A Model of Economic Growth for an Open Developing Country: Empirical Evidence for Brazil

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Abstract

Brazil liberalised its trade and finance in the 1990s as a strategy for higher economic growth. However, the country's GDP growth has been unstable and low compared to its own performance during the industrialization period. This paper builds a model of economic growth that accounts for the main components of effective demand as well as important specificities of developing economies to explain the economic dynamics after the liberalising reforms. The model is estimated for the case of Brazil from 1990 to 2010 and the results suggest that this economy became highly dependent on the world economic growth and the evolution of the real exchange rate. The main finding is that Brazil experiences higher economic growth only in favourable world scenarios but the evolution of the real exchange rate may stimulate investments that only reinforce the existing productive structure, affecting negatively the long-run economic growth.

Key Words: economic growth, effective demand, real exchange rate

JEL Classification: O40, E12, F43

1. Introduction

Brazil liberalised its trade and finance in the 1990s as a strategy for higher economic growth, replacing the Import Substitution Industrialisation (ISI) strategy. The ISI period (1950-1980) generated high economic growth rates and the country built a diversified manufacturing industry (Belluzzo and Almeida, 2002; Carneiro, 2002). However, the economic stagnation, high inflation and the collapse of the public finance during the debt crisis in the 1980s reduced the Brazilian State capacity to intervene in the economy and the necessary investments to keep the industrial structure updated were not undertaken. The Brazilian industrial structure got delayed compared to industrialised countries at the same time the world industrial production went through important changes – alteration in the business organization and technological advancements (Belluzzo and Almeida, 2002).

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The difficulties to resolve the balance of payments disequilibrium, to slow down inflation and to resume GDP growth influenced the Brazilian government to liberalise trade and finance and to privatize state industries and public utility services. According to Rodrik (2004), the result of the liberalising reforms in some Latin American countries, including Brazil, was slower economic growth, compared to other parts of the world and to their own performance in the 1960s and 1970s.

The central purpose of this paper is to understand the Brazilian economic dynamics after trade and financial liberalisation, specifically the reasons underlying its unstable economic growth and its poorer performance compared to its industrialization period. To achieve this aim, we develop a model of economic growth that accounts for the main components of effective demand in the determination of economic activity as well as important features of developing countries.

The novelty of this model is the inclusion of the influence of international trade and finance on the country's economic growth through the balance of payments. The balance of payments affects the nominal exchange rate and therefore domestic inflation and the real exchange rate. The model considers that the real exchange rate affects the country's external trade (imports and exports) as well as the country's internal absorption (investment and private and government consumption). The estimation of the model for the case of Brazil provides important insights to understand the Brazilian economic growth after 1990, explaining how a favourable world scenario generates good perspectives for the country to expand its economic growth and reduce its inflation in the short-run, but, at the same time, it does not create the conditions to stimulate changes in the productive structure, necessary to strengthen the country's competitiveness.

The paper is organized in six sections, including this introduction. Section two presents some stylised facts for the Brazilian economy. Section three shows the theoretical background, based on the Keynesian tradition. Section four develops the model of growth for an open developing country.

Section five estimates the model for the case of Brazil after trade and financial liberalisation. And section six presents the main conclusions.

2. Stylised Facts for the Brazilian Economy

Table 1 shows the Brazilian GDP, Exports, World GDP and Real Exchange Rate, all in level and in growth rates. The table reveals that Brazilian GDP growth is unstable with a short period of relatively higher growth rates between 2004 and 2008. Despite this short period, the Brazilian average GDP growth rate after the liberalising reforms was low, especially compared to the growth rates verified during the ISI period.[2]

Table 1: GDP, World GDP, Exports, Imports and Real Exchange Rate (level and growth rates)

	Domestic GDP	World GDP	Exports	Imports	Real Exchange Rate	Domestic Growth	World Growth	Exports Growth	Imports Growth	Changes in Real Exchange Rate
1992	101.0	102.4	113.2	97.7	105.3	-0.5	2.4	13.2	-2.3	15.6
1993	105.7	104.9	121.9	120.0	101.1	4.7	2.4	7.7	22.9	-4.0
1994	111.3	108.8	137.7	157.2	90.0	5.3	3.8	12.9	31.0	-10.9
1995	116.2	112.9	147.1	237.5	74.0	4.4	3.7	6.8	51.1	-17.8
1996	118.8	117.0	151.0	253.5	69.7	2.2	3.7	2.7	6.8	-5.8
1997	122.8	121.7	167.6	284.0	67.7	3.4	4.0	11.0	12.0	-2.8
1998	122.8	124.9	161.7	274.5	70.7	0.0	2.6	-3.5	-3.3	4.4
1999	123.2	129.4	151.8	234.3	105.9	0.3	3.6	-6.1	-14.6	49.9
2000	128.5	135.6	174.3	265.4	97.4	4.3	4.8	14.8	13.3	-8.1
2001	130.2	138.7	184.3	264.3	120.9	1.3	2.3	5.7	-0.4	24.1
2002	133.7	142.7	191.1	224.5	133.6	2.7	2.9	3.7	-15.0	10.5
2003	135.2	147.9	231.5	229.7	138.4	1.1	3.6	21.1	2.3	3.6
2004	142.9	155.1	305.7	298.6	136.1	5.7	4.9	32.1	30.0	-1.6
2005	147.4	162.1	374.8	349.8	111.0	3.2	4.5	22.6	17.1	-18.5
2006	153.3	170.4	435.8	434.2	99.2	4.0	5.1	16.3	24.1	-10.6
2007	162.7	179.2	508.1	573.3	92.1	6.1	5.2	16.6	32.0	-7.2
2008	171.1	184.6	626.0	822.2	88.8	5.2	3.0	23.2	43.4	-3.6

[2] The Brazilian average GDP growth rate between 1950 and 1980 (industrialization period) was 7.4% per year and between 1990 and 2011 (period after liberalising reforms) was on average 2.7% per year.

