# A Structuralist-Keynesian Model for Determining the Long-Term "Optimal" Real Exchange Rate for Economic Development: The Case of Brazil

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**ABSTRACT**

This paper shows an econometric estimation for Brazil's long-term "optimal" real exchange rate covering the 1999-2015 period. The long-term "optimal" real exchange rate is understood as that which is able to efficiently reallocate production resources towards industries with a high capacity to generate and spillover productivity gains to the economy as a whole. In doing so, all else being equal, economic development is accelerated and sustained. Differently from the conventional models, we present a Structuralist-Keynesian model to theoretically and empirically demonstrate that the variables in the trajectory of the long-term real exchange rate, as well as its misalignment from the "optimal" level that is appropriate for economic development, are all simultaneously explained by both structural variables and those associated with the short-term economic policy. We estimate that, after having crossed a long trend of significant real appreciation since the end of 2005, the real exchange rate reached its "optimal" level in Brazil in the first half of January 2016.

Keywords: real exchange rate; "optimal" real exchange rate; overvaluation; Brazil.

JEL classification: F30; F32; F39

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## 1. Introduction

In an effort to construct a Structuralist development macroeconomics, Bresser-Pereira (2010) has emphasized the key role of the real exchange rate[1] in the process of development and economic convergence (catching up)[2] of developing countries.[3] This does not mean reducing economic development, a complex phenomenon influenced not only by economic forces, but also by historical, sociological and cultural forces, among others, to only one variable (the real exchange rate). On the contrary, assuming that all factors that positively influence economic development are present, Bresser-Pereira, Oreiro and Marconi (2014) argue that the process of economic development is sustainable provided a country is able to keep a low and stable inflation rate, an average real interest rate below the average real return on capital, a real wage increasing according to the augmentation of aggregate productivity and a "competitive" real exchange rate.[4] Among all these variables, the authors stress that the real exchange rate is the most important one, for it influences all the others (including the inflation rate). As they point out:

[1] In this paper, we define the exchange rate as the domestic price of a foreign currency (say, Brazilian reals per US dollar). Thus, an increase (decrease) in the exchange rate means a depreciation (appreciation) of the domestic currency.

[2] The problem of economic convergence (catching up), understood as the effective capacity of poor countries to catch up to levels of per capita income and well-being of developed countries, is core in Classical and Neoclassical literature on development economics, although the theoretical approaches of these two economic schools are radically different from each other. For details on Classical literature on economic development, see Rosenstein-Rodan (1943), Prebisch (1950), Lewis (1954), Myrdal (1957), Hirschman (1958) and Kaldor (1966), among others; and on Neoclassical literature, see Solow (1956), Swan (1956), Romer (1986) and Lucas (1988), among others.

[3] The relationship between the real exchange rate and economic development has been more widely analyzed by empirical studies than theoretical ones, in spite of some authors having recognized its importance (especially Kaldor, 1966, 1978). As we will comment ahead, several recent empirical studies have concluded that, ceteris paribus, countries in process of catching up whose currencies are marginally undervalued in real terms tend to accelerate long-term growth. See Rodrik (2008), Williamson (2008), Berg and Miao (2010). For developing countries, see Gala (2008) and Araújo (2009).

[4] A "competitive" real exchange rate is one which is able to keep the domestic currency marginally undervalued relative to the US dollar (or, alternatively, to a basket of currencies) in real terms. As we will comment ahead, empirical evidence suggests that, all else being equal, a "competitive" real exchange rate tends to accelerate economic development.

*In our developmental macroeconomics, the key macroeconomic variable, besides the investment rate, are the current account deficit and the [real] exchange rate – the less studied of the (...) macroeconomic prices. Imports, exports, the investment rate, the savings rate, and inflation depend on it. Investments depend on it because we may think of the exchange rate as the light switch that connects or disconnects the efficient business enterprises existing in a country from foreign markets and their own domestic markets (Bresser-Pereira, Oreiro and Marconi, 2014: 10-11).*

Not by chance, in all successful Asian countries that have already caught up with high levels of per capita income and well-being (especially South Korea, Taiwan and Singapore) as well as those currently pursuing such a strategy (like China and India), their domestic currencies are hardly ever overvalued for a long period of time, as has been the case of Brazil in the last decade.[5]

Curiously, the theoretical literature on economic development has not given the real exchange rate its due importance as an absolutely strategic variable to promote structural change and catching up.[6] Notwithstanding, we cannot draw the same conclusion on the large empirical literature that seeks to evaluate the relationship between the trajectory of the real exchange rate and long-term economic growth. Since the end of the 1990s, several empirical studies have concluded that, unless it is a "natural" result of the increase in the productivity of tradable goods compared with nontradable goods (particularly services) – a phenomenon that captures the Harrod-Balassa-Samuelson effect –, an overvaluation of domestic currency for a long period of

[5] See Amsden (2001), for Asian countries; Nassif, Feijó and Araújo (2011), for the case of Brazil; and Nassif, Feijó and Araújo (2015), for the cases of China and India.
[6] As observed by Gala (2008:273),"while the econometric literature on this issue is relatively rich, theoretical analysis of channels through which real exchange rate levels could affect economic development are very scarce".

time tends to reduce long-term growth (Razin and Collins, 1999; Dollar and Kray, 2003; Prasad, Rajan and Subramanian, 2006; Gala, 2008).

Recently, empirical studies have gone further by showing that not only is overvaluing bad for economic development, but also a small undervaluation tends to accelerate it. Although such an empirical conclusion has been pioneeringly pointed out by Rodrik (2008) and confirmed by Berg and Miao (2010), Williamson (2008:14), a specialist on the topic, has stressed that “the very best policy (in terms of maximizing growth) appears to be a *small* undervaluation” (italics from the original) and concludes: “The evidence that overvaluation hurts development is now sufficiently strong to merit being reflected in policy, including delay to capital account liberalization where it appears likely to threaten overvaluation” (op.cit.: 24). Williamson’s emphasis on the word “small” is not desultory, as a marked undervaluation in relation to the “neutral” real exchange rate, consistent with the real purchasing power parity, would replicate inflationary processes for an excessive period of time.[7]

In a previous paper (see Nassif, Feijó and Araújo, 2011), we proposed a theoretical and econometric estimation of the long-term trajectory of the real exchange in developing countries. In this study, we also introduced and econometrically estimated (pioneeringly, as far as we know) the long-term “optimal” (or “competitive”) real exchange rate for Brazil.  All else being equal, we defined the “optimal” real exchange rate as that capable of efficiently reallocating the existing productive resources industries with capacity to spill over gains from productivity to the economy as a whole. Empirical evidence suggests that such industries are located in the manufacturing sector, which is understood as the dynamic engine of productivity growth of not only its own sector, but also the economy as a whole, as emphasized by Kaldor (1966) after

[7] As Krugman and Taylor (1978) showed in a classical paper, when a country (say, Brazil throughout 2015) suddenly adjusts its real exchange rate after a long period of overvaluation, the immediate impacts are inflationary and recessive. However, as soon as economic agents adapt to this new relative prices equilibrium, the real profit rate on the capital employed in productive activities tends to improve and, therefore, both economic growth and productivity are sustained in the long term.

having observed the stylized fact originally indicated by the Dutch economist A.P. Verdoorn (1949).[8]

Our concept of "optimal" real exchange rate is close to Bresser-Pereira's (2010) concept of "industrial equilibrium" real exchange rate. According to this author, the "industrial equilibrium" is a real exchange rate that stimulates entrepreneurs in their respective industries to adopt technologies in the-state-of-the-art world. However, this concept differs from our "optimal' real exchange rate, for this latter, by being only marginally depreciated in relation to its long-term trajectory, is not necessarily an equilibrium exchange rate, be it "industrial equilibrium" or the "neutral" purchasing power parity equilibrium.[9] Not by chance, since our "optimal" real exchange rate does not assume any maximization methodology, the term "optimal" is always written in quotation marks.

Our first study (see Nassif, Feijó and Araújo, 2011) concluded that the real exchange rate would have reached its "optimal" level (the <u>estimated</u> real exchange rate, not the observed one) in 2004 (average of the year). In April 2011, as the "optimal" real exchange rate should have been at 2.90 Brazilian reals per US dollar, against an observed level at only 1.59 Brazilian reals per US dollar, the Brazilian currency was sharply overvalued in real terms, so incapable of sustaining Brazil's economic development.

Considering that the Brazilian real has sharply depreciated in nominal terms throughout 2015, this paper has two main goals: first, refining our proposed theoretical Structuralist-Keynesian model, with the aim to highlight its main differences from the conventional models of determining both the long-term trajectory of the real exchange rate and the misalignment of the actual real exchange rate from the "optimal" level; and second, estimating once again the "optimal" real exchange rate with the aim to identify if the observed level prevailing in the beginning of 2016 was above (undervalued), below

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[8] For recent empirical evidence of such empirical regularity (known as Kaldor-Verdoorn law) for Latin American countries, see Ros (2014).

