proposed an extension of Botta (2009)´s model. In this context, it is followed the recent economic literature which has shown that the RER level play an important role in the international trade elasticities. In other words, the RER level is not neutral in the long run, once it is related to higher *per capita* income growth rates. So, in the analysis presented here, the RER levels matters for influencing the industrial (manufacturing) share as well as the economic growth rate compatible with the Balance of Payments equilibrium. Besides, higher levels of economic complexity influence South growth rate, depending on the international trade elasticities magnitudes concerning the effects of the innovation, knowledge stock and human capital over them. Thereafter, an empirical analysis is carried out from a heterogeneous sample of countries. The panel data estimations present that excessively overvalued RER can accelerate the structural heterogeneity, affecting in a particular negative way the industrial sector. This process implies a regressive productive specialization, mainly in developing economies. The empirical evidences suggests that undervalued RER and the higher manufacturing share in the developing countries sample present positive and significant effects upon the economic complexity levels.

Resumo

O objetivo do presente artigo é analisar teórica e empiricamente as inter-relações entre o nível da taxa real de câmbio e o grau de complexidade econômica em um modelo do tipo *Balance of Payment Constrained Growth* (BoPG) com duas regiões, o Norte (desenvolvido) e o Sul (em desenvolvimento). Para tanto, em termos teóricos, inicialmente, propõe-se uma extensão do trabalho de Botta (2009). Nesse caso, seguimos a literatura econômica recente que tem demonstrado que o nível da taxa real de câmbio real possui um papel relevante nos determinantes das elasticidades do comércio internacional por meio de sua influência na estrutura produtiva da economia. Desta forma, o nível da taxa real de câmbio não é neutra no longo prazo, uma vez que ela está relacionada à maiores taxas de crescimento de produto *per capita*. Logo, na análise a ser desenvolvida, o nível de taxa real de câmbio importa por afetar a participação do setor industrial na economia do Sul e a taxa de crescimento econômico compatível com o equilíbrio no Balanço de Pagamentos. O maior nível de complexidade econômica influencia a taxa de crescimento do Sul a depender das magnitudes das elasticidades das taxas de crescimento das exportações e importações, respectivamente, em relação aos efeitos que o nível de inovação, estoque de conhecimento e capital humano possuem sobre elas. Em seguida, desenvolve-se a análise empírica a partir de uma amostra representativa de economias em desenvolvimento ou emergentes. As estimações por meio de dados em painel permitem observar que taxas de câmbio excessivamente apreciadas podem aumentar a heterogeneidade estrutural das economias afetando de maneira particularmente negativa a indústria manufatureira, implicando em uma especialização produtiva regressiva, principalmente em economias não desenvolvidas. Além disso, as evidências empíricas sugerem que taxas de câmbio reais depreciadas e a participação da indústria manufatureira possuem efeitos positivos e significativos sobre o nível de complexidade econômica da amostra de economias.

Área 4: Economia industrial e mudança estrutural

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1. Introduction

A growing literature has shown evidences indicating undervalued RER levels are positively associated with higher *per capita* growth rates. These evidences are robust to different estimation techniques, such as cross section OLS, fixed and random effects panel data, dynamic panel data (GMM), non-linear panel estimations and cointegration analysis.

Rodrik (2008) as well as Rapetti, Scott and Razmi (2012), among others, verified significant differences between developed and developing countries, even when the threshold of GDP *per capita* is different in the definition of the developing countries´ samples. Such differences are similar in other works as in Dollar (1992), Gala (2008), Razin and Collins (1999).

Other studies have tested whether these results are robust to measurement errors. For instance, MacDonald and Vieira (2010) constructed seven different RER misalignment variables. Even so, they found a significant and positive association between RER (undervalued) and economic growth.

According to Frankel and Rapetti (2014, p.5) the causality runs from RER levels to economic growth, although there might be room for debate, as highlighted for the authors. A rather important question concerning this relationship is about the mechanisms explaining how undervalued RER levels would affect economic growth. The strongest mechanism is that rests on the important role played by the modern tradable activities play in the process of economic development. In other words, economic development consists of structural change, investment in new activities, and the acquisition of new productive capabilities (Rodrik, 2008).

These productive capabilities and knowledge cannot be learned easily by workers or entrepreneurs. According to Hausmann and Hidalgo *et al.* (2011) this kind of knowledge also requires structural change, i.e, developing a new industry requires changes in the pattern of interactions inside de organizations and economic sectors. Besides, the speed each country conducts structural transformation is a key factor that differentiates the income expansions and productivity gains (McMillan, Rodrik and Verduzco-Gallo, 2012).

According to the Kaldorian and Structuralist approach manufacturing represents the main important tradable sector, though some sophisticated services (e.g. finance services, software engineering, and so on) and knowledge-intensive agricultural activities (as seed production) also play important role in the structural change process. Given these features the reallocation of resources to the modern tradable activities can accelerates economic growth.[3] In other words, the labor flow from low productivity activities to high-productivity activities is an important driver of economic development (McMillan *et. al.*, 2012). The main hypothesis concerning this role played by manufacturing toward a more sophisticated economy can be tested through the analysis of how each sector, in aggregated terms, impact economic complexity in the framework developed by Hausmann and Hidalgo *et al.* (2011), as we do in this work.

In a different approach, in *à lá* Thirlwall´s models, the demand side of the economy is a factor of extreme importance to the process of industrialization and structural change, as emphasized by the Balance of Payment Constraint Growth Models (BoPC)´s models, such as in Botta (2009). In this approach assymmetric productive structures give rise to economic growth alongside an external constraint, as in Thirlwall (1979) and McCombie and Thirlwall (1994), among others. Furthermore, the productive specialization in mature or stagnant technology sectors may reduce the competitiveness of these countries´ production, reinforcing the existing external constraint and the own capacity to expand demand, diminishing the potential for economic growth. Thus, different productive structures generate differentiated growth trajectories.

In such framework long run growth is demand constrained and the level of RER is neutral on growth dynamics because only continuous depreciation could foster it. However, there are robust evidences that RER is an important determinant of tradable profitability and capital accumulation

[3] From an endogenous growth model, Rodrik (2008) demonstrates that the reallocations of resources in non-tradable activities can slower economic growth.

(Frankel and Rapetti, 2014). So, the level of RER influences the long run supply of the domestic tradable sectors.

According to McMillan *et al.* (2012, p.26-27) the great difference between Asia and both Latin America and Africa productivity performance is accounted for the differences in the pattern of structural change. Since 1990 structural change in Latin America, in special, has been growth reducing, with labor force moving to less productivity activities, notably in services and informality. In large part this process occurred because countries in Latin America, most notably Brazil and Argentina, has liberalized their economies with overvalued RER in a context of disinflationary monetary policies or short term foreign capital inflows.

In light of the above mentioned literature, the objective of this work is twofold. Firstly, it is presented a structuralist North-South model of economic growth, where RER, manufacturing and the economic complexity play important roles in the catching up process in a BoPG framework. Secondly, empirical tests are conducted to analyze the main interrelationships presented in the model: if manufacturing plays an important role to the growth of economic complexity of different countries samples and how RER impacts different economic sectors.