2009	170.1	183.5	483.8	607.0	87.8	-0.6	-0.6	-22.7	-26.2	-1.1
2010	182.9	191.2	638.6	863.3	76.1	7.5	4.2	32.0	42.2	-13.3

Source: Own Calculation with data from the Central Bank of Brazil (2011) and IMF (2011). GDP and World GDP are at constant prices. The year-base for the Index for GDP is 1990 and for the World GDP, Exports and Imports is 1991. Exports and Imports are related only to goods in US$ dollars. Real Exchange Rate is the real effective exchange rate index ERP_i/P_d, with June/1994 = 100, where ER is the nominal exchange rate (domestic currency unit per foreign currency unit), P_i is international price and P_d is domestic price.

Table 1 also shows that domestic GDP, world GDP and exports follow the same path, both in level and growth rates. The Pearson's correlation coefficient for GDP growth and exports growth in the considered period was 0.70 and for GDP growth and world growth is 0.63, suggesting that world economic growth and exports growth have an influence on the dynamics of domestic GDP.

Imports are directly correlated with GDP and inversely correlated with the real exchange rate. Thus, higher economic growth with currency appreciation probably increases the country's imports. The opposite would occur when GDP decreases and the national currency depreciates.

The Pearson's correlation coefficient for domestic GDP growth and changes in the real exchange rate is negative (-0.61). Even if we exclude the year 1999, a big outlier, the correlation coefficient remains the same. This coefficient is expected to be positive if the impact of the real exchange rate on GDP takes place through exports. In this case, an increase in the real exchange rate would stimulate exports, positively affecting the country's economic activity. Conversely, a currency appreciation would make imports relatively cheaper, therefore stimulating imports and affecting negatively exports, with negative consequences for the country's GDP. However, the correlation is negative, suggesting that the effect of the real exchange rate on the country's economic activity may be more complex than what the standard theory implies for the case of Brazil after trade and financial liberalisation. A possible explanation is the influence of the balance of payments on both the real exchange rate and domestic GDP, as discussed later in the paper.

There is an important debate on the effects of exchange rates on Brazil's economic performance. Bresser-Pereira (2009 and 2011) and Nassif et al. (2011), for example, are concerned with the impact of a possible tendency towards the currency overvaluation on the long-run economic growth. Additionally, IEDI (2012) points that the increasing globalisation of the manufacturing production together with misalignments in the real exchange rate can cause irreversible losses in the manufacturing structure of countries with overvalued currency. Table 1 shows that higher economic activity is followed by periods of currency appreciation and lower economic activity is followed by periods of currency depreciation. In this case, even with a simple oscillation in the real exchange rate without a clear trend, changes in the real exchange rate will probably affect negatively the economic growth trend.

The concern with the impact of a currency overvaluation on the Brazilian economic growth brought back the deindustrialisation debate. According to Palma (2005), Brazil is passing through a process of deindustrialisation as a consequence of trade and financial liberalisation. Palma (op. cit.), Nassif (2006) and IEDI (2007) identify the process of deindustrialisation as lower share of manufacturing in the GDP growth or total employment as well as changes in the manufacturing production structure. In the last case, a process of deindustrialisation would be identified as a higher share of sectors intensive in natural resource vis-à-vis sectors intensive in capital, knowledge and technology.

This paper contributes to the debate by explaining the difficulties Brazil has faced to boost its economic growth after trade and financial liberalisation, as revealed by Table 1. In this sense, the paper discusses how the economy evolves after trade and financial liberalisation and how its performance became dependent on the international scenario. The suggested analysis does not evaluate whether Brazil is passing through a deindustrialisation process, but it relates the difficulties to boost the country's economic growth with the impediments to develop the productive structure. A specificity

exhibited in the Table 1 is that the correlation between the real exchange rate and GDP is not affected mainly by exports and imports, as expected by the standard theory. The paper explains this negative correlation between GDP and the real exchange rate, relating it to the influence of the international scenario on consumption and investment as well as on the real exchange rate.

3. Theoretical Background

In the Keynesian tradition, the effective demand determines the use of the production capacity. Consumption uses the production capacity while investment increases it. Therefore, investment is crucial for the continuity of production growth. Two types of investment can be distinguished: one that increases the production capacity without changing products and productivity and another that introduces new products and increases productivity (Possas, 1987). Investment that only increases the production capacity is a result of higher sales expectations, without changing the competitors' position in the market. In this case, expectations of sales of each supplier correspond to the expectations of the total sales in the market. Investment that introduce new products and increase productivity change the competitors' position in the market. The suppliers that improve products and processes expect to grow, absorbing part of the market that belongs to other suppliers. This market competition with new products and production processes can increase the volume of total sales in the market. Higher sales associated with changes in products and productivity has an important role in the determination of the growth trend of production.

Thus, two processes can be identified in the production activity. In the first one, already existing production increases in all sectors of the economy, without augmenting productivity. In the second one, new products are developed, higher productivity achieved in many sectors of the economy and its growth rate tend to be higher than in the first process. In the first case, the production structure is not

altered, while in the second, it is. Therefore, the first case represents “simple” economic growth while the second represents economic development (Possas, 1987).

During the economic development process, investment changes products and processes and competition affects the demand for products. Kaldor (1967), however, considers that economic growth is led by demand. This interpretation is reasonable when investment comes together with technical progress. A better evaluation is necessary when investment induces high changes in production and demand while introducing new products and processes. In times of high transformation in technology and production organization, economic growth should not be analysed as led by the effective demand. Under these circumstances of high transformations in the economic structure, effective demand is still determining the magnitude of GDP, although a deeper study of the productive structure is necessary to understand the evolution of effective demand. However, times of high transformation in the economic structure are exceptional and investment that introduces technical progress is predominant, in the sense suggested by Kaldor (Possas, 1987).

In the case of investment that introduces technical progress, the activity sectors have different potentialities. They include novelties and increase productivity in terms of the nature of their own products and processes. Changes in products in one sector can facilitate changes in products and processes in other sectors. In an economy with high share of these sectors that creates new products and increase productivity, its economic growth tends to be higher than in an economy that only uses these new products and higher productivity. Economic growth would be higher when both production and the use of these products are combined.