[9] Even if the "industrial equilibrium" real exchange rate does not also assume any maximization methodology for its estimate, its level of real depreciation comparatively to the "neutral" real exchange rate equilibrium can or cannot be so high. In our concept of the "optimal" real exchange rate, as already stressed, the level of real depreciation is only a bit above the "neutral" real exchange rate equilibrium.

(overvalued) or close to (or even equal) that "optimal" level. With this in mind, the paper is divided as follows. Section 2 makes a critical analysis of the conventional models for determining the real exchange rate in the long-term, as well as its misalignment. Section 3 presents our proposed Structuralist-Keynesian model, remarking on its theoretical and empirical methodological differences from the conventional models for determining the long-term trajectory of the real exchange rate. Section 4 shows the econometric estimation of both the long-term trajectory of the real exchange rate in Brazil in the 1999-2015 period and its "optimal" level in the beginning of 2016. Section 5 draws the main conclusions, including some economic policy implications.

## 2. The conventional model for determining the long-term real exchange rate: a critical appraisal

The core theory on the behaviour of the real exchange rate in the long-term is based on relative purchasing power parity (PPP) hypothesis.[10] According to this hypothesis, for the purchasing power between two currencies (denominated in a common monetary unit) to keep constant over time, the actual nominal exchange rate (defined by the domestic price of a foreign currency) negotiated in the foreign exchange markets must be corrected by the difference between domestic and international inflation rates.[11] The change in real exchange rate over time can be expressed by:

$$RE\dot{R} = \dot{e} - (\dot{P} - \dot{P}^*) \quad (1)$$

[10] The purchasing power parity (PPP) was originally developed by Cassel (1918) and, since then, it has been the main theoretical reference for evaluating the behaviour of the real exchange rate in the long-term (see Sarno and Taylor, 2002). However, the empirical evidence does not validate the PPP hypothesis in the "absolute" version (Sarno and Taylor, 2002). In spite of weak empirical evidence on the validity of the PPP in its "relative" version, Rogoff (1996: 647) comments that "most instinctively believe in some variant of purchasing power parity as an anchor for long-run real exchange rates".

[11] For an excellent mathematical demonstration of the PPP in the relative version, see Simonsen and Cysne (1994:99-100).

Where *RER* is the real exchange rate; e is the nominal exchange rate; *P* is the domestic price level; and *P** is the international price level. As the dots over the variables indicate instantaneous rate of change in time, equation (1) shows that an increase in the real exchange rate over time (that is, a real depreciation of the domestic currency relative to the foreign currency) must be equal to the augmentation of the nominal exchange rate (that is, a nominal depreciation of the domestic currency) minus the difference between domestic and international inflation rates.

Such a definition implies that an increase in either the *RER* or e causes a depreciation of the domestic currency in relation to the foreign currency (respectively, real and nominal), while a reduction of either the *RER* or *e* causes an appreciation of the domestic currency in relation to the foreign currency (respectively, real and nominal). The main theoretical issue is to determine the key forces that lead the real exchange rate to its equilibrium level in the long term, in such a way that it can equalize to the "neutral" nominal exchange rate from the competitive point of view. That is to say, a "neutral" exchange rate means that exporters, importers and domestic producers who compete with foreign producers are equally benefited. According to the traditional theory of the real exchange rate, in the absence of nominal or real shocks, there would be "fundamental" forces under the capitalist system with the capacity to lead the nominal exchange rates to their long-term equilibrium level (Taylor and Taylor, 2004).[12] For this theory, any deviation of the real exchange rate from its "fundamental" real equilibrium level would be transitory and explained by random shocks (Razin and Collins, 1999).

Not by chance, in conventional empirical estimates of the real exchange rate trajectory as well as of the deviation of the real exchange rate from its long-term equilibrium, the two "fundamental" forces that explain such trends are: i) the relation between change in the productivity of tradable goods in comparison with change in productivity of nontradable goods; and ii) the terms of trade (*ToT*) behaviour.

[12] Taylor and Taylor (2004) also stress that there is empirical evidence that, due to the rigidity of nominal prices, changes in the nominal exchange rates transmit proportionally 1 by 1 to the real exchange rates. In other words, a nominal depreciation implies proportionally a real depreciation.

As to the first “fundamental” force, as the productivity in tradable goods tends to increase faster than in nontradable goods in the process of economic development, then the drop in relative prices of the former in a country implies that its currency tends to “naturally” appreciate in real terms. This is the so-called Harrod-Balassa-Samuelson effect, according to which, as Obstfeld and Rogoff (1996: 212) point out, is related to the prediction that “price levels tend to rise with country per capita income.”[13]

Yet, as to the second “fundamental” force, the expected impact of the *ToT* on the real exchange rate trajectory is twofold. Baffes et al.(1999:413) sustain that (as most authors do) “an improvement in the terms of trade, by augmenting the national income measured in imported goods, produces an expansionary effect on the aggregate income. Such an effect increases, in turn, the demand for all goods (tradables and nontradables) and, therefore, appreciates the domestic currency in real terms.” However, Edwards (1989) theoretically shows that this effect can be inverse. That is, if an increase in income resulted in the improvement of the *ToT* in such a way that stimulates a strong substitution of tradable goods for nontradable goods (especially services), then an augmentation of the former tends to depreciate the domestic currency in real terms. In other words, according to Edwards (1989), the impact of an improvement in the *ToT* on the real exchange rate can be twofold: if the income-effect prevails, the tendency is to appreciate the domestic currency in real terms; if the substitution effect prevails, the tendency is to depreciate it.[14]

By proceeding to the econometric implementation for measuring the exchange rate misalignment (that is to say, for estimating how much, in percentage terms, the nominal exchange rate is overvalued or undervalued in relation to the “fundamental” equilibrium level), the conventional approach is normally used to associate such a

[13] As we will show ahead, when translated into the econometric equation, the sign of the estimated coefficient of the per capita income (the variable used to capture the Harrod-Balassa-Samuelson effect) is negative, for an increase in the per capita income tends to reduce (appreciate) the real exchange rate.

[14] Yet, as we showed earlier, the expected sign of the estimated coefficient of the *ToT* in the econometric equation will be negative if the income effect prevails; and positive if the substitution effect prevails.

misalignment with transitory random shocks.[15] In this theoretical framework, as defined by Razin and Collins (1999:59-60), "an RER is misaligned when it deviates from the underlying RER that would have prevailed [that is, from its "fundamental" level] in the absence of price rigidities, frictions and other short run factors." It should be noted that all models based on such a theoretical definition have different degrees of sophistication. However, in the econometric equations that seek to estimate the level of misalignment, this level is measured as the deviation of the observed real exchange rate – which is estimated in Brazil by Brazil's Central Bank through price indices associate with equation (1) – from the linear combination of a set of variables taken as proxies for the long-term equilibrium trajectory of the real exchange rate (which is, in turn, associated with *flex-prices*).[16] In the econometric implementation, such deviations result from variables representing "short-run shocks plus the error term of regression" (Ibidem, 1999:65-67).

The conventional theoretical model can be expressed by the following equation (except for the interest rate, all other variables are expressed in logarithms):

$$RER_t = g_t(y_t^{\,s}, d_t, i^*) + f_t(\lambda_{mt}, \lambda_{yt}) \tag{2}$$

Where the real exchange rate *RER* (all subscripts *t* indicate time) is simultaneously determined by two sets of factors: the first one, represented by the function *g (…)*, basically captures "fundamental" variables which would have the power to make the real exchange rate converge to its long-term equilibrium level. For this reason, all variables that compound *g (…)* are real variables: $y^s$ is the real GDP; D is the aggregate demand; and $i^*$ is the world interest rate (compatible with the long-term "natural" interest rate). This model suggests that, in a world characterized by perfect competition and the absence of all kinds of nominal price rigidities and random shocks, the RER would

[15] This means that if the misalignment of the real exchange rate from its long-term equilibrium level is caused by transitory shocks, the main normative implication of this theoretical approach is that the most appropriate exchange rate regime is one of pure (or almost pure) floatation.

[16] For details, see Razin and Collins (1999: 59-60).

naturally converge to *g (…)* in the long run. This level would also be compatible with the equilibrium level determined by economic fundamentals.

However, given the several imperfections in the real world, the conventional theory of the real exchange rate attributes to the variables of the function f (…) – be them monetary shocks represented by $\lambda_M$ or real shocks represented by $\lambda_Y$ – the causes of the misalignment of the real exchange rate from its long-term “fundamental” equilibrium level.

Thus, for estimating the long-term trajectory of the real exchange rate as well as the misalignment from its equilibrium level, equation (1) is translated into the following form (see Razin and Collins, 1999: 64-65):[17]

$$RER_t = \alpha W_t + \beta Z_t + \varepsilon_t \qquad (3)$$

| “Fundamental” variables (responsible for determining the long-term real exchange rate equilibrium) | Variables related to short-term shocks plus the error term of regression (responsible for determining the real exchange rate misalignment) |
|---|---|

Where *RER* is the actual real exchange rate (expressed in logarithms); *W* is a set of variables which capture factors of long-term “fundamental” equilibrium; *Z* is a set of variables of short-term shocks that, together with the error term of regression, explain the exchange rate misalignment.[18]

[17] It is important to show the theoretical and econometric representations for determining the long-term trajectory of the real exchange rate as well as the methodology of estimation of the exchange rate misalignment according to the conventional models, for they help to highlight the radical differences of these models from our Structuralist-Keynesian theoretical and empirical models which we will propose ahead.