To fulfill the proposed objectives this paper is divided into four other sections, besides this introduction. In the second section the discussion about economic growth, RER and economic complexity is deepened. So, it is possible to understand that countries that manage to grow faster are those that are able to diversify away from agriculture and the economic activities based on natural resources. In the third section is presented a structuralist North-South simple model of economic growth, RER and economic complexity. In the fourth section are presented panel data estimations about the main interrelationship highlighted in model. Finally, in the fifth section are developed the concluding remarks.

2. **RER, Economic Growth and Economic Complexity**

One of most central insights on economic development is that this process implies structural change. The conventional literature highlights that the structural change can occur as a result of Engel´s Law (Engel 1895, Houthakker, 1957), or by the productivity growth trend (e.g. Baumol, 1967) or yet by some combination of the transformation into the production system (and labor) of the different sectors (Duarte e Restuccia, 2010)[4].

According to Bresser-Pereira (2014), to the classical economists the productivity growth would come from the change from low qualificated activities to higher qualificated activities, through technological sophistication. In the same sense, when labor and other resources move from less productive to more productive activities, the economy grows at higher rates. So high-growth countries are typically those that have been able to experience growth-enhancing structural change (McMillan, Rodrik and Verduzco-Gallo, 2013, p.11).

To Kaldor (1967) and Rodrik (2006), there are special features of the industrial sector that make it a source of dynamism and engine of long-term growth, mainly to developing countries. As this sector develops, externalities among firms and the productive sectors, along with their macroeconomic and distributive effects, may produce sudden leaps in the growth process or may block it (Rosenstein-Rodan, 1943). In doing so, it can generate successive phases of imbalances, given the capacity of industrial activities to be important vectors of the dynamism spreading in the economy, through its high backward and forward linkages (Hirschman, 1958). As highlighted by

[4] A broad view of the development process, dating back to Kuznets (1973), also includes the commercialization of domestic production and the introduction of modern technologies in the household. According to this author: "The rate of structural transformation of the economy is high. Major aspects of structural change include the shift away from agriculture to non-agriculture pursuits, and, recently, away from industry to services; a change of the scale of productive units, and a related shift from personal enterprise to impersonal organization of economic firms, with a corresponding change in the occupational status of labor." (Kuznets, 1973, p. 248). To a general overview about the theoretical and empirical literature on structural change, see Matsuyama (2008) and Herrendorf *et al.* (2013a).

Ocampo (2005), these approaches imply, in short, that the dynamics of production structures are an active determinant of economic growth.

In this context, if the dynamics of the production structures matter to growth, then the question arises as to what are the variables capable of promoting structural change towards to modern tradable activities. In this work we present that the level of the real exchange rate (RER) is an important variable to this process. That is, following the argument of the classical development economists (Nurkse, Myrdal, Rosestein-Rodan, Hirschman, Myrdal, Prebisch and Furtado), a change in the productive structure toward the industrial sector is desirable to developing economies, given the inherent characteristics of this sector in increasing returns to scale, high synergies, and linkages effects. The point to be emphasized is that we include the RER as a variable capable of inducing industrial development and the associated technical progress.

Thus, at the same time this approach is away from the canonical Thirlwall model (and its further developments), which kept a certain skepticism about the exchange rate, justified by the belief in the inability of undervalued RER to produce changes in production or industrialization (Díaz-Alejandro , 1963, Krugman and Taylor, 1978, Arida and Bacha, 1984, Fajnzylber, 1988), we are close to the approach of two more recent developments within post-Keynesian tradition, namely: i) the theoretical developments and empirical findings that show the importance of the RER on structural change and growth and ii) the Developmental Macroeconomics, which places the real exchange rate at the center of the theory of economic development (Bresser Pereira, 2012, 2015).

Regarding this last point, according to Bresser-Pereira (2012, p.8):

> *"Usually this macroeconomic price is not considered part of the development theory because it is presumed either that it floats gently around the current equilibrium, as in neoclassical theory, or that it floats in a volatile manner around this equilibrium, as in Keynesian theory. It would therefore be a short-term problem to be studied by macroeconomics. However, if instead of that we assume that the exchange rate tends to appreciate cyclically, it's easy to understand why it remains chronically overvalued, and therefore it is an issue of medium term also to be studied by development economics. An overvalued exchange rate prevents modern and efficient companies in developing countries have access to the international market."*

In line with the literature analyzed, in the next section we develop a formal structure that is compatible with the following stylized growth facts:

i. Economic development requires productive diversification;
ii. Developing countries with higher growth rates are those with the most significant industrial sectors (especially in manufacturing);
iii. The growth acceleration is associated with structural changes towards the modern tradable sector;
iv. The productive diversification is not associated with well-endowed countries with natural resources and primary products.
v. The maintenance of a competitive RER favors the development of the tradable sector and thereby increases the average productivity of the economy (the production of these goods generates positive dynamic externalities throughout the economy in order to learn from competition in foreign markets and generate more learning to the firm that compete in this markets);
vi. Undervalued RER stimulates the investment in the modern export oriented tradable sector because it increases the profitability of the firms;
vii. Stable and competitive RER stimulates the technological progress (firstly, because much of this progress is a consequence of capital accumulation, since new technologies are usually incorporated into new machines and equipment, secondly, because by guaranteeing the profitability of the tradable sectors, the capacity of financing the innovative activities of the firms is improved).

By the last stylized fact is highlighted that RER can increase the firms capabilities regarding its innovative activities, such as Research and Development (R&D) as well as stimulate new investments in the modern tradable sector (specially, in manufacturing)[5]. In doing so, a country productive diversity grows. Differently, natural resources products, such as niobium, uranium or diamond are more dependent of international demand and new markets (among other factors) but not of the RER levels.

Hausmann and Hidalgo *et al.* (2011) developed a measure of economic complexity which diversity and ubiquity are approximations of the variety of capabilities available in an economy. Whilst more diversified and less ubiquitous products tend to demand large quantities of capabilities and knowledge, such as an aircraft, more ubiquitous products (e.g. cloths) or less ubiquitous products based on scarcity, such as niobium (and other natural resources), reflects the need of less capabilities and knowledge[6]. Insofar RER affects the modern tradable sector, it follows that it can promote or damage the economic complexity of a country. This hypothesis is modeled in section 3 and tested in section 4.

3. A Structuralist North-South model of economic growth, Real Exchange Rate and Economic Complexity: a simple model

The starting point of the present model is the work of Botta (2009), which represents a benchmarking in the structuralist macroeconomics approach. Botta (2009) puts in evidence important post-Keynesian and evolutionary elements. In addition to addressing how structural change and different industry shares in the GDP affect uneven economic development between North (developed country) and South (a developing country). However, in its original model the effects of the real exchange rate (RER) and economic complexity are not taken into account. Thus, our aim here is to make advances in these two aspects, mainly.

Following the structuralist approach and the demand-driven economic growth view, North-South productive asymmetries limit the economic growth of developing countries through their Balance of Payment constraints on growth. Moreover, the emphasis on domestic industrialization as the key factor for North-South convergence is in accordance with the Kaldorian and neo-structuralist literature, which emphasizes the fundamental role of industry as an activity of increasing returns to scale and dynamic economies. The latter refers to the increasing incomes brought about by technological progress induced by learning (specifically learning by doing) and by economies of scale.