Similar considerations on the different sectoral innovation made Kaldor (1967) highlight the importance of the manufacturing production to economic growth. Schematically, it is possible to affirm that primary production of natural resources processing tend to present lower returns to scale, while in manufacturing production, returns tend to be higher when the production scale is greater. In services,

higher production scale tends to keep returns constant (Lall, 2003). Accordingly, manufacturing growth is crucial for the economic growth process. Manufacturing growth introduces new products and increase productivity, not only in the manufacture, but also on the primary production and in services.

Kaldor (1967) presents some empirical generalisations, which attempt to account for growth rate differences between countries (McCombie and Thirlwall, 1994). The first proposition affirms that the faster the rate of growth of the manufacturing output, the faster will be the rate of growth of labour productivity in manufacturing due to the existence of static and dynamic economies of scale or increasing returns to scale. This proposition is known in the literature as Verdoorn's Law and it is often pointed out as a key player in models of circular and cumulative causation in the Kaldorian tradition (Libanio, 2006). The second proposition affirms that there is a strong positive relationship between industrial sector growth rate and the productivity growth outside the industrial sector. Finally, the last proposition maintains that the faster the rate of growth of the manufacturing sector, the faster will be the rate of growth of GDP. In short, and in McCombie and Thirlwall's (1994) words:

"Kaldor substantiates the role of manufacturing as the 'engine of growth'" (p. 166).

Economic growth depends on the effectiveness of investment that increases the production capacity in the manufacturing and in other sectors of the economy. Investment means the purchase of capital goods produced by the manufacturing industry. Thereby, manufacturing growth depends crucially on investment in the economy.

International relationships (both trade and finance) are crucial for the economic activity of an open economy. Thus, the balance of payments should be properly accounted. McCombie and Thirlwall (1994) point out three main reasons for the importance of considering carefully the balance of payments, especially its current account, and its effects on the growth performance. The first one is related to the behaviour of exports and imports. An adverse long-run trend in the performance of

exports and imports will have implications for the real output and employment. This is because import penetration worsens the balance of payments and takes custom away from domestic activities at the same time. In this sense, the balance of payments has implications for the functioning of the real economy. The second reason is that no country can grow faster in the long run than that rate consistent with balance of payments equilibrium on current account, unless it can finance ever growing deficits. In the short term, growing current account deficits may be financed by capital inflow, but this is not possible to maintain in the long run.[3] And finally, the third reason is that high interest rates favour the accumulation of financial assets and discourage investment in productive assets. The conclusion of McCombie and Thirlwall (1994) is that dynamic exports are required to cover imports and other components of the current account of the balance of payments for a country to have higher economic growth.

4. Economic Growth Model for an Open Developing Country

In this section, we build a model for economic growth accounting for the main components of effective demand and other specificities of developing countries, such as currency inconvertibility, high short-term public debt[4] and an inflationary policy based on high interest rates. Currency inconvertibility refers to developing countries' currencies that do not perform their money functions in an international context, making the exchange rate highly volatile, therefore affecting domestic

[3] Several models of economic growth incorporate the balance of payments restriction along with a Kaldorian framework. For a discussion of these models, see McCombie and Thirlwall (1994), Thirlwall (2011, 1979), Dixon and Thirlwall (1979), Lopez and Cruz (2000), Thirlwall and Hussain (1982), Moreno-Brid (1998-9, 2003), Araujo and Lima (2007) and Cimoli and Porcile (2010). Many other studies validated the model of growth constrained by the balance of payments for various countries, including developing ones, such as Britto (2008), Carvalho et. al. (2005), Carvalho and Lima (2009), Jayme Jr. (2003) and Pacheco-López and Thirlwall (2005).

[4] The term 'high short-term public debt' is explained in equation 8 for the market interest rate.

inflation.[5] Inflation policy has been undertaken through a macroeconomic policy of activity slowdown with high bank rate, primary surplus (tax revenues higher than non-financial expenditures from the State) and flexible exchange rate.[6]

The effective demand assumption implies that aggregate demand determines sales, sales determine production and production determines income and employment. Firms and/or producers take into consideration their expectations about future profit to decide the amount of production, therefore determining the level of production and employment. Changes in expectations can make entrepreneurs to alter their production, consequently influencing the level of employment (Davidson, 2001).

Aggregate demand (AD) consists of domestic consumption – private consumption (C) and government expenditure (G) –, gross investment (I) and exports (X). This aggregate demand determines domestic production (Y) and imports (Q). The equation for the aggregated demand is:

$$AD_t = C_t + I_t + G + X_t - Q_t = Y_t \qquad (1)$$

Where the sub-index t represents time.

According to Possas (1987), it is possible to distinguish two aspects of the effective demand determining the economic activity. The first aspect relates to the decision of purchasing that can be from inside the economy (consumption, government expenditure and investment) or from abroad (exports). The second aspect concerns the performance of the effective demand regarding production, where part of the effective demand stays in the country in terms of GDP, i.e. national production, and part is lost for international production, i.e. imports. These two aspects of the effective demand is visualized by rearranging equation 1 and provide the following equation:

[5] The term inconvertible currency is adopted in the Brazilian literature and a deeper discussion of this term is found in Baltar (2013), Prates (2002), Conti (2011) and Carneiro (2008).

[6] At the beginning of the reforms, the macroeconomic regime made use of a fixed or crawling-peg exchange rate, in combination with a more open trade policy. The exchange rate was the price anchor and the use of high interest rates was designed to attract foreign capital for balance of payments purposes. After repeated financial crises, the crawling-peg exchange rate was abandoned and the flexible exchange rate and the Inflation Targeting Regime were introduced.

$$C_t + I_t + G + X_t = Y_t + Q_t \quad (2)$$

The effective demand materialises when the decisions for consumption, government expenditures and investment – purchases from inside the economy – and for exports – purchases from outside the economy – are taken, determining domestic production (Y) and imports (Q). The first aspect of the effective demand determining the economic activity is when internal absorption and external purchases of domestic products are decided. These two purchase decisions determine the second aspect the effective demand determining the economic activity, i.e. domestic production, in terms of GDP, and imports. Hence, consumption, investment and government expenditures can be aggregated as internal absorption (A):

$$C_t + I_t + G_t = A_t \quad (3)$$

Internal absorption and exports determine the effective demand.