[18] Not by chance, in conventional models, the misalignment of the actual real exchange rate from its long-term equilibrium level is estimated by the difference between the left side and the first component of the right side of equation (3).

## 3. The determination of the long-term real exchange rate and of its misalignment from the "optimal" level for development: a Structuralist-Keynesian model

The Structuralist-Keynesian model proposed in this paper assumes that both the estimated long-term real exchange rate as well as its deviation from the actual (observed) real exchange rate in relation to its "optimal" level (as previously defined) are explained simultaneously by structural factors and by variables associated with the short-term macroeconomic policies (that is to say, variables that are handled by policy-makers to deal with short-term movements of the business cycle). Particularly, we assume that short-term macroeconomic policies (especially monetary and fiscal policies) have large and long-lasting effects on the misalignment of the real exchange rate from its "optimal" level.

We can formally express the long-term trajectory of the *RER* and the deviation of the actual real exchange rate from its "optimal" level as follows:

$$RER_t = g_t(struct_{lp_t}) + m_t(cp_t) \qquad (4)$$

All variables on the right side of equation (structural and short-term ones) determine both the long-term trajectory of the real exchange rate and the misalignment of the actual real exchange rate in relation to its "optimal" level.

Where the *g* component is formed by a set of structural variables ($struct_{lpt}$) that influence the real exchange rate in the long run (such as the per capita income *Y*, which captures the Harrod-Balassa-Samuelson effect, as mentioned before, the terms of trade *ToT* and the current account balance *CC)*, while the *m* component represents the set of variables that are directly or indirectly influenced by the short-term macroeconomic policy ($cp_t$).[19]

[19] In the econometric specification to be presented in the following section, the error term of regression will be added to the right hand side of the equation. This means that the error term, along with the variables which represent both structural and short-term variables, influences the trajectory of the real

The short-term variables that will be considered in our empirical model for the Brazilian economy are the difference between the nominal domestic interest rate *i* and the external nominal interest rate *i* (IDIFER)*, the stock of international reserves (*RI*) and the country risk premium (*CR*).

Two characteristics distinguish our model from the conventional ones when determining the long-term real exchange rate: first, although the variables considered in *g* are similar to those that influence the " fundamentals" in the conventional literature, our model rejects the assumption that these variables <u>always</u> make the real exchange rate converge to its long-term equilibrium level;[20] and second, in our model <u>all</u> components of the right hand side of equation (4) can <u>simultaneously</u> explain the deviation of the actual real exchange rate from its long-term equilibrium level and from the "optimal" level. In the conventional literature, only short-term shocks explain the deviation of the actual real exchange rate from its long-term equilibrium level.

This implies that our econometric procedure for estimating the deviation of the actual real exchange rate from its "optimal" level also differs from the conventional literature. In the conventional literature, the deviation of the actual real exchange rate from its long-term equilibrium level results from short-term shocks, that is to say, from the variables associated with short-term macroeconomic policies and the error term of regression. In our econometric model, the calculation of such a misalignment is done in two steps: first, we apply the Hodrick-Prescott (HP) filter for estimating the long-term trend of the real exchange rate; and second, considering the equation with the HP filter,

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exchange rate in the long run as well as the deviation of the observed real exchange rate in relation to the "optimal" level.

[20] This means that market forces can or cannot lead the real exchange rate to converge to its long-term equilibrium level, but if this occurs, it will be either a mere coincidence or a result of rapid and intense exchange rate adjustments in times of crisis (for example, as occurred in Brazil after the speculative attack in 1999 and, more recently, with the political and economic crisis throughout 2015, from which resulted President Dilma Rousseff's impeachment). Indeed, since market forces are not always effective in avoiding significant exchange rate misalignments (especially overvaluation), the main normative implication is that policy-makers should strive not only to prevent volatility, but also to prevent the real exchange rate from deviating from its "optimal" level, as well as from entering into the real appreciation trend. In other words, instead of a pure or even "dirty" floating exchange rate regime, the most appropriate exchange rate regime for developing countries is the managed floating exchange rate, ones like those pursued by most Asian developing countries, as shown by Aizenman et al. (2010).

we choose a period that is taken as a reference for calculating the deviation of the actual real exchange rate in relation to the estimated "optimal" real exchange rate.[21]

Summing up, our model has Structuralist roots because it accepts the assumption that the long-term trajectory of the real exchange rate is affected by structural variables, especially by the relation between the productivity growth of tradable and nontradable goods as well as by the terms of trade. It is also a Keynesian one because it assumes, following Keynes (1936, ch. 12), that the long-term trajectory of the economy is, indeed, the result of a series of short-term events.[22] In this sense, we reject the conventional hypothesis that makes a distinction between short-term and long-term real exchange rate equilibrium. In other words, we assume that both rates are two sides of the same coin. This does not mean that the Keynesian approach rejects the notion of an "optimal" real exchange rate, or even of a long-term real exchange rate equilibrium level. The point made by the Keynesian approach is to assume that the short-term and the long-term real exchange rates are both influenced by short-term economic policies.[23] Indeed, in an emerging and financially integrated economy to world markets, the real exchange rate is strongly influenced by net short-term capital flows (Kaltenbrunner, 2008; 2010), which respond, in turn, to several variables directly linked to short-term economic policies, such as the interest rate differential and the country-risk premium, among others. Not by chance, Keynes (1923), even not living in a financially globalized world, had called attention to the fact that, by manipulating short-term interest rates, core countries such as England could attract large amounts of capital inflows and influence the movement of their real exchange rates.

[21] These procedures will accurately be shown ahead.

[22] See also Hahn (1984).

[23] Structural variables such as productivity growth and the terms of trade, even if they can be seen as long-term variables, are also strongly influenced by short-term economic policies. So, we insist that the long run is nothing but a result of a series of short-term events (and also influenced by short-term economic policies).

**4. Econometric estimate of the long-term trajectory of the real exchange rate and the "optimal" level**

For determining the long-term path of the real exchange rate for the Brazilian economy between 1999 and 2015, our theoretical model [see equation (4)] can be translated into the following econometric specification (all variables are expressed in logarithms):

$$\ln RER_t = c_0 + \alpha_1 \ln Y_t + \alpha_2 \ln ToT_t + \alpha_3 \ln CC_t + \\ + \beta_1 (\ln IDIFER)_t + \beta_2 (\ln IDIFER)_{t-2} + \beta_3 \ln RI_t + \beta_4 \ln CR_t + \varepsilon_t \qquad (5)$$

Where *RER* is the actual (observed) real exchange rate; *Y* is the per capita GDP in US dollar; *ToT* is an index for the terms of trade; *CC* is the current account as a share of GDP;[24] *IDIFER* is the difference between the short-term domestic nominal interest rate (*Swap DI* pre-fixed for 360 days) and the short-term international nominal interest rate (*FDTR- US Federal Fund Target Rate*, taken as proxy for the short-term international nominal interest rate); $IDIFER_{t-2}$ is the same variable lagged two periods;[25] *RI* is the stock of international reserves as a share of GDP; *CR* is Brazil's risk premium, represented by the *EMBI Brazil Sovereign Foreign Currency*, from JP Morgan; *ε* is the error term of regression and the subscript *t* stands for time (in our case a month). The first three variables on the right hand side of equation (5) represent our structural variables (the per capita income *Y*, the terms of trade *ToT* and the current account balance *CC*), while the others are associated with the short-term macroeconomic policy. Appendix 1 lists the statistical data sources. Our period of analysis covers January 1999 to July 2015.

[24] Following Bogdanski, Tombini and Werlang (2000), when account balances (*CC*) showed negative results, we had to add a positive number for applying the logarithmic form. In such cases, we have adopted the following procedure: *CC = 1 + CC.*

[25] The incorporation of a lagged short-term nominal interest rate differential in our econometric equation is justified by the fact that, given the short-term international nominal interest rate and assuming everything else constant, an increase in the short-term domestic nominal interest rate tends to first stimulate the short-term net capital inflows and, only later (so with some time lag), to appreciate the domestic currency in nominal and real terms.

The choice of the variables in our model is not arbitrary, since they are present in most models for determining the long-term real exchange rate (see, for example, Helmers, 1988; Edwards, 1988; Calvo, Leiderman and Reinhart, 1993; Rodrik, 2008; and Berg and Miao, 2010). However, it is important to stress that both the theoretical approach and the empirical determination of the long-term real exchange rate, as well as its level of misalignment (in our case, the misalignment in relation to the "optimal" level for economic development), are quite distinct from the conventional models. Thus, the choice of the explanatory variables in our model is finely aligned with the proposed theoretical model. In fact, from the long-term perspective, the per capita income, the terms of trade and the current account balances have been the most important structural variables for Brazil. In fact, Brazil's productive structure and export basket have been highly dependent on natural resource-based goods and the Brazilian strategy of economic development has been based on external savings (current account deficits) in recent decades. The choice of short-term explanatory variables is aligned with the Keynesian literature, which emphasizes that the short-term nominal interest rates differential, the stock of international reserves and country's risk premium are the most relevant to capture their direct and indirect effects on the real exchange rate in an economy highly opened to capital flows, as has been the case of Brazil since the early 1990s.