A productive regime and a pricing dynamic are defined for the North and the South. In relation to the first, we have:

$$q_{nt=}r + \alpha_n g_{nt-1} \quad (1)$$

$$q_{st=}r + \alpha_s g_{st-1} \quad (2)$$

According to equations (1) and (2) the labor productivity growth rate q_{st} (South) and q_{nt} (North) depends on endogenous and exogenous components. The exogenous component is represented by r and is equal across countries, for the sake of simplicity. The endogenous component α is a parameter that depends positively on the growth rate of the industry share in the economy g_{t-1} (in terms of value added). This component generates the Kaldor-Verdoorn cumulative effect. [7]

[5] The variable cash flow and sales, lagged in one period, are the main determinants of investment in R&D (Hall, 1992; Himmelberg and Petersen, 1994; Harhoff, 1998). These variables are directly affected by the RER.

[6] Of course, low ubiquity can come from the need of large capabilities and knowledge. In this case the products are more complex, such as X-Ray Machines, computerized tomography machines (CAT scan).

[7] Traditionally, according to Botta (2009), the economic literature on the effects of Kaldor-Verdoorn uses the growth rate of the aggregate product or the rate of growth of the industrial product.

It is assumed a constant mark-up rate, prices and monetary wages for the North and South are defined as:

$$p_{nt} = w_{nt} - q_{nt} \quad (3)$$

$$w_{nt} = r + \rho_n \alpha_n g_{nt-1} \quad (3a)$$

$$p_{st} = w_{st} - q_{st} \quad (4)$$

$$w_{st} = r + \rho_s \alpha_s g_{st-1} \quad (4b)$$

The prices are defined by the difference between the monetary wage inflation (w) and labor productivity growth rate (q). Moreover, according to structuralist theory, monetary wage inflation is an institutional variable, depending on the bargaining power of workers and the government´s income distribution policies.

Following Botta (2009)´s model it is assumed that the exogenous component of labor productivity growth (r) is totally transferred to wages, both in the North and in the South. The endogenous component of the labor productivity growth rate affects wages by means of the parameters ρ, where $\rho_n \leq 1$ and $\rho_s \leq 1$.

In dynamic terms, the BP constraint, without capital flows, is:

$$p_{st} + x_{st} = p_{nt} + m_{st} \quad (5)$$

For all $t = 1 \ldots \infty$, with:

$$x_{st} = \beta_n(p_{nt} - p_{st}) + \varepsilon_n y_{nt} + \beta_{cx}(G) \quad (6)$$

$$m_{st} = \beta_s(p_{st} - p_{nt}) + \varepsilon_s y_{st} - \beta_{cm}(G) \quad (7)$$

In equations (6) and (7) x_{st} and m_{st} represent the growth rates of exports and imports from the South (in terms of quantum), respectively. The variables y_{st} (for the South) and y_{nt} (for the North) represent the growth rates of income, β_s represents the price elasticity of imports from the South and β_n the price elasticity of exports from the North, and ε_s and ε_n are the income elasticities of imports and exports from the South, respectively. Finally, G represents the variable of economic complexity and β_{cx} and β_{cm} represent the elasticities of the growth rate of exports and imports, respectively, in relation to the changes in the level of economic complexity from the South.

Hausmann and Hidalgo *et al.* (2011) define the complexity of an economy as the multiplicity of useful knowledge embedded in the economic system. In this way:

> "For a complex society to exist, and to sustain itself, **people who know about design, marketing, finance, technology, human resource management, operations and trade law must be able to interact and combine their knowledge to make products**. These same products cannot be made in societies that are missing parts of this capability set. **Economic complexity, therefore, is expressed in the composition of a country's productive output and reflects the structures that emerge to hold and combine knowledge."** Hausmann and Hidalgo *et al.* (2011, p, 18) – added emphasis.

From this, formally G (economic complexity) follows the following function:

$$G = \kappa(I_s - I_n) + \psi(H_s - H_n) + \zeta(T_s - T_n) \quad (8)$$

In the equation above, the level of economic complexity depends on the innovative activities (I), the level of human capital (H) and the stock of knowledge (T), all in terms of their difference between the North (developed) and the South (a developing economy). The parameters κ, ψ and ζ capture the elasticity of the innovative activities, human capital and the stock of knowledge, respectively, in relation to the level of economic complexity of the economy. By this equation (8) it can be expressed the capabilities of the South´s economy in aggregate terms as cross-sector and economy-wide factors that influences economic complexity.

Innovative activities (I) are all those carried out internally by the firms, which involve research and development (R&D). In this way, there is no incorporation of any possibility of absorption of technological spillovers from the North.

The concept of human capital used in (8) is related to the neoschumpeterian (or evolutionary) perspective, which relates the educational formation of the workers, as well as the training of the workforce, as proxies for technological training and learning potential capability, which can affect growth through increased productivity and, later, by the Kaldor-Verdoorn mechanisms, the economic growth compatible with the restriction in the Balance of Payments.[8]

The stock of knowledge in (8) refers to the productive knowledge available in the economy already used by existing companies. It is easier for countries to produce new goods or provide new services from the knowledge they already have as long as this means adding little or no new productive knowledge. This process depends on the social accumulation of productive knowledge (Hausman and Hidalgo *et al*., 2011).

Substituting equations of (1) to (1.4b), (6) and (7) into (5), it can be obtained the growth rate of the South consistent with the Balance of Payments constraint:

$$y_{st} = \frac{(\beta_s+\beta_n-1)[(w_{nt}-w_{st})+\alpha_s g_{st-1}-\alpha_n g_{nt-1}]}{\varepsilon_s} + \frac{\varepsilon_n}{\varepsilon_s} y_{nt} + \frac{(\beta_{cx}+\beta_{cm})[\kappa(I_s-I_n)+\psi(H_s-H_n)+\zeta(T_s-T_n)]}{\varepsilon_s} \quad (9)$$

Equation (9) implies that the growth rate consistent with the equilibrium in the Balance of Payments depends on the growth rate of the North, on the exports and imports elasticities ratio, on the price competitiveness expressed by the difference between the wage growth rates and the productivity differentials growth rate associated with the share of the manufacturing in the economy, that is, the effect of the Kaldor-Verdoorn Law and extra-price competitiveness. In the equation (9) we consider $\beta_s + \beta_n > 1$, in the way that Marshall-Lerner´s condition is valid.