$$A_t + X_t = Y_t + Q_t \quad (4)$$

The growth rate of the effective demand equals the weighted average growth of internal absorption (a) and exports (x) on the left hand side and the weighted average of GDP growth (y) and imports (q) growth rate on the right hand side, as follows:

$$(1- \theta)a_t + \theta x_t = (1-w)y_t + wq_t \quad (5)$$

where θ is the proportion of the effective demand triggered by exports, i.e. $\theta = \frac{X}{A+X}$, and thus (1- θ) corresponds to the proportion of the effective demand triggered by the internal absorption. Similarly, w is the proportion of the effective demand triggered by imports, i.e. $w = \frac{Q}{Y+Q}$ and, thus, (1-w) is the proportion of the effective demand attended by domestic production. Rearranging equation 5, we have:

$$y_t = \frac{(1-\theta)}{(1-w)} a_t + \frac{\theta}{(1-w)} x_t - \frac{w}{(1-w)} q_t \quad (6)$$

Equation 6 shows that economic growth is a function of the growth rate of internal absorption, exports and imports.

Internal absorption (consumption, government expenditures and investment) is higher if GDP is greater. Consumption is traditionally considered as a function of GDP. Higher economic growth means more jobs and income for the population. The relationship between consumption and GDP emphasize the role of investments determining GDP. The theory of the multiplier reveals how the level of GDP react to changes in investment, considering that consumption follows the GDP path, but by less than the full amount of the change in income (Matthews, 1959). The part of consumption formed by durable goods is purchased in instalments and access to credit is facilitated when the income of the population is higher. Hence, greater GDP means a more favourable situation that allows people to take debts. Investment, in turn, depends on the degree of productive capacity utilization. Greater GDP increases the use of this capacity, thereby inducing more investment (accelerator idea).

However, internal absorption is also influenced by the market interest rate that affects the cost to finance both consumption and investment. The capitalist evaluation of investments to increase the productive capacity also considers other possibilities of capital applications and accounts high risk and low liquidity related to this type of capital application. Therefore, this investment should provide sufficiently high profitability to compensate the high risk and low liquidity. The level of interest rate, then, indicates both the cost of financing and the capital application in relation to other existing alternatives. High market interest rates mean that only highly profitable investments could be undertaken, implying an inverse relationship between investment and interest rate: lower levels of interest rates reinforce the effects of GDP on internal absorption (consumption, government expenditures and investment) because lower interest rates imply lower financial costs and low profitability of other capital application vis-à-vis investments to expand the productive capacity.

The novelty of this model consists of the inclusion of the real exchange rate determining internal absorption by considering that the real exchange rate influences the impact of the GDP and market interest rate on internal absorption. In an open developing economy with a macroeconomic policy that prioritizes low inflation, the performance of GDP and market interest rate depends on the international scenario in terms of trade and finance. Macroeconomic policy will enable higher GDP growth and lower market interest rate only if the international scenario positively affects the country's international reserves. Higher international reserves decrease the nominal exchange rate, pressing domestic inflation down. Thus, lower nominal exchange rate and domestic inflation, for a given international inflation, reduces the real exchange rate.[7]

A favourable international scenario for trade and finance, then, cheapens imported inputs, consumption goods and capital goods, thereby increasing internal absorption (consumption and investment). However, lower real exchange rate due to a favourable international scenario impacts negatively the price-competitiveness of domestic production. In this case, investment in tradable goods may be negatively affected (Lima and Porcile, 2012).

Yet, investment may be stimulated by a favourable international scenario even if the national currency appreciates, affecting negatively the price-competitiveness of domestic production. This would be the case of investment in the production of non-tradable goods and tradable goods in which the country has high comparative advantage. Thus, decreases in the real exchange rate will affect the composition of investment and not necessarily the volume of investment.

[7] Baltar (2013) proposes some equations for the behaviour of the real exchange rate that depends on international inflation, changes in the nominal exchange rate and domestic inflation. The nominal exchange rate is assumed to be a function of the balance of payments and domestic inflation is examined by separating the behaviour of tradable and non-tradable goods prices. International inflation is deduced from the evolution of the real exchange rate and inflation in Brazil, supplying information on changes in international prices that are important for this country.

The inclusion of the real exchange rate as a determinant of internal absorption is then important in the determination of the specific effects of GDP and market interest rate. Changes in the real exchange rate indicates whether the international scenario favours or not economic activity (GDP growth and inflation); at the same time it designates the continuity of changes in GDP and the market interest rate that, in turn, affect internal absorption (consumption and investment). In other words, a favourable international scenario for trade and finance that positively affects the country's economic performance will increase the country's international reserves, appreciate the national currency, decrease domestic inflation, increase GDP growth, decrease the market interest rate and improve its public finance. Currency appreciation then synthesises these effects of the favourable international scenario for the country's economic performance, indicating the continuity of GDP growth, the reduction in the market interest rate, thereby reinforcing their effects on the internal absorption.

Under this positive scenario, families and firms expect that employment and income will increase, stimulating them to assume debts. The same perception of low inflation and equilibrium in the balance of payments and public accounts stimulates banks to offer more credit. Therefore, higher credit increases internal absorption and GDP, signalling the continuity of higher economic activity. In this sense, the currency appreciation generated by the positive international scenario is interpreted by families, firms and banks as if the prosperity of the economy will continue.

Conversely, an unfavourable international scenario will affect the balance of payments decreasing international reserves, depreciating the national currency, increasing domestic inflation, decreasing GDP growth, raising the market interest rate and deteriorating the country´s public finances. The currency devaluation would then synthesise the effects of the international situation, indicating the continuity of a bad performance for GDP and market interest rates, reinforcing the negative effects on internal absorption.