Table 1 presents the expected signs of the estimated coefficients of equation (5).

**Table 1**

**Structuralist-Keynesian model for determining the long-term real exchange rate: expected signs of the estimated coefficients of the variables**

| **Variables** | **Expected signs of the estimated coefficients** |
|---|---|
| Per capita GDP (*Y*) | - |
| Terms of trade (*ToT*) | Twofold (+ or -) |
| Current account balance (*CC*) | + |
| Interest rate differential (*IDIFER)* | Twofold (+ or -, respectively, in the very short and short/medium term |
| Stock of international reserves (*RI*) | Twofold (+ or -) |
| Country risk premium (*CR*) | + |

The expected signs of the estimated coefficients associated with per capita income (*Y*) and the terms of trade (*ToT*) were already justified in Section 2. The expected sign of the coefficient related to the current account balance (*CC*) is positive because a long-term current account surplus is associated with a depreciated currency in real terms, as discussed in the theoretical literature (Obstfeld and Rogoff, 1996). The expected sign of the coefficient for the interest rate differential is ambiguous: on the one hand, in the very short-term, given the short-term international nominal interest rate, an increase in short-term domestic interest rates may depreciate the currency (+ sign) through the expectations channel ("fear of floating" or, in truth, "fear of depreciating" in this case, as supported by Calvo and Reinhart, 2002); on the other hand, in the medium and long-term, an increase in the short-term domestic nominal interest rate (given the international interest rate) tends to, ceteris paribus, encourage net capital inflows and, therefore, to appreciate the currency in real terms (- sign). The expected sign of the coefficient of the stock of international reserves is also ambiguous: an increase in the stock of international reserves over time means that the policy-makers have made strong purchases of foreign exchanges in the spot market in order to, among other goals, reduce the tendency of appreciation or even induce higher depreciation of the domestic currency in real terms (+ sign). However, a large amount of international reserves, by reducing, ceteris paribus, the country risk premium, can stimulate net capital inflows and, hence, appreciate the domestic currency in real terms (- sign). The expected sign of the country risk premium is positive since an increase in this variable can stimulate capital flights and, consequently, the depreciation of the domestic currency in real terms (+ sign).

The first step of the empirical analysis was the implementation of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. The results showed that all series are integrated to the order 1, i.e., are non-stationary in level, but stationary in first difference.

In addition to stationary tests, it is important to consider the possibility of endogeneity between the variables of the model. This is because the latter, by violating the assumption of the OLS model that the error term should not be correlated with the explanatory variables in the regression, would entail biased, inconsistent and inefficient OLS estimators, compromising the inferential analysis.

However, as shown by Baffes et al. (1999, ch.10), even relevant exogenous tests such as those proposed by Engle, Hendry and Richard (1983) are not always able to solve problems of endogeneity when changes occur in the marginal distribution of the explanatory variables. Moreover, the Johansen (1988) cointegration test is highly potent for treating the problem of endogeneity in models with more than one endogenous variable because it considers all the variables in the estimation process as endogenous and also simultaneously determines the equilibrium relationship between them.

Considering that the variables are non-stationary and have the same order of integration, we can use the cointegration test proposed by Johansen (1988) and investigate whether there is a stable long-term relationship between them. As the test indicated the existence of a cointegration vector between the series, it is possible to ensure the existence of a long-term stable relationship between the variables of the model.[26]

As the series are non-stationary and cointegrated, it is possible to estimate equation (5) using the OLS method,[27] and the Error Correction Model (ECM). Table 2 shows the results of our econometric model. It should be noted that all the estimated coefficients were statistically significant and showed the expected signs as summarized in Table 1. It is important to emphasize that while the interest rate differential was incorporated into our econometric equation (5) with time lags due to economic reasons (see footnote 25), some other variables were lagged in the model in one or two periods for purely econometric reasons. Indeed, as our variables are monthly, it is reasonable to assume that the impact of structural explanatory variables and economic policy do not cause an impact on the real exchange rate in such a short time (in one month). So we used the best-fitted data in our model, incorporating at most up to three lags.

[26] Results of all tests can be made available from the authors upon request.

[27] According to Hamilton (1994), if the series of the model possess these characteristics, the OLS method remains a super consistent estimator. For a formal statement on this subject, see Hamilton (1994: 587).

**Table 2**

**The long-term real exchange rate: estimated models for Brazil (1999-2015)**

**Dependent variable: real exchange rate (RER)**

| **Variable** | **Description of the Variable** | **Coeficient OLS (*t* statistics in brackets)** | **Variable** | **ECM coefficient (*t statistics in brackets*)** |
|---|---|---|---|---|
| ***C*** | Constant | 6.650088*** [10.41783] | ***C*** | 5.9805*** |
| ***lnY-2*** | Log GDP per capita | -0.33637*** [-7.61376] | ***lnY-3*** | -0.763422*** [-7.93942] |
| ***lnTOT*** | Log terms of trade | -0.26492** [-1.91535] | ***lnTOT-1*** | -0.454013* [-1.69178] |
| ***lnCC-1*** | Log current account balance/GDP | 0.068764*** [4.538101] | ***lnCC-1*** | 0.085584*** [2.34562] |
| ***Ln(IDIFER)*** | Log short-term nominal interest rates differential | 0.296203** [2.320963] | ***Ln(IDIFER)*** | - - |
| ***Ln(IDIFER)-2*** | Log lagged short-term nominal interest rates differential | -0.24448** [-2.0114] | ***Ln(IDIFER)-2*** | -0.26921** [-4.41106] |
| ***lnRI-1*** | Log stock of international reserves/GDP | 0.223979*** [6.6185] | ***lnRI-1*** | 0.167482** [2.37291] |
| ***lnCR*** | Log Brazil's risk premium | 0.039893* [1.70786] | ***lnCR-1*** | 0.372263*** [5.96244] |

Notes on OLS model: R-square: 0.839; R- square adjusted: 0.833; Durbin-Watson: 1.833; F Statistics: 141.169; Prob (test F): 0.000; number of observations: 197 after adjustments. *IDIFER* variable was considered in level and with two lags; *CC* and RI variables were included with one lag, *Y* variable with two lags.
Notes on ECM model: 3 lags; number of observations: 193 after the adjustments. ToT, CC, RI and *CR* variables were included with one lag; *IDIFER* with two lags, and *Y* with three lags.
Note: *** Significant at 1% level ; ** Significant at 5% level ; * Significant at 10% level

The results show that the per capita income, the terms of trade and the short-term interest rates differential were the variables with the highest estimated coefficients to explain the long-term trajectory of the real exchange rate in Brazil between 1999 and 2015. In this sense, our econometric model suggests that the long-term trajectory of the real exchange rate, which was tendentially appreciated most of the period, was affected by both structural variables (especially by the per capita income and the terms of trade behaviours)[28] and by variables linked to short-term macroeconomic policy (especially high nominal interest rates differentials practiced in Brazil in the last decade, encouraging large short-term capital inflows during the period of economic boom and high international liquidity).