Regarding the extra-price competitiveness, it can be observed that, for the South, the growth rate of human capital, the stock of knowledge and innovation, *per se*, does not increase the South rate of economic growth compatible with the equilibrium in the BP, since they depend on their interaction with the elasticities of the growth rate of exports and imports in relation to the changes in the level of economic complexity from the South $(\beta_{cx} + \beta_{cm})$. Formally:

$$\frac{\partial y_{st}}{\partial(I_s-I_n)} = \frac{\kappa(\beta_{cx}+\beta_{cm})\varepsilon_s-\varepsilon_s'[(\beta_{cx}+\beta_{cm})G]}{\varepsilon_s^2}>0 \quad \text{if} \quad \kappa\varepsilon_s > \varepsilon_s'(G), \quad (9a)$$

$$\frac{\partial y_{st}}{\partial(H_s-H_n)} = \frac{\psi(\beta_{cx}+\beta_{cm})\varepsilon_s-\varepsilon_s'[(\beta_{cx}+\beta_{cm})G]}{\varepsilon_s^2}>0 \quad \text{if} \quad \psi\varepsilon_s > \varepsilon_s'(G), \quad (9b)$$

$$\frac{\partial y_{st}}{\partial(T_s-T_n)} = \frac{\zeta(\beta_{cx}+\beta_{cm})\varepsilon_s-\varepsilon_s'[(\beta_{cx}+\beta_{cm})G]}{\varepsilon_s^2}>0 \quad \text{if} \quad \zeta\varepsilon_s > \varepsilon_s'(G), \quad (9c)$$

$$\frac{\partial y_{st}}{\partial G} = \frac{(\beta_{cx}+\beta_{cm})}{\varepsilon_s} >0 \quad \text{if} \quad |\beta_{cx}| > |\beta_{cm}| \quad (9d)$$

[8] This definition of human capital used is also well synthesized by Lall (1992, p.170), where: "*(...) the term human capital is used broadly here to include not just the skills generated by formal education and training, but those created by on-the-job training and experience of technological activity, and the legacy of inherited skills, attitudes and abilities that aid industrial development.*"

In order to the partial derivatives in (9a) to (9c) to be positive, it is necessary that the parameters (elasticities) of the innovative activities, human capital and the stock of knowledge, respectively, are higher than the growth rate of the income elasticity of imports (ε_s'), a plausible situation for a developing economy, in a context of catching up. In other words, as G influences positively the South´s exports toward more sophisticated goods, there is a trend to reduce the South import income elasticity over time. Thus, formally, $\varepsilon_n' > \varepsilon_s'$.

By means of these partial derivatives it can be observed that the economic growth rate compatible with the Balance of Payment equilibrium depends on how the relevant amount of knowledge of the economy influences the international trade of the South and, consequently, its economic growth. For a developing economy, the growth rate compatible with the intertemporal equilibrium of the BP imposes $|\beta_{cx}| > |\beta_{cm}|$ and $\varepsilon_n > \varepsilon_s$ (situation of sustainable converge, which will be better explained below).

In this sense, we are following Thirlwall (2002, p.54), where exports differ from other components of demand in three important respects. Firstly, exports are the only true component of autonomous demand in an economic system.[9] Secondly, exports are the only component of demand that can pay for the import requirements for growth. Although, according to Thirlwall (idem) the process may be possible to initiate consumption-led growth, investment-led growth or government expenditure-led growth for a short time, but each of these components of demand has import content. So, exports are of great significance if Balance of Payments equilibrium on current account is a long-run requirement. What it means is that exports have not only a direct effect on demand, but also an indirect effect by allowing all other components of demand to rise faster than otherwise would be the case. The third important aspect of exports is that imports (permitted by exports) may be, in the short run, more productive than domestic resources because certain crucial goods necessary for development are not produced in the South. In this model this ability to produce more productive goods in the South depends crucially of G and g_{st}.

Botta (2009) assumes a fixed exchange rate. However, as presented in section 2, the real exchange rate (RER) level has a relevant role in the determinants of trade elasticities through its influence on the productive structure of the economy.

The change in the RER follows the function:

$$e = \phi(\theta_r^* - \theta_r) \qquad (10)$$

In this formulation we are following Ferrari *et al.* (2013). In this case, $\phi \gtreqless 0$, θ_r^* represents the real exchange rate target (determined by the monetary policy makers) and θ_r the RER compatible with a BP equilibrium. In a simplified way, θ_r is one in which there are no changes in exchange currencies reserves and is at a level compatible with the stability of domestic prices.

The growth rate of the industry share (in terms of value added) in the South is a function of the level of the real exchange rate as defined in (10), that is, $g_{st} = f(e)$, such that:

$$g_{st} = \phi(\theta_r^* - \theta_r) \qquad (11)$$

The idea underlying equation (11) is that since firms in the South are operating below the technological frontier and therefore at a disadvantage from the point of view of non-price competitiveness, they need to compensate for this disadvantage with some competitive price advantage, which is represented here by means of a real exchange rate greater than θ_r. Besides, if $\theta_r^* > \theta_r$, $g_{st} > 0$, in other words, an undervalued RER can improve industrial profitability fostering its growth in terms of value added. Conversely, overvaluation can reduce the tradable industries

[9] The major part of consumption and investment demand is dependent on the growth of income itself (Thirlwall, 2002).

share in the South economy, mainly because it damages the firms that operate at tight profit margins[10]. So:

$$\frac{\partial g_{st}}{\theta_r^*} > 0 \text{ if } \theta_r^* > \theta_r \rightarrow \phi > 0 \quad (11a)$$

$$\frac{\partial g_{st}}{\theta_r^*} < 0 \text{ if } \theta_r^* < \theta_r \rightarrow \phi < 0 \quad (11b)$$

In this way, the dynamic of the growth rate of manufacturing in the South´s economy has effects on the income growth rate of this region. By means of equation (9) we can observe that the greater g_{st}, the greater y_{st}. However, this growth will also affect m_{st} (equation 7), that is, the growth rate of imports. In this case, this process will only be sustainable if $|\beta_{cx}|>|\beta_{cm}|$, since the elasticity of the export growth rate (equation 6) in relation to the economic complexity is higher than that found in imports.

According to Tregenna (2009) the growth pulling properties of manufacturing operate mainly through value added share and output. Firstly, the manufacturing effects through backward and forward linkages with the rest of an economy are more related to manufacturing share in GDP and growth of manufacturing output than its share of employment or growth in manufacturing employment. This occurs because if this sector is growing, then this can give rise to higher demand for inputs from backward-linked sectors as well as providing stimulus and potentially lower input costs to forward-linked sectors.

Secondly, as learning-by-doing applies not only at the level of individual workers but also in terms of management and the planning of production and technology, manufacturing output is also relevant. The learning-by-doing process is one channel of this endogeneity of manufacturing productivity growth to manufacturing output growth. Besides, it is the output of manufacturing (both in level and its share) that is most relevant to its net balance of payment position (Tregenna (2009, p.440).

Although in the modern tradable sector there are many knowledge-intense services (or sophisticated services), Guerrieri e Meliciani (2005) have found that the development of an internationally competitive service sector depends on manufacturing. In particular, they find that knowledge-intensive industries (e.g. chemical and pharmaceutical industries, computer equipment, communication equipment, among others) are the main users of financial services, communication and business services (various kind of services provided to companies).

To a large extent, this result is also corroborated by Marconi (2015), in spite of the growth of the services sector in the productive structure of several countries, there are evidences that the smaller participation of the manufacturing industries generates lower growth in the modern service sector in detriment of the growth of services with lower *per capita* value added, productivity and related technological content, which produces less productive sophistication and, in turn, lower rates of economic growth. More importantly, to the point of view of structural change, RER is determinant of industrial tradable profitability and therefore the capital accumulation of this sector (Frenkel and Rapetti, 2014).[11]

In this model, the industry (specially manufacturing) is an important source of economic complexity in the economy, in other words, directly influencing *G*. This occurs because manufacturing offers greater opportunities to the progress of incorporated technologies in the goods, increasing the use of capabilities by the firms and the learning by doing processes. Besides, this sector has higher capacity of technological diffusion to other sectors and so it presents better

[10] Initially, the lack of a diversified economy in the South, which is reflected in lower extra price competitiveness, must be compensated by an undervalued RER. With the growing manufacturing share in the South (if $\phi > 0$), the extra price competitiveness may increase the embodied and disembodied technology.