In short, the model considers that expectations on the continuity of the performance of the economy are influenced by inflation and the country's public account and balance of payments. The variable chosen to capture these expectations on the performance of the economy is the evolution of the real exchange rate. So, the growth rate of internal absorption (a) is a function of GDP growth (y), the growth rate of the market interest rate (r) and the growth rate of the real exchange rate (rer):

$$a_t = h_1 + b_1 y_t + b_2 r_t + b_3 rer_t \qquad (7)$$

The growth rate of the real exchange rate is defined as $(1+rer) = [(1+p_i)(1+er)]/(1+p_d)$, where p_i is international inflation, er is the growth rate of the nominal exchange rate, the nominal exchange rate defined as domestic currency units per foreign currency units, and p_d is domestic inflation. Government taxes are considered as given and its performance is included in the constant h_1. b_1 is expected to be positive due to the multiplier and accelerator effects. b_2 is expected to be negative because of the negative influence of interest rate on internal absorption. And the sign for the coefficient b_3 can be positive or negative, depending on the effects of the real exchange rate on internal absorption as discussed previously. The variable 'growth of real exchange rate' is considered an endogenous variable but its determinants are not discussed in this paper. The behaviour of the real exchange rate depends on changes in the nominal exchange rate and domestic and international inflations and the corresponding equations are found in Baltar (2013). h represents a constant in all equations, changing the sub-index and b represents the coefficients of the variables also changing the sub-indexes.

The growth rate of the market interest rate is considered as a function of the growth rate of the bank rate and the growth rate of the public debt. The bank rate is an exogenous variable set by the monetary authority and an increase in the bank rate raises the market interest rates. The public debt is an endogenous variable of the model and its effect on the market interest rate is especially high for the case of a developing economy. Usually, developing countries do not possess large and developed domestic financial system. Besides that, the public debt tends to be big for the size of the domestic

financial system and it tends to be a short-term public debt.[8] Accordingly, to refinance the public debt, the interest rate tends to be high. If the interest rate for the public debt is high, private debt is attractive for the domestic financial market when its interest rate is also high. Consequently, the evolution of the public debt affects the market interest rate because the conditions to refinance the public debt depend on the evolution of this debt and impact the costs of credit for the private sector. So, an increase in the public debt tends to make more difficult the conditions to refinance this public debt and the interest rate increases. Consequently, private interest rate has to increase to make private loans attractive in the domestic financial market. Thus, increases in the public debt tend to raise the level of the interest rate of the domestic financial system.

The public debt in a developing country has special characteristics which are not only due to fiscal unbalances. The fact that the public debt is big for the size of the domestic financial system and it is a short-term debt makes the refinancing of this debt more difficult, producing high interest rates with consequences for the evolution of the public debt. An increase in the public debt can materialise even when the government has primary surplus (tax revenues higher than the non-financial expenses of the government) and does not need to take loans to finance the fiscal deficit. As a result, the refinancing of the public debt affects the level of the interest rate of the domestic financial system even if tax revenues are higher than non-financial expenses of the government. Therefore, applications of the private sector will be attractive only if they promise to pay high interest rates.

So, the growth rate of the market interest rate is then a function of the growth rate of bank rate (br) and the growth rate of the public debt (pd):

$$r_t = h_2 + b_4 br_t + b_5 pd_t \qquad (8)$$

[8] For the case of Brazil, for example, the stock of the public debt in January 2006 was 46% of the GDP of the previous year. The average term of this debt was 28.76 months, i.e. 2.4 years; and 41% of this debt matures in 12 months (Lopreato, 2008). Because it is a short-term public debt, 46% of GDP is very high.

b_4 and b_5 are then expected to be positive. Bank rate is considered an exogenous variable and the model determines endogenously the public debt growth.

The growth rate of the public debt shows the relationship between the total public deficit and the public debt. The total public deficit is the difference between tax collections and government financial and non-financial expenditures. The primary surplus is directly related with the GDP growth; therefore, the growth rate of GDP affects negatively the growth rate of the public debt. And the government financial expenditures are directly affected by inflation, bank rate and nominal exchange rate due to the public debt indexation. The public debt is indexed to inflation, bank rate or nominal exchange rate, depending on the economic circumstances. The inflation targeting regime and the high influence of the nominal exchange rate on domestic inflation makes the inclusion of domestic inflation in the equation of the public debt redundant. Hence, public debt growth depends on GDP growth rate, the growth rate of bank rate and the growth rate of the nominal exchange rate:

$$pd_t = h_3 + b_6 y_t + b_7 br_t + b_8 er_t \qquad (9)$$

where b_6 is then expected to be negative and b_7 and b_8 are expected to be positive.

Baltar (2013) suggests that the nominal exchange rate is a function of lagged nominal exchange rate and changes in the balance of payments, showing that there is an inverse relationship between changes in the nominal exchange rate and the balance of payments (current and/or capital accounts). The balance of payments depends on the current and capital account, therefore considering the international situation in terms of trade and finance. Capital inflow increase international reserve, even if there is deficit in the current account, decreasing the nominal exchange rate, i.e. appreciating the national currency. Conversely, a reduction in international reserves increases the nominal exchange rate.

Exports and imports are modelled using standard equations. Accordingly, exports growth (x) depends on the world economic growth (z) and the growth rate of the real exchange rate (rer). World economic growth positively affects exports because it increases the demand for national products. The real exchange rate also has a positive effect, since a higher real exchange rate means lower domestic price than the international price in domestic currency, thus making exports more attractive.

$$x_t = h_4 + b_9 z_t + b_{10} rer_t \qquad (10)$$

b_9 and b_{10} are then expected to be positive.

And imports growth (q) depends on the domestic economic growth and changes in the real exchange rate. Higher GDP growth rate augments imports and an appreciation in the national currency that cheapens imports, increasing them.

$$q_t = h_5 + b_{11} y_t + b_{12} rer_t \qquad (11)$$

The sign of the coefficient b_{11} is then expected to be positive and the sign of b_{12} is expected to be negative.

In short, the standard theory considers that changes in the real exchange rate affect imports and exports, therefore impacting the country's GDP through the external trade. The data for Brazil after trade and financial liberalisation shows that the relationship between the real exchange rate and the Brazilian economic activity is more complex than what the standard theory implies. The model developed in this paper suggests that the world scenario, seen through the balance of payments, affects the real exchange rate and at the same time it influences consumption and investment, thereby affecting the country's GDP.

5. Results for the Case of Brazil

In this section, we estimated the model developed previously for the case of Brazil after the liberalising reforms – from 1991 to 2010. The database is built with quarterly information from the Central Bank of Brazil (2011) and from IMF (2010). Next, the econometric analysis is described.