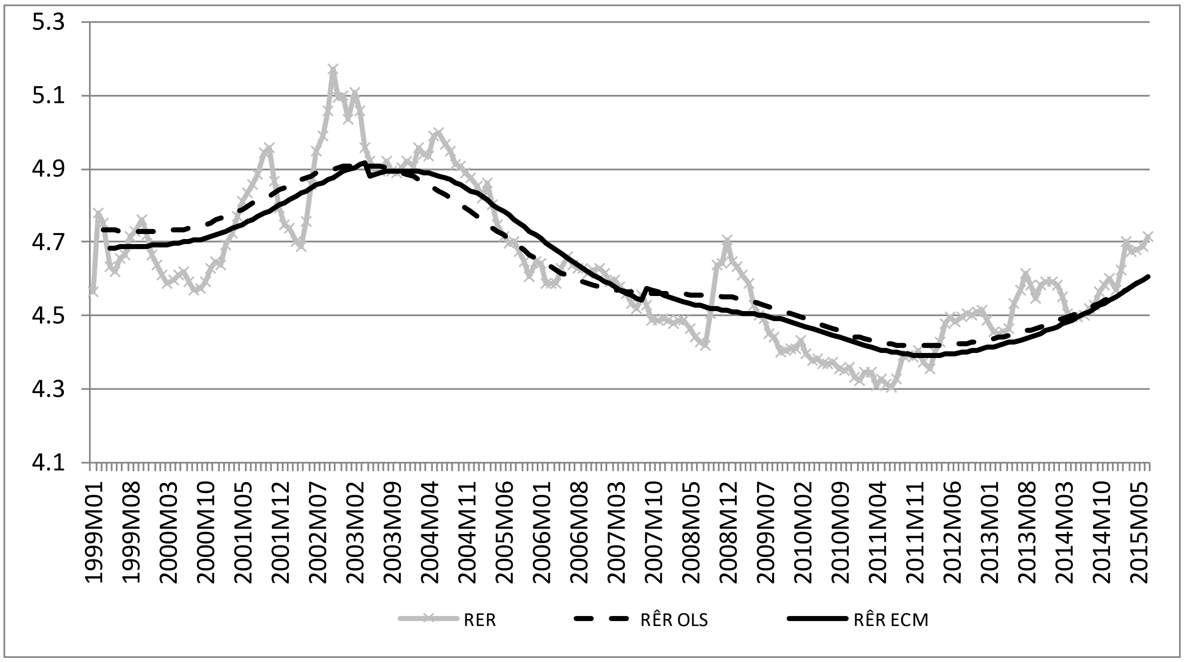
The coefficients of the econometric model are used to estimate the long-term trend of the real exchange rate (RÊR). This result is then compared with the actual exchange rate to build an index that allows us to assess whether the latter is overvalued, undervalued or in tune with the estimated "optimal" level. Following Edwards (1989) and Alberola (2003), our study uses the Hodrick-Prescott (HP) filter technique to estimate the RÊR. Figure 1 shows the evolution of the actual real exchange rate (RER) (as informed by Brazil’s Central Bank) and the estimated real exchange rates in accordance with our two econometric models (OLS and EMC). The results are presented in logarithms.

[28] Note that these two structural variables were partly responsible for the long-term trend of appreciation of the Brazilian currency in real terms, as predicted by economic theory.

**Figure 1**

**Long-term actual and estimated real exchange rates for Brazil**

**January 1999 to July 2015 (in logarithms)**




Sources: For actual real exchange rates *RER,* Brazil's Central Bank; and for estimated real exchange rates, econometric estimates by the authors according to the proposed methodology.

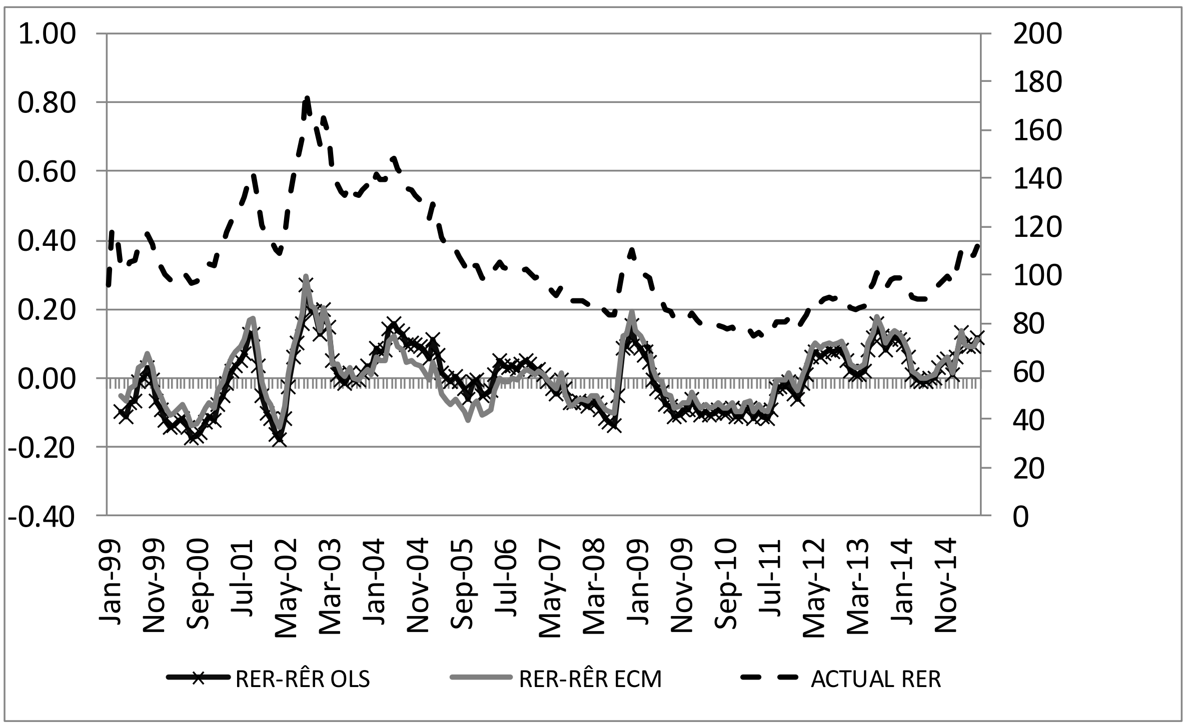
The robust results of our estimates can be confirmed not only by the significance level of the estimated coefficients (detailed in Table 2), but also by the superposition of the long-term paths of the estimated real exchange rates by the two estimation models, indicating quite close results both in OLS and ECM estimates. Moreover, it is worth noting the high correlation between the trajectories of the estimated real exchange rates (on both models) and the actual real exchange rates. The two estimated models suggest that the real exchange rate in Brazil began an appreciation trend between the end of 2003 and early 2004, despite 2004, the observed real exchange rate still registered a significant level of undervaluation, as can be seen in Figure 2.

Figure 2 allows us to compare the trajectories of the actual real exchange rates with long-term estimated real exchange rates according the OLS and ECM models.

**Figure 2**

**Undervaluation and overvaluation levels of the actual real exchange rates in relation to the estimated real exchange rates**

**January 1999 to July 2015**




Notes: i) The actual real exchange rates (shown in the top lines of the Figure) are expressed as index numbers as indicated on the right side (average of 2000=100): above 100 means undervaluation of the Brazilian real related to the base year; lower than 100 means overvaluation of the Brazilian real related to the same base year (average of 2000).

ii) The percentages of undervaluation and overvaluation were calculated as the difference between the observed real exchange rate (RER) and the long-term trends of the estimated real exchange rates by the two models (RÊR). If this result is greater than zero, there is an undervaluation of the Brazilian real; if it is less than zero, there is an overvaluation. These results, expressed in percentages, are shown on the vertical scale on the left of Figure 2.

Sources: Estimated by the authors according to the methodology described above; Data for the actual exchange rates from Brazil's Central Bank (see also Appendix 1).

With respect to the estimated long-term real exchange rates by both models (indicated by the two overlapping lines at the bottom of Figure 2), results below 0.00 indicate overvaluation (in percentage) of the actual exchange rates in relation to the estimated real exchange rates, while results above 0.00 indicate undervaluation related to these rates. Yet with respect to the observed real exchange rate (indicated by the dotted line at the top of Figure 2), indices below 100 mean overvaluation with respect to the average of 2000 (which is the year when the actual real exchange rate was in equilibrium or equal to 100, according to Brazil's Central Bank), while indices above 100 denote undervaluation compared with the average of 2000.

Once we have estimated the long-term trajectory of the real exchange rates according to the two models, we must describe the methodology for determining the real exchange rate equilibrium and identify the period in which the real exchange rate reached its "optimal" level for economic development. Once we have identified this period, we can finally conclude if the nominal exchange rate observed in the first half of January (the period when we finished this paper) was overvalued, undervalued or equal to its long-term "equilibrium" level.

The criteria for the choice of the period in which the real exchange rate reached the "equilibrium" level for Brazil's economic development must fulfill three simultaneous conditions: i) in line with recent empirical studies already cited, according to which the domestic currency should be marginally undervalued (i.e. the domestic currency must indicate a small real depreciation against the US dollar or to a basket of currencies of major foreign trade partners), the chosen period should fall on a subperiod in which the estimated real exchange rate (and not the observed real exchange rate) is a little (but not too much) undervalued (above 0.00 in Figure 2); ii) the chosen subperiod should fall on a phase in which the macroeconomic indicators are relatively strong, especially the current account balance, which must be in equilibrium or show a surplus; and iii) the chosen subperiod should fall on a phase in which the observed real exchange rate is not overvalued (indices should not be below 100 in Figure 2).