[11] According to Marconi (2015, p. 31), "productive sophistication" occurs when there is an increase in production participation in sectors with higher value added per worker. These sectors demand more qualified workers, that is, with a higher level of human capital, increasing the potential of value added in the goods and productivity.

features for knowledge diffusion. Part of this dynamic occurs because of the so-called productive linkages and spillovers effects, which are stronger in this sector.

In order to simplify the analysis of equation (9), let us assume that the wage structures of the North and South regions are the same and the growth rates of the manufacturing industries in relation to the two regions are not different. In this way, (9) becomes:

$$y_{st} = \frac{\varepsilon_n}{\varepsilon_s} y_{nt} + \frac{(\beta_{cx}+\beta_{cm})G}{\varepsilon_s} \quad (12)$$

Analyzing the equation (12), we can say in what circumstances the South will be able to grow sustainably or not:

a) If $\varepsilon_n > \varepsilon_s$ and $|\beta_{cx}| > |\beta_{cm}|$ there is sustainable convergence: this situation occurs when $(\varepsilon_n/\varepsilon_s)$>1, i.e., meaning that the South´s current account is either in equilibrium or shows a surplus. In this case a greater amount of knowledge is used in the exports from the South. A more diversified and less ubiquitous basket of products (not based on scarcity) are sold to the international markets as well as the South is less dependent of the North economic rate of growth.
b) If $\varepsilon_n > \varepsilon_s$ and $|\beta_{cx}| < |\beta_{cm}|$ there is not sustainable convergence: this situation occurs when $(\varepsilon_n/\varepsilon_s)$>1, i.e., meaning that the South´s current account is either in equilibrium or shows a surplus. Besides the exports from the South are not knowledge-intensive products and it is dependent of natural resources or low skilled workers. In this situation the South is either more dependent of the North economic rate of growth or goods exports heavily based on natural resources.
c) If $\varepsilon_n < \varepsilon_s$ and $|\beta_{cx}| < |\beta_{cm}|$ there is divergence: this situation occurs when $(\varepsilon_n/\varepsilon_s)$<1, i.e., meaning that the South´s current account is either in disequilibrium or shows a deficits and, similarly to the last case, the exports from the South are not knowledge-intensive products and it is dependent of natural resources or low skilled workers. The divergence process occurs independent of the magnitude of North´s economic rate of growth.
d) If $\varepsilon_n < \varepsilon_s$ and $|\beta_{cx}| > |\beta_{cm}|$ there is not sustainable convergence: this situation occurs when $(\varepsilon_n/\varepsilon_s)$<1, i.e., meaning that the South´s current account is either in disequilibrium or shows a deficits but the basket of products exported exhibit knowledge-intensive products and is dependent of high skilled workers. This case scenario could occur when there is biding constraint of imports of the North or high barrier to entry.

4. Productive Structure, RER and Economic Complexity: panel data estimations

As it was discussed in the sections 2 and 3, manufacturing industries represent the most important tradable sector, mainly to developing countries. Given these features the reallocation of resources to the modern tradable activities can accelerates economic growth. Different sectors are influenced by RER in very different manners. If manufacturing is affected in a negative way economic growth can be hampered, as the North-South model demonstrated in section 3 (equations 9 and 11). In the same way, economic complexity can be reduced or its rate of growth may slow down, hampering sustainable economic growth and the increase of exports with more knowledge-base content from the South, which are very important for the Balance of Payment equilibrium (equation 6, 7 and 9) and convergence (analysed from equation 12) .

In this section it is tested how the different sectors (in aggregated terms) of 118 economies respond to a measure of RER (Appendix 1 presents the sample of countries). This sectors are divided by the *International Standard Industrial Classification* (ISIC) (see Table 1). The variable *misxrate* is calculated from 3 steps (Rodrik, 2008). First it is used the nominal exchange rates from the countries ($XRAT_{it}$) and the conversion factor of purchasing power parity (PPP_{it}) to calculate the real exchange rate (RER_{it}):

$$lnRER_{it} = ln(XRAT_{it}/PPP_{it}) \quad (13)$$

where the index *i* are the 118 countries in the sample and *t* the time index, which in this work are 22 years (1990-2011). The variables $XRAT_{it}$ and PPP_{it} are expressed in terms of dollars. RER values above one indicate that the value of the national currency is more undervalued than indicated by the purchasing power parity (PPP_{it}). However, the non-tradable sector is also cheaper in poorer countries (through the Balassa-Samuelson effect), which requires an adjustment. Thus, in the second step it takes into account this effect regressing RER_{it} in relation to *per capita* GDP:

$$lnRER_{it} = \alpha + \beta ln\ (PIBpc_{it}) + f_t + u_{it} \quad (14)$$

where f_t is the fixed effect for the period of time and u_{it} is the idiosyncratic error term.

Finally, in order to calculate Rodrik (2008)´s $misxrate_{it}$ indicator, it is estimated the following equation:

$$ln(misxrate_{it}) = lnRER_{it} - ln\widehat{RER}_{it} \quad (15)$$

Defined this way, the variable $misxrate_{it}$ is comparable between the panels of countries over time. When $misxrate_{it}$ it is above the unity, we have the real exchange rate (RER) is set so that the domestically produced goods are relatively cheaper in terms of dollar, that is, the exchange rate is undervalued. Conversely, when $misxrate_{it}$ is below the unity, the real exchange rate is overvalued.

In the Table 1 is briefly described all the variables used in the estimations.

Table 1 – Description of the variables used in the models, its measures and sources

Abbreviations	Brief variable description	Source
pibpc	*per capita* GDP in real terms (US$ dollars - 2005).	IMF
tcpibpc	Real per capita GDP growth rate.	IMF
vamanu	Manufacturing sector share to GDP (value added , in %) - 15-37 divisions from the *International Standard Industrial Classification* (ISIC)*.	WDI- GGDC
vaprim	Primary sector share to GDP (value added , in %) - 1-5 division from *International Standard Industrial Classification* (ISIC)*.	WDI- GGDC
vaserv	Services sector share to GDP (value added , in %) - 50-99 divisions from *International Standard Industrial Classification* (ISIC)*.	WDI- GGDC
gaptec	Technological gap between countries from Verspargen (1993) methodology.	Author´s own elaboration based on PWT 8.0
misxrate	RER adjusted by the Balassa-Samuelson effect according to Rodrik (2008) – undervaluation measure.	Author´s own elaboration based on PWT 8.0
ppp	Purchasing Power Parity (PPP) in relation to GDP of each country measured in US$ units of 2005.	PWT 8.0
xrat	Nominal exchange rate for each country in terms of USA dollars.	PWT 8.0
rer	RER adjusted by the Purchasing Power Parity (PPP).	Author´s own elaboration based on PWT 8.0
txinfla	Annual inflation rate (from the *Consumer Price Index* – CPI, for each country)	WDI
ainv	Gross fixed capital formation as a proportion of annual GDP.	WDI
govexp	Government consumption in terms of goods and services in relation to GDP in real terms.	*World Bank*
ttrade	Terms of trade: index calculated as the percentage ratio of the unit export value	WDI

	index in relation to the unit import value index - base year 2000.	
eci	Hausmann and Hidalgo *et al.* (2011) complexity indicator	MIT

Source: Author´s own elaboration.
Note: * Revision 3.0 of the *International Standard Industrial Classification* for economic activities of the United Nations Statistics Division (UNSD); Value added is the net product of the economic sector after adding the gross value of the entire product and subtracting the intermediate goods involved in the production process. It was calculated without taking into account deductions for depreciation, depletion and degradation of natural resources. Relative participation (%) calculated at constant prices in terms of 2005 dollars. IMF - *International Monetary Fund*; WDI - *World Development Indicators*; PWT - *Penn World Tables* 8.0 (see Feenstra *et al*., 2015) and MIT - *Massachusetts Institute of Technology*. GGDC - *Groningen Growth and Development Center*.