The model entails simultaneity, i.e. the growth rate of all GDP, internal absorption, market interest rate, public debt, nominal and real exchange rates, exports and imports are endogenous variables. Because of the simultaneity of the equations, the explanatory variables are jointly determined with the dependent variable and the regressors are not exogenous. Ordinary Least Squares (OLS) – a method for estimating the unknown parameters in a linear regression model – generates consistent estimators only when the regressors are exogenous and there is no multicolinearity or simultaneity bias. However, the model's regressors are endogenous and OLS estimators would be inconsistent, blurring the impact of the explanatory variable on the dependent one, discarding the use of OLS.

Thus, the method used to estimate the parameters is the Generalized Method of Moments (GMM). The GMM allows consistent estimates of the parameters in the presence of endogenous variables amongst the explanatory variables. GMM is a robust estimator because it does not require information of the exact distribution of the disturbances. GMM estimation is based upon the assumption that the disturbances in the equations are uncorrelated with a set of instrumental variables. Hence, it is important to find instruments that are not correlated with the error term such as the predetermined variables (Wooldridge, 2003), i.e. lagged endogenous variables treated as ‘safe’ instrumental variables. The Vector Error Correction also accounts for endogeneity; however, as we will see later, the variables do not adhere to the unit-root principle. Therefore, the most appropriate econometric methodology is the GMM.

To build the econometric analysis and evaluate the quality of the estimations, we follow Hendry and Richard (1983). The first step is to check whether the data is coherent. For that, tests for

stationarity are undertaken, such as the Augmented Dick-Fuller (ADF) and the Durbin Watson (DW) tests. The true value of the parameters based on the sample estimate is tested with the use of the Wald test which indicates whether the fitted model describes well the relevant data. The inclusion of lagged dependent and independent variables is also considered in the estimation, to verify whether these variables in the past have an influence on current values. Hendry and Richard (op. cit.) suggest including four lags for the dependent variable in the case of quarterly data and eliminating the non-significant ones. The Root Mean Square Error and the R-squared statistics are also considered to measure the goodness of fit of the statistical model. The instruments used for the estimations are also lagged endogenous variables and the number of lags are decided through the ´partial R^{2}´ (Shea, 1997) and the ´J-statistic´ (Hansen, 1982).

The ADF test was performed on all variables to verify whether they are stationary and present the same order of integration. The test does not indicate unit root, suggesting the variables may be stationary and may have the same order of integration. To reassure stationarity, after all estimations, the DW test is performed on each variable to verify whether the combination of the variables is stationary.

Table 2 shows the result for all estimations. The coefficients of each variable were significant at 1%. The goodness of fit was checked through the R-squared and the Root Mean Square Error (MSE) statistics. Following Hendry and Richard (1983) approach, lagged dependent and independent variables were included in the estimations, improving the goodness of fit of the model as indicated by the R-squared and Root MSE results. Each estimated equation is commented subsequently.

Table 2: Estimation of All Equations of the Model (GMM)

Equation	a_t	r_t	pd_t	x_t	q_t
Constant	0.65*	-0.41	6.30*	3.01*	0.66*
a_{t-1}	0.13*				
y_t	0.82*		-0.53*		2.48*
y_{t-1}			-1.94*		1.05*

y_{t-2}	0.02*				
z_t				0.74*	
z_{t-1}				0.66*	
r_t	-0.01*				
r_{t-1}		0.24*			
r_{t-2}		0.17*			
r_{t-3}		0.17*			
br_t		0.15*	0.73*		
br_{t-1}		0.28*			
pd_t		0.37*			
pd_{t-1}		0.09*	-0.15*		
x_{t-1}				-0.13*	
x_{t-2}				-0.62*	
q_{t-1}					0.15*
q_{t-2}					0.17*
rer_t	-0.49*			0.04*	-0.11*
rer_{t-1}	-0.38*			0.07*	-0.61*
er_t			0.55*		
er_{t-2}			0.13*		

* significant at 1%, ** significant at 5%

Instruments	y_{t-1},y_{t-5},r_{t-3},r_{t-4}, r_{t-5},rer_{t-4},rer_{t-5}	br_{t-2},br_{t-3},br_{t-4},br_{t-5}, pd_{t-2},pd_{t-3},pd_{t-4},pd_{t-5}	y_{t-3},y_{t-4},y_{t-5},br_{t-1}, br_{t-2},br_{t-3},er_{t-1},er_{t-3}	z_{t-2},z_{t-3},z_{t-4}, z_{t-5},rer_{t-3},rer_{t-4}	y_{t-2},y_{t-3},y_{t-4},y_{t-5},rer_{t-2}, rer_{t-3},rer_{t-4},rer_{t-5}
Observations	74	74	74	74	74
R-squared	0.1	0.81	0.62	0.41	0.63
Root MSE	19.9	21	27.1	11	8.2
Wlad stat	23774.27(prob=0)	110000(prob=0)	1300000(prob=0)	85280.95(prob=0)	46000(prob=0)
Durbin Watson d-stat	1.97	2.1	2.01	2.4	2.4
J-test	2.4225(p=0.9829)	2.0517(p=0.7263)	2.3702(p=0.9967)	2.3390(p=0.9387)	2.25278(p=0.9723)
Shea's (1997) Partial R-sq	12% for y_t, 28% for y_{t-2}, 50% for r_t, 10% for rer_t, 26% for rer_{t-1}	10% for br_t, 17% for br_{t-1}, 10% for pd_t, 10% for pd_{t-1}	71% for y_t, 76% for y_{t-1}, 24% for br_t, 33% for er_t, 52% for er_{t-2}	12% for z_t, 14% for z_{t-1}, 39% for rer_t, 55% for rer_{t-1}	75% for y_t, 80% for y_{t-1}, 10% for rer_t, 34% for rer_{t-1}

The instruments used for each estimation are indicated in the Table. The Shea's partial R-squared test shows that the instruments are relevant to explain all endogenous regressors. This result is reinforced by the J-statistic tests, that shows that the over-identifying restrictions are satisfied, so the instruments can be used as exogenous variables as a group. Therefore, the instruments are not

correlated with the error, which is an important condition for the GMM estimation. The Wald test indicates the value of the parameters based on the sample estimate is true and the Durbin Watson tests are close to two, suggesting that the combination of the variables is stationary.