Following the proposed criteria, all periods in which the observed or estimated real exchange rates were overvalued must be discarded (for instance, from January

2010 to January 2012, to name one).[29] In addition, subperiods must be also discarded when the estimated real exchange rate, by having been excessively undervalued, could have permanent effects on inflation rates, like, for instance, the subperiod between April 2002 and April 2003.[30] Note that the subperiod from April 2012 to April 2013 must be discarded as well because although the estimated real exchange rate showed a small undervaluation − an average of 7% in the subperiod, according the average of the two estimated models −, satisfying the first condition, not only was the observed real exchange rate overvalued (a real exchange rate average index of 95.70), but the Brazilian macroeconomic indicators were also already showing clear signs of deterioration.[31]

A little more detailed inspection in Figure 2 shows that the "optimal" real exchange rate was reached at some phase along the subperiod between June 2003 and April 2005. It was the only period that simultaneously satisfies the three conditions set out above: firstly, the Brazilian economy, being at the end of the consolidation of its macroeconomic adjustment that had begun after the external crisis of 1999, was showing significant real GDP growth rates and a current account surplus;[32] second, the average estimated real exchange rate according to the two models indicated a small undervaluation of 5.05%; and finally, the average index for the observed real exchange rate showed no sign of overvaluation.[33] Thus, taking the subperiod between June 2003

[29] During this period, the estimated real exchange rates was 7.8% overvalued (average of the two models), the index of the observed real exchange rate (RER) was 81.67 (indicating an overvaluation of 18.3% of the Brazilian real related to the average of 2000) and economic indicators were already much less solid than, for example, in 2007. In fact, taking only the year 2011 and naming just two indicators, according to Brazil's Central Bank, the real GDP growth rate was 3.9% (against 6.1% in 2007) and the current account deficit had already reached around 2.1% of GDP (compared with a surplus of 0.1% in 2007).

[30] Our models indicate a very excessive average estimated undervaluation of the Brazilian currency between April 2002 and April 2003 (of around 11%, average of both models).

[31] Restricting to only two indicators in 2013, according to the database of Brazil's Central Bank, the real GDP growth rate was 3.0% (against 4.5% per year between 2007 and 2010) and the current account had already reached a deficit equivalent to 3.6% of GDP.

[32] In 2004, for example, the database of Brazil's Central Bank registered a real GDP growth rate of 5.8% and a current account surplus of 1.8% of GDP.

[33] The average index for the observed average real exchange rate was 135.52, indicating a real undervaluation of 35.5% compared with the average of 2000. One could argue that this subperiod should

and April 2005 as the one when the real exchange rate would have reached its "optimal" level, the average estimated index of long-term real exchange rate was 127.82 (OLS: 125.87 and VEC: 129.87).[34] Comparing this latter estimated index of the real exchange rate with the observed real exchange rate in July 2015 – the last month for which data were available for all variables of the model – (corresponding to 111.81), we conclude that, in this last month, the Brazilian real still showed a real overvaluation of around 14.36%, compared with its long-term "optimal" level. That is, in July 2015, the average nominal exchange rate should have reached approximately 3.88 Brazilian reals per US dollar (compared with the observed average nominal exchange rate of 3.39 Brazilian reals per US dollar) to preserve the "optimal" level achieved in the subperiod June 2003 to April 2005.

Although the available data have only allowed our econometric estimation to be run until July 2015, we adjusted the results for this latter period until December 2015, based on the relative real purchasing power parity hypothesis.[35] Based on data for consumer price index in Brazil and the United States (respectively, the IPCA and the CPI) until December 2015 and accumulated inflation rates between August and December 2015 (IPCA: 3.6%; CPI: -0.1%)[36], we conclude that the "optimal" real

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not be taken as the one when the real exchange rate has reached its "optimal" level due to the excessive real undervaluation of the currency. However, this critique is misleading for two reasons: first, because what registered as a high level of undervaluation was the observed real exchange rate (and not the estimated real exchange rate, whose indices are constructed using domestic and foreign inflation differentials as deflators); and second (and perhaps more importantly), as can be seen in Figure 2, the Brazilian currency had been eliminating the excessive undervaluation since October 2002, when a clear overshooting of the exchange rate of the Brazilian real per US dollar had occurred. As stated by Barbosa Filho (2015: 405), the 2003-2005 period corresponded to a phase of "exchange rate adjustment", during which "the appreciation of the Brazilian real basically eliminated the rapid and substantial undervaluation accumulated in the previous years."

[34] As all series are in logarithmic terms, we used the anti-logarithmic function to find these indices of the estimated real exchange rate.

[35] As already discussed above, the relative purchasing power parity hypothesis ensures that, for preserving the real level of the purchasing power of a currency, the nominal exchange rate should be corrected by the difference between the accumulated domestic and foreign inflation rates.

[36] Brazil's data from the Brazilian Institute of Geography and Statistics (IBGE), and the US's data from the US Bureau of Labor Statistics. For IBGE, http://www.ibge.gov.br/home/estatistica/indicadores/precos/inpc_ipca/defaultinpc.shtm. For the United States, http://www.bls.gov/cpi/ . Accessed on January 20th, 2015.

exchange rate in December 2015 should have been around 4.02 Brazilian reals per US dollar. This result is very close to the average nominal exchange rate of the month (3.90 Brazilian reals per US dollar) and exactly equal to the average of the first half of January 2016 (4.02 Brazilian reals per US dollar, as stated on the website of Brazil's Central Bank). Thus, after experiencing a long cycle of significant real appreciation since the end of 2005 (interrupted only by six months in the aftermath of the September 2008 global crisis), the real exchange rate in Brazil reached its "optimal" level in mid-January 2016.

We understand that, for deducing whether in a relatively short period of time (say, in the next two years, that is, until the end of 2017) the Brazilian real will be overvalued, undervalued or equivalent to its "optimal" level, the same procedure of adjustment based on the relative purchasing power parity hypothesis could be applied. However, for longer periods, since the long-term trajectory of the real exchange rate is strongly affected by structural variables and by short-term economic policies, we suggest that models for determining the "optimal" level such as ours (or similar to ours, as that proposed by Marconi, 2012) be re-estimated.

## 5. Conclusion

In the recent overvaluation cycle of the Brazilian real, as occurred between mid-2005 and the end of 2014, and only temporarily interrupted in the six months that followed the September 2008 global financial crisis, Brazil's former Minister of Finance, Guido Mantega, attributed this trend to external factors. Particularly, he attributed it to the quantitative easing policy (QE) in the US, which resulted in a huge expansion of the liquidity of the US dollar in global markets, the main cause of the real appreciation of emerging countries' currencies, notably the Brazilian real. He also accused the Federal Reserve Bank (FED) of the United States of spreading a "currency war" throughout the world exchange markets.

In a paper prepared for the traditional Mundell-Fleming Lecture, sponsored annually by the International Monetary Fund, Ben Bernanke (2015), the former chairman of the FED, showed that Mr. Mantega's accusations had no theoretical and empirical support. According to Bernanke (2015: 3-4), expressions like "currency wars" in such a context make no sense because:

> *concerns about currency wars on the part of emerging-market policymakers appear to be motivated in large part by those 4 policymakers having separate goals for their own exchange rates, over and above assuring the stability of domestic output and incomes. To the extent that they have additional exchange-rate objectives, foreign policymakers are constrained primarily by the Mundell-Fleming "trilemma"—the impossibility of combining free capital flows, independent monetary policy, and exchange rate targets—not by US policy per se.*

Moreover, Bernanke (2015:4, boldface ours) also argued "that monetary and exchange-rate policies should focus on macroeconomic objectives, with the problem of spillovers being tackled by regulatory and macroprudential measures, **possibly including targeted capital controls**, and through careful sequencing of market reforms". Not surprisingly, as recently argued by Hey (2015:1) in an influential academic article, "the global financial cycle transforms the trilemma into the "dilemma" or an "irreconcilable duo": independent monetary policies are possible if and only if the capital account is managed."

Bernanke's criticisms are relevant because, as Aizenman et al. (2010) also showed, most Asian countries have sought to avoid long cycles of chronic appreciation of their currencies in real terms by adopting a mix of exchange rate policy instruments aiming at overcoming the constraints imposed by the "impossible trinity." According to the authors, after the traumatic consequences from the 1997 Asian crisis – whose roots can be linked to the previous period in which massive net foreign capital inflows had produced significant overvaluation of their currencies – policy-makers in most countries in the region sought to keep monetary and exchange rate stability by using a mix of available instruments, such as interventions in the spot and forward exchange markets, regulatory and macroprudential measures as well as ad hoc capital controls.[37] Needless to say that the use of capital control instruments, which was considered heretical by multilateral credit institutions some years ago, has been advocated recently by the International Monetary Fund (IMF) in official documents (see Ostry et al., 2011, a study published as IMF Staff Notes). Our suggestion is that Brazilian policy-makers, by reflecting on the Asian example , adopt prudently and efficiently, the menu of exchange rate policy instruments to prevent the economy from a new long cycle of chronic appreciation of the Brazilian currency in real terms.[38]

We have already highlighted that a slightly undervalued currency works as a powerful driver for promoting structural change, economic development and catching up in the long term. With respect to these expected results, however, it is worth warning that, even if the Brazilian real exchange rate is successful at maintaining the "optimal" level, which was reached in January 2016, it will not be an easy task to overcome the huge technological backwardness accumulated by the Brazilian manufacturing industry in the last decade.[39] In fact, the technological and relative weight of the Brazilian manufacturing sector is a *sine qua non* condition for sustaining higher levels of productivity not only in this sector, but also in the economy as a whole. Such a conclusion is in tune with robust empirical evidence that the manufacturing sector (even in the micro-electronic era) is still the main dynamic engine of productivity growth in this sector and in the economy as a whole, as pioneeringly emphasized by Verdoorn (1949) and Kaldor (1966).[40]

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[37] See Aizenman et al. (2010) for the general case of Asia, and Subbarao (2014) for the case of India.