The following panel data econometric models are tested:

$$vamanu_{it} = \beta_0 + \beta_1 misxrate_{it} + \beta_2 gaptec_{it} + \beta_3 \sum_{J=3}^{K} \beta_j Z_{i,tj} + \mu_t + \eta_i + u_{it} \quad (16)$$

$$vaprim_{it} = \beta_0 + \beta_1 misxrate_{it} + \beta_2 gaptec_{it} + \beta_3 \sum_{J=3}^{K} \beta_j Z_{i,tj} + \mu_t + \eta_i + u_{it} \quad (17)$$

$$vaserv_{it} = \beta_0 + \beta_1 misxrate_{it} + \beta_2 gaptec_{it} + \beta_3 \sum_{J=3}^{K} \beta_j Z_{i,tj} + \mu_t + \eta_i + u_{it} \quad (18)$$

$$eci_{it} = \beta_0 + \beta_1 misxrate_{it} + \beta_2 gaptec_{it} + \beta_3 vaprim_{it} + \beta_4 vamanu_{it} + \beta_4 vaserv_{it} + \beta_3 \sum_{J=3}^{K} \beta_j Z_{i,tj} + \mu_t + \eta_i + u_{it} \quad (19)$$

Where $vamanu_{it}$ is the variable that represents the share of the manufacturing industries in terms of its value added in GDP, $vaprim_{it}$ represents the share of the primary sector in terms of its value added in each country and $vaserv_{it}$ represents the share of the service sector in terms of its value added in each country; eci_{it} is the variable of economic complexity, calculated by Hausmann and Hidalgo *et al*. (2011). The variable $misxrate_{it}$ is the undervaluation index taking in account the Balassa-Samuelson effect, $gaptec_{it}$ represents the technological gap and $Z_{i,tj}$ are the K variables of control to each country *i*, over time *t*. The β_j´s are the parameters to be estimated, μ_t is the time specific effect, η_i captures the non-observed effects of each country *i* that are invariant over time and u_{it} is the idiosyncratic error term.

The control variables used to estimate equation (16-19) follow the literature on economic growth and structural change (Bhalla, 2012, Szirmai and Verspagen, 2011, Rodrik, 2008, among others) and can be classified according to the following variables (i) government liabilities: the share of government expenditure in per capita GDP (*govexp*) is used as a proxy; (ii) stabilization policies: the average inflation rate (*txinfla*); the technological gap (*gaptec*) is defined following the methodology used by Verspagen (1993), among others. In this case the technological leader is the United States and its *per capita* GDP is a proxy for productivity; iv) gross fixed capital formation as a proportion of annual GDP (*ainv*) as a proxy for aggregated investment; v) the population growth rate (*tcpop*), which affects negatively the average *per capita* income and thus the countries´ rate of growth and vi) terms of trade (*ttrade*), which inversely, affects economic growth.

A higher technological gap, government consumption share or high population growth rates tend to make countries grow more slowly. In the same direction, economies with high inflation rates tend to grow less than a situation with more stable prices. Conversely, economies with high levels of investments tend to have higher economic growth rates. Moreover, a worsening of the terms of trade will tend to depreciate the RER, which can boost economic growth.

The first model estimated is from equation (16). In order to choose between fixed and random effects we used the Hausman (1978) test. The results show that the null hypothesis of the non-systematic coefficients is rejected for both samples, indicating the fixed effects model. We used the modified Wald test for heteroskedasticity in regression models with fixed effects and the

Wooldridge test for serial correlation in the panel model. Results indicate that the errors of the model are serially correlated and heteroskedastic, both results with 1% statistical significance. Moreover, the Collin test (Ender, 2015) was applied and the problem of multicollinearity was not detected (the VIF, i.e., the variance inflation factor average was as low as 1,10).

In this context, we used the Generalized Least Squares (GLS) method, which corrects for heteroskedasticity and autocorrelation. For the latter the autoregressive component of idiosyncratic error term is modeled as a "*within*" AR(1) process and the heteroskedasticity was modeled for each panel.

In Table 2 the results are presented. It can be observed that the undervalued real exchange rate positively affects manufacturing industries and with statistical significance all samples, but with higher magnitude in the emerging or developing economies when compared to the broad and advanced economies. Moreover, a high technological gap has a negative sign but it is not statistically significant for the advanced economies and it is positive, but not statistically significant for the sample of emerging economies. The control variable *ainv* obtained the positive and significant sign for the broad sample of advanced economies and a positive but not statistically significant to the emerging economies. The *txinfla* variable was positive and significant for all three estimations. The *tcpop* control variable presents a negative and statically significant sign, except for advanced economies. Finally, *govexp* presents a negative sign in the broad sample and in the advanced economies sample, but it was statistically significant only for the last one.

Table 2 – Panel GLS (*Generalized Least-Squares*) estimations for advanced or developed countries and emerging or developing countries - 1990 – 2011

$VAMANU_{it}$(v. d.)	Broad Sample	Advanced countries	Emerging or developing economies
misxrate	1.286^{***}	0.704^{*}	1.510^{***}
	(7.38)	(2.54)	(7.60)
gaptec	0.00199	-0.345	0.00143
	(0.37)	(-0.84)	(0.27)
txinfla	0.00260^{***}	0.0261^{***}	0.00207^{***}
	(4.30)	(6.67)	(3.32)
ainv	0.0170^{***}	0.0758^{***}	0.00854
	(3.37)	(3.78)	(1.62)
tcpop	-0.381^{***}	-0.125	-0.469^{***}
	(-5.52)	(-0.84)	(-6.93)
govexp	-0.0140	-0.204^{***}	0.00282
	(-1.21)	(-5.56)	(0.23)
_cons	16.01^{***}	20.77^{***}	15.69^{***}
	(59.29)	(21.15)	(58.22)
N	2112	380	1732

Note: *t* statistics in parenthesis. * p<0.05, ** p<0.01, *** p<0.001.
Source: Author´s own elaboration.

In order to estimate (17) the Hausman test indicates that the most appropriate model has fixed effects (with 1% significance). Again, we used the modified Wald test for heteroskedasticity in for fixed effects models and the Wooldridge test for serial correlation in the panel model estimated. The results indicate that the model error term is serially correlated and heteroskedastic, both results with 1% significance. Moreover, the Collin test (Ender, 2015) was applied and the problem of multicollinearity was not detected (the VIF average was as low as 1,18).

To correct the detected problems, we used the Generalized Least Squares (GLS) method, which corrects for heteroskedasticity and autocorrelation. In the latter the autoregressive component of idiosyncratic error term is modeled as a “within” AR(1) process and the heteroskedasticity was modeled for each panel.