The estimation of internal absorption equation indicates its evolution as directly related to GDP rate and inversely related to variations in the interest rate and real exchange rate, suggesting that there is evidence for this relationship in the case of Brazil. The variable used for the market interest rate is the referential rate swaps, pre-fixed DI 360 days, average of the period. The literature on Brazil considers that this is the most appropriate interest rate to represent the evolution of taxes of the domestic financial market (Prates and Farhi, 2009). This variable is available only after 1999. So, extrapolation technique is used to generate the data series from 1991 to 1998.

GDP growth rate affects internal absorption through its effect on consumption and investment. This coefficient is significant and positive, the same verified for lagged GDP growth. Accordingly, higher GDP means more jobs and income for the population, increasing consumption. Besides that, greater GDP increases the use of the productive capacity, consequently inducing more investment. The inclusion of lagged GDP growth rate is important because it is not only the GDP growth in the present time that affects internal absorption growth, but the decisions for consumption and investment are also influenced by the economic performance in the previous period. Therefore, if greater economic growth is followed by higher growth rate in the previous period, the effect of the economic performance on consumption and investment will be greater.

The market interest rate affects internal absorption through its effect on the costs to finance consumption and investment and signals alternative capital application, especially in financial assets. The coefficient of this variable is significant, showing the importance of the market interest rate for the determination of economic growth.

Last but not least, the growth rate of the real exchange rate has a negative effect on internal absorption growth. The negative coefficient for this variable means that an appreciation in the national currency has a positive effect on internal absorption. The interpretation of this result is that currency appreciation contributes to higher GDP growth rate because it indicates a favourable international scenario, the last seen through an improvement in the country's balance of payments (surplus in the current account and/or capital inflow), that increases the country's international reserves. The nominal exchange rate decreases with the improvement in the balance of payments, pressing domestic inflation down (Baltar, 2013). The interest rate decreases with inflation, favouring credit. But, the decrease in inflation and the strengthening of the balance of payments reinforce the effect of a decrease in the interest rate on credit, therefore increasing consumption and investment. Lower inflation and equilibrium in the balance of payments help to consolidate continued economic growth. Banks would then offer more credit and families and firms would make more debts, increasing consumption and investment.

The coefficient of the real exchange rate growth is significant and very high, being even greater than the coefficient for the market interest rate. Besides that, the coefficient for lagged real exchange rate growth is also high and negative, reinforcing the effect of changes in the real exchange rate on internal absorption growth. So, a favourable economic situation in the present time, seen through the real exchange rate, may stimulate consumption and investment if the situation in the previous period is also favourable to economic performance. In short, lower real exchange rate, apart from its negative influence on the country's external trade, affects positively consumption and investment through a healthier economy (higher international reserves and lower inflation), stimulating the level of economic activity.

In this sense, the results confirm that the effect of the real exchange rate on the Brazilian economic activity after trade and financial liberalisation is more complex than what the standard theory

implies. The Swan diagram[9], for example, is not able to show properly this complex effect of the real exchange rate on the level of economic activity. The diagram does not consider that changes in the real exchange rate may also affect internal absorption, apart from the traditional effect on the external balance. The diagram suggests that an appreciation in the national currency affects negatively the country's external trade, decreasing its economic activity. To compensate for this lower economic activity, an increase in autonomous internal absorption is necessary. In this sense, the diagram ignores that the circumstances that appreciates the national currency may have favourable induced effects on internal absorption. These induced effects were crucial in the recent experience of the Brazilian economy.

The second estimated equation is the market interest rate that affects the cost to finance consumption and investment. The bank rate is set by the monetary authority and has a direct impact on the market interest rate. This effect is also seen through previous values for bank rate growth, as suggested by the significant coefficients for the lagged bank rate growth. In this case, market interest rate increases due to increases in the bank rate as well as the behaviour of the bank rate in the past, i.e. if the bank rate was increasing previously, this increase will positively influence the market interest rate in the present.

The estimation for the market interest rate equation shows that, for a given bank rate, the market interest rate tends to be higher if public debt is high, confirming our theoretical model. Hence, in circumstances of increases in the bank rate, accretion in the market interest rate will also depend on the public debt growth. Conversely, in circumstances of decreases in the bank rate, reductions in the market

[9] The Swan diagram shows two types of the relationship between internal absorption and real exchange rate: one that determines product and employment, and another that determines trade balance. Different combinations of internal absorption and real exchange rate generate different relationships between product/employment and trade balance. For a given internal absorption, higher real exchange rate implies better trade balance and therefore greater product and employment. And for a given real exchange rate, greater internal absorption stimulates imports, decreasing the trade balance, therefore reducing the effect of great internal absorption on product and employment. The diagram shows that only one combination of internal absorption and real exchange rate generates full employment product with trade equilibrium.

interest rate also depends on changes in the public debt. Both bank rate and public debt variations should then negatively influence effective demand through market interest rate and internal absorption. The inclusion of bank rate, as a mechanism to control inflation, and public debt, crucial for the interest rate of the domestic financial market, allows verifying the negative effect of increases in both variables on the financing conditions of the Brazilian economy.

The next estimated equation is the public debt growth. The coefficient for economic growth is negative as expected, indicating that when GDP growth increases, the government earning from taxes augments. The coefficients for changes in the bank rate and in the nominal exchange rate are positive, signalling that an increase in both variables enhances public debt.

The estimation of the exports growth equation shows that the relationship between exports and world economic growth is significant. The real exchange rate also affects exports significantly, confirming the standard theory. Accordingly, higher world economic growth as well as the national currency depreciation influence positively the Brazilian exports.

Exports growth has a direct impact on the effective demand, increasing GDP growth rate. Besides that, exports are also important for the balance of payments. If exports are higher than imports, the country has surplus in trade. Depending on the amount of this surplus, the current account may be in surplus. This result is verified in Brazil for several years after 2003, when commodity prices had a sharp increase, augmenting Brazilian exports. With surplus in the current account, combined with capital inflow, the country increased its international reserves. Consequently, the country's vulnerability was reduced and the Brazilian economy was able to experience faster and continued economic growth after a long period of low and unstable economic activity.