[38] Unfortunately, it seems that Brazilian policy-makers continue to not take seriously the real exchange rate as an important macroeconomic price for economic development. On the occasion when we were finishing this paper (end of September 2016), Brazil's Central Bank registered an observed nominal exchange rate of 3.22 Brazilian reals per US dollar for September 2016 (average until September 23rd), corresponding to an overvaluation of 24% in relation to the "optimal" real exchange rate.

[39] According to Nassif, Feijó and Araújo (2015), the Brazilian technological gap, measured as the ratio between Brazil's labour productivity and US's labour productivity (this latter being a proxy for the international technological frontier), after increasing from 70% to 80% between 1980 and 2000, was stationary in this latter level by 2013.

40 For recent empirical evidence on this topic (called the Kaldor-Verdoorn law) for Latin American countries, see Ros (2014).

However, due to the strong regression of the industrial structure and reprimarization of Brazilian exports in recent decades[41], technological restructuring and development, by being strongly path-dependent and locked-in, may be "locked" for a long time. This means that even consistent industrial and technological policies, in coordination with short-term macroeconomic policy, may not be able to eliminate the "hysteresis" of the Brazilian productive structure after more than two decades of high real interest rates (and such high capital costs) and overvalued real exchange rates.[42] As argued by Baldwin and Krugman (1989: 653), in their classic paper, "if it is wrong to ignore feedbacks from trade to exchange rate, it is probably also wrong to ignore feedback to the costs of capital." According to the authors, "a temporary overvaluation is followed by a persistent reduction in the equilibrium exchange rate but not enough to regain lost markets" (*Ibidem*: 637).

As shown by Krugman (1991: 652) in another seminal paper, in virtue of the existence of static and dynamic increasing returns to scale, it is probable that an economy, which has deeply fallen behind in relation to the international technological frontier, has a long-term recovery with multiple equilibrium points. This means that “the choice among multiple equilibria is essentially resolved by history: to one or another [positive or negative] steady state.” Krugman also suggests in this paper that it was high time for economists to take more seriously the hysteresis phenomenon in economics.

For this reason, although it is unlikely that the adjustment of the real exchange rate to its “optimal” level is per se able to immediately reverse the recent trajectory of

[41] The loss of the share of the value added of the Brazilian manufacturing industry in total GDP (at 1980 constant prices) has been dramatic in recent decades: 1980: 21.6%; 1990: 18.1%; 2000: 15.1%; 2010: 13.9%; and first semester of 2015: 11.7%. Yet the reprimarization of the Brazilian exports basket can be pictured by the significant increase in the share of agricultural and natural resources-based manufactured goods in total exports, from 40.3% to 62.5% between 2000 and 2014. See Bresser-Pereira, Nassif and Feijó (2016).

[42] The notion of hysteresis, a physical phenomenon which was incorporated to economic theory by Blanchard and Summers (1986), relates to a situation in which a certain material (in our case, the competitiveness of the Brazilian manufacturing sector) has great difficulty to recover its original features (t-he high growth rates of productivity), even after being removed from the main sources of such disturbances (e.g., in our case, a significant overvaluation of a currency for a long period of time).

the Brazilian economy's falling behind[43], this competitive real exchange rate will play an important role in the redirection of the economy to a new process of catching up. Based on much empirical evidence showing strong correlation between a competitive real exchange rate and long-term growth, our main suggestion is that Brazilian policy-makers should consider the real exchange rate as a relevant strategic macroeconomic price for Brazil's economic development, and not as an eternal anchor to keep price stability.

**References:**


Aizenman, Joshua, Chinn, Menzie D., and Ito, Hiro (2010). "Surfing the Waves of Globalization: Asia and Financial Globalization in the Context of the Trilemma". *La Follette Working Papers Series 2010-009.* Robert M. La Follette School of Public Affairs. The University of Wisconsin-Madison.

Alberola, E. (2003). "Misalignment, Liabilities Dollarization and Exchange Rate Adjustment in Latin America". *Banco de Espanha Working Papers* 309, Banco de Espanha.

Amsdem, Alice. H. (1989). Asia's Next Giant: South Korea and Late Industrialization. Oxford: Oxford University Press.

Amsdem, Alice. H. (2001). The Rise of "the Rest": Challenges to the West from Late-Industrializing Economies. Oxford: Oxford University Press, 2001.

Araújo, Eliane (2009). Política Cambial e Crescimento Econômico: Teorias e Evidências para os Países em Desenvolvimento e Emergentes. Tese de Doutorado. Instituto de Economia da Universidade Federal do Rio de Janeiro.


[43] For empirical evidence on the falling behind of the Brazilian economy, see Nassif, Feijó and Araújo (2015a).

Baffes, John, Elbadawi, Ibrahim and O´Connel, Stephen A. (1999). “Single-Equation Estimation of the Equilibrium Real Exchange Rate” In Hinkle, L.E. and P.J. Montiel, P.J. *Exchange Rate Misalignment: Concepts and Measurement for Developing Countries*. *World Bank Research Publication*, Oxford University Press.

Baldwin, Richard e Krugman, Paul R. (1989). Persistent Trade Effects of Large Exchange Rate Shocks. The Quarterly Journal of Economics, Vol.104, nº 4, November, 635, 654.

Barbosa-Filho, Nelson (2015). “O Desafio Macroeconômico de 2015-2018”. Revista de Economia Política, Vol.35, nº 3 (140), julho-setembro:403-425.

Berg, Andrew and Miao, Yanliang (2010). “The Real Exchange Rate and Growth Revisited: The Washington Consensus Strikes Back?” *IMF Working Paper* 10/58. Washington: International Monetary Fund.

Bernanke, Ben (2015). Federal Reserve Policy in an International Context. Artigo preparado para a 16th Jacques Polak Annual Research Conference, November 5-6, 2015. Washington, DC: International Monetary Fund.

Blanchard, Olivier e Summers, Lawrence H. (1986). “Hysteresis and the European Unemployment Problem”. NBER Macroeconomics Annual 1986, Vol.1 (edited by Stanley Fischer). Cambridge, MA: The MIT Press:15-90.

Bogdanski, Joel, Tombini, Alexandre A. and Werlang, Sérgio R. C. (2000). “Implementing Inflation Targeting in Brazil”. *Working Papers Series* 1. Brasilia: Banco Central do Brasil (available at http://www.bcb.gov.br).

Bresser-Pereira, Luiz Carlos (2010). *Globalização e Competição: por que alguns países emergentes têm sucesso e outros não*. Rio de Janeiro: Ed. Campus.

Bresser-Pereira, Luiz Carlos, Nassif, André e Feijó, Carmem (2016). "A Reconstrução da Indústria Brasileira: a Conexão entre o Regime Macroeconômico e a Política Industrial – Propostas para o Brasil". Artigo preparado para a Mesa Especial "Estratégias para a reindustrialização", organizado pela Associação Keynesiana Brasileira (AKB), e apresentado no 43º Encontro dos Centros de Pós-Graduação em Economia (ANPEC), realizado em Florianópolis (SC), entre 8 e 11 de dezembro de 2015 (ainda não publicado).

Bresser-Pereira, Luiz Carlos, Oreiro, José Luis e Marconi, Nelson. (2014). Developmental Macroeconomics: New Developmentalism as a Growth *Strategy.* London: Routledge.

Calvo, Guillermo, and Reinhart, Carmen (2002)."Fear of Floating". *Quarterly Journal of Economics*, 117(2), pp. 379-408.

Calvo, Guillermo, Leiderman, Leonardo and Reinhart, Carmen (1993). "Capital Inflows and Real Exchange Rate Appreciation in Latin America. The Role of External Factors". *IMF Staff Papers*, Vol. 40, no. 1. Washington, DC: International Monetary Fund.

Dollar, David and Kraay, Aart (2003). "Institutions, Trade and Growth". *Journal of Monetary Economics*. Elsevier, vol. 50, nº 1:133-162. January.

Edwards, Sebastian (1988). "Real and Monetary Determinants of Real Exchange Rate Behavior: Theory and Evidence from Developing Countries". *UCLA Working Paper* Number 506. Los Angeles: University of California, Los Angeles. September.

Edwards, Sebastian (1989). *Real Exchange Rates, Devaluation, and Adjustment: Exchange Rate Policy in Developing Countries*. Cambridge, MA: MIT Press, 1989.

Engle, R. F., Hendry, D. F. and Richard, J. F. (1983). "Exogeneity". *Econometrica*. Vol. 51: 277-304.

Gala, Paulo (2008). "Real Exchange Rate Levels and Economic Development: Theoretical Analysis and Econometric Evidence". *Cambridge Journal of Economics* 32:273-288

Hahn, Frank (1984). Die Allgemeine Gleichgewichtstheorie. In: Bell, D. and I. Bristol (eds). Die Krise der Wirtschaftstheorie. Berlin, Springer Verlag.