It can be observed in Table 3 that the undervalued real exchange rate has a negative and statistically significant affect to the primary sector of the sample for emerging countries and a positive and statistically significant sign for the advanced economies. In other words, this evidence suggests that it is the exchange appreciation that positively affects the primary sector for developing economies. The technological gap variable is not significant for the primary sector in all the estimated panels. The control variable *ainv* is negative and significant for the broad sample and for the emerging economies and positive and statistically significant for the advanced economies. The *tcpop* variable is positive and significant for the broad sample and for the emerging economies, but negative and not statistically significant for the advanced economies while the variable *govexp* is negative and statistically significant significant for the broad sample and emerging economies, but not for the sample of advanced economies.

Table 3 - Panel GLS (*Generalized Least-Squares*) estimations for advanced or developed countries and emerging or developing countries - 1990 – 2011

$VAPRIM_{it}$(var. depend.)	Broad Sample	Advanced countries	Emerging or developing economies
misxrate	-0.408	0.939***	-0.863**
	(-1.81)	(5.04)	(-2.80)
gaptec	-0.0163	0.494	-0.0188
	(-1.08)	(1.96)	(-1.26)
txinfla	0.00108***	0.0234***	0.00106***
	(4.24)	(7.24)	(4.44)
ainv	-0.0722***	0.0475***	-0.0793***
	(-8.36)	(3.89)	(-8.71)
tcpop	1.226***	-0.286**	1.142***
	(9.82)	(-2.64)	(7.81)
govexp	-0.229***	0.0251	-0.153***
	(-10.09)	(1.25)	(-6.34)
_cons	19.82***	1.273*	23.47***
	(35.66)	(2.20)	(39.60)
N	2184	398	1786

Note: *t* statistics in parenthesis. * p<0.05, ** p<0.01, *** p<0.001.
Source: Author´s own elaboration.

In order to estimate (18) the Hausman test indicates that the most appropriate model has fixed effects (with 1% significance). Once again, we used the modified Wald test for heteroskedasticity in regression models for fixed effects and the Wooldridge test for serial correlation in the panel model. Results indicate that the errors of the model are serially correlated and heteroskedastic, both results with 1% significance. Moreover, the Collin test (Ender, 2015) was applied and the problem of multicollinearity was not detected (the VIF average was as low as 1,12).

Once more, to correct the detected problems, we used the Generalized Least Squares (GLS) method, which corrects for heteroskedasticity and autocorrelation. In the latter the autoregressive component of idiosyncratic error term is modeled as a “within” AR(1) process and the heteroskedasticity was modeled for each panel.

It can be observed in Table 4 that the undervalued real exchange rate has no statistically significant affect to the service sector in all panels estimated. Furthermore, the technological gap variable is not statistically significant for the service sector in all the estimated panels. Just the control variable *govexp* is statistically significant in all estimations, but with a positive sign. The variable *ainv* is negative and statistically significant for the emerging or developing economies and positive and statistically significant for the advanced countries´ sample. The variable *tcpop* presents a negative sign and is statistically significant just for the sample of advanced countries.

Table 4 - Panel GLS (*Generalized Least-Squares*) estimations for advanced or developed countries and emerging or developing countries - 1990 – 2011

$VASERV_{it}$(var. depend.)	Broad Sample	Advanced countries	Emerging or developing economies
misxrate	-0.192 (-0.77)	-0.387 (-1.18)	-0.772 (-1.96)
gaptec	0.0199 (1.61)	0.0188 (1.52)	0.997 (1.69)
txinfla	-0.000329 (-1.31)	-0.000287 (-1.21)	-0.0375*** (-6.54)
ainv	0.0430*** (5.14)	0.0492*** (5.47)	-0.127*** (-4.18)
tcpop	-0.995*** (-8.32)	-0.754*** (-5.57)	0.0154 (0.07)
govexp	0.521*** (19.39)	0.415*** (13.98)	0.486*** (7.06)
_cons	46.26*** (76.56)	44.77*** (69.24)	60.73*** (32.76)
N	2184	398	1786

Note: *t* statistics in parenthesis. * p<0.05, ** p<0.01, *** p<0.001.
Source: Author´s own elaboration.

The manufacturing industries according to the Kaldorian and Structuralist approach are of great importance for the convergence of the South towards greater economic rate of growth, as it was discussed in the 2. Industry plays a key role as an activity of increasing returns to scale and dynamic economies. The latter refers to the increasing returns brought about by technological progress induced by learning (specifically learning by doing) and by economies of scale. Controlling for other variables, the empirical evidence found suggests that the undervalued real exchange rate affects manufacturing in a positive way for the sample of developing or emerging countries. Except for the variable *txinfla*, all the other control variables in table 2 that affect economic growth also influence manufacturing industries as the expected sign described in the beginning of this section.

The model (19) was estimated for a reduced sample (see Appendix 2) because the economic complexity variable (*eci*) was not available for the broad sample (see Appendix 1). This reduced sample is divided among developed countries (20 countries) and emerging or developing economies (68 countries). The estimations to these different samples faced the same problems concerning heteroskedasticity and serial autocorrelation, when applied the modified Wald test for heteroskedasticity in regression models with fixed effects and the Wooldridge test for serial correlation in the panel model, respectively. Thus, in order to correct the detected problems, we used the Generalized Least Squares (GLS) method.

To check the robustness of the results we applied the Cochrane-Orcutt method with the Prais-Winsten transformation to correct for problems of serial correlation and heteroskedasticity. As Cameron and Trivedi (2005) presents, the Prais–Winsten transformation removes the heteroskedasticity and autocorrelation, and the results are unbiased coefficients and consistent panel corrected standard errors. Furthermore, when calculating the standard errors and the variance-covariance matrix it is assumed that the errors are heteroskedastic and contemporaneously correlated between panels. This was done for the complete estimation (Table 5, seventh column).

The results for emerging or developing economies of the equation (19) are reported in Table 5. Except for the proxy to stabilization policies, all the control variables presented the expected sign and are statistically significant in most complete model estimated (sixth column). For all estimations the undervalued RER has positive impact on economic complexity. Moreover, manufacturing is the main sector in terms of its impact on *eci*. The results for the PCSE estimation are not different in terms of the sectorial impacts on (*eci*), but are different in terms of the control variables results: *gaptec* (positive and not statistically significant), *txinfla* (positive and statistically significant) and *ttrade* (negative and not statistically significant).