Hamilton, J. D. (1994). *Time series analysis*. Princeton University Press.

Helmers, F. Leslie C.H. (1988). "The Real Exchange Rate". In Dornbusch, R. and F. Leslie C. H. Helmers (eds). *The Open Economy: Tools for Policymakers in Developing Countries*. Oxford: Oxford University Press.

Hirschman AO (1958). *The Strategy of Economic Development.* New Haven: Yale University Press.

Johansen, S. (1988). Statistical Analysis of Cointegrating Vectors. Journal of Economic Dynamics and Control, (12): 231–254.

Kaldor, Nicholas (1966). Causes of the slow rate of economic growth of the United Kingdom. An inaugural lecture. Cambridge : Cambridge University Press.

Kaldor, Nicholas (1978). The effect of devaluations on trade in manufactures. In: N. Kaldor. Further Essays in Applied Economics, Collected Economic Essays, Vol.6 London: Duckworth.

Kaltenbrunner, Annina (2008). "A Post-Keynesian Look at the Exchange Rate Determination in Emerging Markets and its Policy Implications: The Case of Brazil". Paper presented at the Research Network Macroeconomics and Macroeconomic Policies, 12th Conference on "Macroeconomic Policies on Shaky Foundations – Whither Mainstream Economics? 31 October-1 November, Berlin.

Kaltenbrunner, Annina (2010). "International Financialization and Depreciation: The Brazilian Real in the International Financial Crisis". *Competition and Change*, Vol. 14 (3-4), December: 296-323.

Keynes, John M. (1923). "A Tract on Monetary Reform". *The Collected Writings of John Maynard Keynes IV*. London: Macmillan, 1973

Krugman, Paul (1991). History versus Expectations. The Quarterly Journal of Economics, Vol. 106, no 2, May: 651-667.

Krugman, Paul R. e Taylor, Lance (1978). “Contractionary Effects of Devaluation”. *Journal of International Economics* 8: 445-456.

Lewis WA (1954). "Economic Development with Unlimited Supplies of Labor". *Manchester School of Economic and Social Studies*, 22 (2):139:191.

Lucas Jr., Robert E. (1988). “On the Mechanics of Economic Development”. *Journal of Monetary Economics*, 22: 3-42.

Marconi, Nelson (2012). “The Industrial Equilibrium Exchange Rate in Brazil: an Estimation”. Revista de Economia Política, Vol. 32, nº 4 (129):656-665, Outubro-Dezembro.

Myrdal G (1957). *Economic theory and underdeveloped regions*. London: Duckworth.

Nassif, André, Feijó, Carmem e Araújo, Eliane (2015a). “Structural Change and Economic Development: is Brazil Catching up or Falling Behind?” Cambridge Journal of Economics, Vol.39: 1307-1332 (Advance Access publication 12, November 2014).

Nassif, André, Feijó, Carmem e Araújo, E. (2015). “The BRICS’s long term economic performance”. Artigo preparado para a 19th Annual Conference of the Research Network Macroeconomics and Macroeconomic Policies (“FMM Conference: The Spectre of Stagnation? Europe in the World Economy/Area: Comparison of Economic Performance in Different Parts of the World”), Berlin, Germany, 22-24 October, 2015. Website: **http://www.boeckler.de/veranstaltung_imk_53337.htm**. Acessado em 17 de dezembro de 2015.

Nassif, André, Feijó, Carmem e Araújo, Eliane (2011). “The Long-term “Optimal” Real Exchange Rate and the Currency Overvaluation Trend in Open Emerging Economies: the Case of Brazil”. *UNCTAD Discussion Papers* nº 206. Geneva: United Nations Conference on Trade and Development (UNCTAD). December (available at http://unctad.org/en/pages/publications/Discussion-Papers-(Series).aspx). Acessado em 19 de janeiro de 2016.

Obstfeld, Maurice and Rogoff, Kenneth (1996). *Foundations of International Macroeconomics.* Cambridge, Mas The MIT Press.

Ostry, J., Ghosh, A.R., Habermeier, K.,Laeven, L., Chamon, M., Qureshi, M.S., Kokenyne, A. (2011). "Managing Capital Inflows: What Tools to Use?". IMF Staff Discussion Note. SDN/11/06. Washington, DC.: International Monetary Fund. April 5.

Ostry, J.D., Ghosh, A.R. e Chamon, M. (2012). "Two Targets, Two Instruments: Monetary and Exchange Rate Policies in Emerging Market Economies". *IMF Staff Discussion Note* 12/01. Washington, D.C.: International Monetary Fund.

Prasad, Eswar, Raghuram Rajan, and Arvind Subramaniam (2006). "Foreign Capital and Economic Growth". Washington: IMF Research Department.

Prebisch R (1950). The Economic Development of Latin America and its Principal Problems. New York: United Nations.

Razin, Ofair and Collins, Suzan M. (1999). "Real Exchange Rate Misalignments and Growth". *In* Razin, A. and E. Sadka (ed.). *The Economics of Globalization: Policy Perspectives from Public Economics.* Cambridge: Cambridge University Press.

Rodrik, Dani (2008). "The Real Exchange Rate and Economic Growth". Brookings Papers on Economic Activity, 2:365-412.

Romer, Paul M. "Increasing Returns and Long-Run Growth". *Journal of Political Economy*, 94, No. 5 (October): 1002-1037.

Ros, J. (2014). Productividad Y Crecimiento em América Latina: por qué la Productividad crece más en unas Economias que en Otras? Desarrollo Económico. México, D.F.: Naciones Unidas/Comisión Económica para América Latina y el Caribe (CEPAL).

Rosenstein-Rodan PN. (1943). "Problems of Industrialization of Eastern and South-Eastern Europe". *Economic Journal*, 53: 202-211. June-September.

Simonsen, Mário H. e Cysne, Rubens P. (1995). Macroeconomia. 2ª edição. São Paulo: Editora Atlas.

Solow, Robert M. (1956). “A Contribution to the Theory of Economic Growth”. *Quarterly Journal of Economics*, 70 (February): 65-94

Subbarao, D. (2014). “Capital Account Management: Toward a New Consensus?”. In: G. Akerlof, O. Blanchard, D. Romer and J. Stiglitz (eds). *What Have we Learned? Macroeconomic Policy after the Crisis*. Cambridge, MA: The MIT Press: 265-270.

Swan, Trevor W. (1956). “Economic Growth and Capital Accumulation”. Economic Record, 32 (November): 334-361.

Taylor, Alan M. and Taylor, Mark P. (2004). “The Purchasing Power Parity Debate”. *NBER Working Papers Series* 10607. Cambridge, Massachusetts. National Bureau of Economic Research.

Verdoorn, P. J. (1949). Fattori che Regolano lo Sviluppo della Produttivitá del Lavoro. L’Industria. Republicado como “Factors that Determine the Growth of Labour Productivity”. *In*: L. Pasinetti (ed.), *Italian Economic Papers*, Vol. II, Oxford: Oxford University Press, 1993.

Williamson, John (2008). “Exchange Rate Economics”. *Working Paper Series* WP 08-3. Washington, DC. Peterson Institute for International Economics.

## APPENDIX 1

### Description of variables and database sources

***RER*** is the Brazilian effective real exchange rate, obtained from the Series 11.752, available on Brazil's Central Bank database:

https://www3.bcb.gov.br/sgspub/localizarseries/localizarSeries.do?method=prepararTelaLocalizarSeries

***Y*** is the Brazilian per capita real GDP, expressed in US dollars. This variable was estimated as the ratio between the Series 4,385 related to the monthly GDP in US dollar and the Series 21,774 related to the population of the year (estimation from the Brazilian Institute of Geography and Statistics - IBGE). Both Series are available on Brazil's Central Bank database (see website above). For 1999, the population data refer to the Series 7,330.

***ToT*** is the Brazilian terms of trade, estimated by *Fundação Centro de Estudos do Comércio Exterior* (FUNCEX), available at IPEADATA: https://www.ipeadata.gov.br/

***CC*** is the Brazilian current account balance as a share of GDP. The current account balance is calculated as the ratio between the Series 2,731 (corresponding to the monthly current account balance) and the Series 4,385 (corresponding to the monthly GDP), both available on Brazil's Central Bank database (see website above).

***IDIFER*** is the difference between the short-term (monthly based) Brazilian nominal interest rate (*Swap DI Pré-360 dias*) and the short-term (monthly based) international nominal interest rate (*FDTR – US Federal Funds Target Rate,* used as proxy for international interest rates), both available on the following website:

https://www.blumberg.com/?utm_source=Microsoft&utm_medium=cpc&utm_campaign=BLUM

***RI*** is the stock of Brazilian international reserves (expressed as a share of GDP) and calculated by the ratio between the 3,546 (corresponding to the stock of Brazilian international reserves) and the Series 4,385 (corresponding to Brazilian GDP), both available on Brazil's Central Bank database (see website above).

***CR*** is Brazil's risk premium, represented by the *EMBI Brazil Sovereign Foreign Currency*, from JP Morgan, available at: https://www.macrodadosonline.com.br