Table 5 - GLS (*Generalized Least-Squares*) Panel Estimations and PCSE (*Panel Corrected Standard Errors*) estimations – Emerging or developing economies – 1990 - 2011

ECI_{it} $(d.p.)$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
misxrate	0.0246	0.0497	0.0790**	0.111***	0.109***	0.0668*	0.106**
	(1.05)	(1.73)	(2.82)	(4.29)	(3.90)	(2.05)	(2.75)
vaprim		-0.0185***	-0.0204***	-0.0156***	0.00768***	-0.00540*	-0.0186***
		(-13.06)	(-15.87)	(-9.12)	(-3.38)	(-2.03)	(-6.37)
vamanu			0.0135***	0.0204***	0.0195***	0.0237***	0.0285***
			(5.55)	(8.17)	(7.95)	(8.95)	(10.20)
vaserv				0.00925***	0.0118***	0.0159***	0.0160***
				(5.17)	(6.60)	(7.95)	(10.13)
gaptec					-0.00410***	-0.00354***	0.000586
					(-6.78)	(-5.55)	(1.21)
ainv					0.00251*	0.00529***	0.0139***
					(2.07)	(4.09)	(4.34)
tcpop						-0.0626***	-0.0862***
						(-4.91)	(-6.31)
txinfla						0.0000810	0.000403**
						(1.26)	(2.66)
ttrade						-0.000614**	-0.000600
						(-2.73)	(-1.48)
_cons	-0.465***	-0.0640	-0.313***	-0.921***	-1.045***	-1.253***	-1.451***
	(-15.68)	(-1.83)	(-6.15)	(-7.06)	(-7.74)	(-7.56)	(-7.14)
N	1419	1413	1344	1340	1303	1130	1130

Note: *t* statistics in parenthesis. * p<0.05, ** p<0.01, *** p<0.001.
Source: Author´s own elaboration.

The results for developed countries estimations of equation (19) are reported in Table 6. Contrary to the results for emerging or developing countries, the proxy for stabilization policies, aggregated investment and terms of trade are not statistically significant. However, *gaptec* and *tcpop* has the expected sign and are statistically significant. Although this fact, for all estimations the undervalued RER has a negative impact on economic complexity for this sample of countries and manufacturing presents the strongest impact on economic complexity. This result corroborates the hypothesis presented in the model developed in the last section, manufacturing industries positively influences the complexity in the economies, in this case, even for the developed countries.

Table 6 - GLS (*Generalized Least-Squares*) Panel Estimations and PCSE (*Panel Corrected Standard Errors*) estimations – developed economies – 1990 – 2011.

ECI_{it}(*d.p.*)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
misxrate	-0.158**	-0.142*	-0.238***	-0.235***	-0.153*	-0.0869	-0.0180
	(-3.01)	(-2.33)	(-3.53)	(-3.57)	(-2.42)	(-1.12)	(-0.18)
vaprim		-0.0778***	-0.119***	-0.0909***	-0.0187	-0.140***	-0.203***
		(-5.67)	(-8.36)	(-5.75)	(-1.12)	(-7.55)	(-12.01)
vamanu			0.0636***	0.0613***	0.0589***	0.0738***	0.0916***
			(10.41)	(8.88)	(9.24)	(9.96)	(17.09)
vaserv				0.00999	0.0184***	0.0221***	0.0246***
				(1.74)	(3.30)	(3.36)	(5.12)
gaptec					-0.141***	-0.126***	-0.0894***
					(-7.38)	(-4.38)	(-3.93)
ainv					-0.00101	0.00140	-0.00857
					(-0.29)	(0.31)	(-1.29)
tcpop						-0.127**	-0.150**
						(-2.74)	(-2.81)
txinfla						0.000137	-0.0156
						(0.02)	(-1.25)
ttrade						0.000842	-0.00120
						(0.44)	(-0.46)
_cons	1.693***	1.786***	0.642***	-0.0331	-0.463	-0.929	-0.871
	(31.76)	(30.33)	(4.99)	(-0.07)	(-0.95)	(-1.37)	(-1.37)
N	427	407	389	389	389	234	234

Note: *t* statistics in parenthesis. * p<0.05, ** p<0.01, *** p<0.001.
Source: Author´s own elaboration.

5. Concluding Remarks

There is a great deal of researches that support the claim that undervalued RERs can positively influence the economic development, as discussed in sections 2 and presented in a formal model in section 3. Besides, manufacturing industries represent the main important tradable sector as highlighted in the panel data empirical investigation in section 4.

The model developed in this work demonstrate that there is sustainable convergence just when $\varepsilon_n > \varepsilon_s$ and $|\beta_{cx}| > |\beta_{cm}|$. This means that the South´s current account is either in equilibrium or shows a surplus. In this context, a greater amount of knowledge is used in the exports from the South. A more diversified and less ubiquitous basket of products (not based on scarcity) are sold to the international markets as well as the South is less dependent of the North economic rate of growth. A situation where there is no constraint to economic growth by the BoP and the countries structure development is toward a more complex economy.

Controlling for other variables, the empirical evidence in this work suggests that the undervalued real exchange rate affects manufacturing in a positive way in the sample of developing or emerging countries. However, the results are the opposite to the developed countries and are not statistically significant to services activities. This means that overvalued RERs can hamper economic growth in developing economies through its influence on manufacturing industries. In other words, the panel data estimations present that excessively overvalued RER can accelerate the structural heterogeneity, affecting in a particular negative way the industrial sector. This process implies a regressive productive specialization, mainly in developing economies hampering economic growth and complexity.

According to the Kaldorian and Structuralist approach manufacturing industries are of great importance for the economic growth. Manufacturing industries plays a key role as an activity of increasing returns to scale and dynamic economies. Our empirical findings suggest that manufacturing also plays an important role on the countries´ economic complexity. This occurs because insofar RER affects this modern tradable sector, it also affects the higher capacity of technological diffusion to other sectors. Part of this dynamic is a consequence of the productive linkages and spillovers effects, which are stronger in manufacturing industries.

Economic diversification, proxied here by the economic complexity index, plays a central role in the long-term growth of emerging and developing countries. Thus, structural change toward activities in the modern tradable sector is one key determinant to higher economic rate of growth.

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Appendix 1 – Samples of countries for the estimations in Table 2,3 and 4

Developed Countries	Underdeveloped Countries
Australia, Austria, Denmark, Finland, France, Germany, Greece, Italy, Japan, Korea. Rep., Latvia, Lithuania, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom, United States.	Antigua and Barbuda, Argentina, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo. Dem., Congo. Rep., Costa Rica, Cote d'Ivoire, Cyprus, Dominica, Dominican Republic, Ecuador, El Salvador, Estonia, Ethiopia, Fiji, Gabon, Georgia, Ghana, Grenada, Guinea, Guinea-Bissau, India, Indonesia, Iran. Islamic Rep., Jordan, Kenya, Lao PDR, Liberia, Macao SAR. China, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nepal, Niger, Nigeria, Oman, Pakistan, Panama, Paraguay, Philippines, Russian Federation, Rwanda, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Swaziland, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Turkey, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Venezuela. RB, Vietnam, Zambia, Zimbabwe.
(N=20 and T=22)	(N=98 and T=22)

Appendix 2 –Samples of countries for the estimations in Table 5 and 6

Developed Countries	Underdeveloped Countries
Australia, Austria, Denmark, Finland, France, Germany, Greece, Italy, Japan, Korea. Rep., Latvia, Lithuania, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom, United States	Argentina, Bangladesh, Bolivia, Botswana, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt. Arab Rep., El Salvador, Estonia, Ethiopia, Gabon, Georgia, Ghana, Guinea, India, Indonesia, Iran. Islamic Rep., Jordan, Kenya, Lao PDR, Liberia, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nigeria, Oman, Pakistan, Panama, Paraguay, Philippines, Russian Federation, Saudi Arabia, Senegal, Singapore, South Africa, Sudan, Tajikistan, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Venezuela. RB, Vietnam, Zambia, Zimbabwe.
(N=20 and T=22)	(N=68 and T=22)

Source: Author´s own elaboration based on the WDI (2015)´s classification.