What seems to be peculiar in the Brazilian case after trade and financial openness is the relationship between the real exchange rate and the GDP growth rate. Economic growth tends to be higher in periods of appreciated national currency and lower in periods of depreciated national

currency. This relationship between real exchange rate and GDP growth rate may reinforce the relationship between imports growth and product growth. This is because when GDP exposes high growth rates and national currency appreciates, imports are very high.

The estimation of the Brazilian imports growth equation shows that the influence of the Brazilian GDP growth rate on this country's imports is very high. This result is expected in a country that depends on imports and decides to open its trade to the rest of the world. Besides this, the national currency appreciation also stimulates imports growth considerably and this currency appreciation occurs in Brazil when GDP growth is healthier. The combination of higher economic growth and appreciated currency results in very high imports, explaining the very high growth rate of imports when Brazilian GDP growth is greater.

For an economy to be able to sustain this higher economic growth and the consequent high imports, exports should be greater, despite the currency appreciation. Higher exports then require greater world economic growth and that this economic growth stimulates increases in demand and price for the products Brazil has comparative advantage for its exports.

The estimation results show that the income elasticity of demand for exports is much lower than the income elasticity of demand for imports. This means that the Brazilian GDP growth rate consistent with the equilibrium in trade is lower than the world economic growth. In the whole period 1991 to 2010, the average growth rate for the Brazilian GDP (3.1% per year) was lower than the average world growth (3.5% per year), but the difference between these rates is lower than the difference between the income elasticity of demand for exports and the income elasticity of demand for imports. Capital movements that occurred in the period contributed to improve the performance of the Brazilian economy and this performance was reinforced by the international boom of commodities that highly increased the Brazilian exports.

After the liberalising reforms there are two periods of higher economic growth: from 1993 to 1997 and from 2004 to 2008, whose dynamics confirm the economic structure revealed by the model and estimations of this study. Higher exports growth materialised in the second period, and it allowed more consistent economic growth with trade surplus. In the first period, GDP growth rate tended to decline and there was trade deficit.

In short, the estimations of this study confirm its model propositions, explaining why the Brazilian economic growth has been slower and more unstable after the liberalising reforms. Higher economic growth depends on exports through its direct effects on the effective demand and through its indirect effects on the balance of payments that set a better macroeconomic scenario. Higher international reserves decrease the nominal exchange rate, reducing inflation. Consequently, demand and supply of credit increase, despite the high level of interest rates, raising consumption and investment.

However, the currency appreciation resulted from international reserves accumulation affect negatively the country's external trade, stimulating imports and dampening exports. In this case, induced investment would occur in the production of non-tradable goods or in the production of tradable products where the country has already comparative advantage. Hence, the short-term dynamics of production and price may not be the most convenient for the long-run growth trend, because it exposes the country to a high dependence on the international situation, leaving the country vulnerable to the world scenario.

6. Main Conclusions

The model of growth for a developing country was estimated for the Brazilian case after the liberalising reforms and validates the relationships of the model. One important result is that the real exchange rate affects in different directions the internal absorption and the country´s external trade,

suggesting that the influence of the real exchange rate is more complex than what the standard theory proposes for the case of Brazil in the period under investigation. In favourable circumstances for the balance of payments, the national currency appreciates and the external trade is negatively affected due to the stimulus to imports and the negative influence on exports. However, internal absorption is positively affected because in moments of healthy balance of payments, domestic inflation decreases, GDP growth increases and the currency appreciation signals the continuity of higher GDP growth and lower inflation, stimulating the demand and supply of credit. In circumstances of worse balance of payments, the national currency depreciates, positively affecting exports and negatively affecting imports; and internal absorption is negatively affected because worse balance of payments is followed by lower GDP growth and higher inflation. In this case, the currency depreciation signals to families, firms and banks the continuity of lower economic growth and higher inflation, therefore harming the demand and supply of credit.

The estimation of the model shows the direct influence of exports on the effective demand. However, exports have an even greater indirect effect, creating the conditions for higher internal absorption through the balance of payments. The possibility of higher exports and surplus in the current account is very important for a developing country such as Brazil because of the structural deficit in the part of the current account of the balance of payments related to services. This deficit in service is mainly a consequence of the payments of interest of the external debt plus remittances of profits and dividends. The remittances of profits and dividends tend to increase when the national currency appreciates. Another item of the deficit in service, which also increases when the national currency appreciates, is tourism. So, the equilibrium in the balance of payments is dependent on capital inflows, unless exports are higher than imports, and consequently there is surplus in trade and/or current account. Besides that, financial openness made the Brazilian financing highly dependent on capital inflows (international loans, foreign application in the domestic financial market and foreign direct

investment). So, capital inflow is important for the equilibrium in the balance of payments and for the financing of the economy. The continuity of capital inflow presupposes good performance of exports.

The balance of payments is crucial to create the favourable circumstances for the internal absorption because it enables lower inflation and appreciates the national currency. The model suggests that a favourable international scenario for exports growth and capital inflow helps to decrease the bank rate and the public debt growth, favouring the internal absorption through a reduction in the interest rate of the domestic financial system. The robustness in the inflation reduction and in the equilibrium of the balance of payments, with increases in international reserves and capital inflow higher than the deficit in current account, induce expectations of continuity in the GDP growth and increases in employment and income. Therefore, demand and supply of credit may increase, despite the high level of interest rate of the domestic financial system.

The continuity of economic growth depends on favourable international conditions for trade and finance. The high effect of the international scenario on the country's performance reveals that the real exchange rate hinders the national development of tradable goods production, and higher GDP rate becomes more dependent on the world economic growth. The latter became greater after 2003 with an increased participation of Asia, particularly China, benefiting the domestic GDP rate of countries that produce commodity goods. But the national currency was appreciated, increasing imports and concentrating the incentives for investment in the production of non-tradable or in tradable goods that the country already has comparative advantage. Therefore, the Brazilian vulnerability to the world scenario in terms of trade and finance did not reduce.

To conclude, the new development strategy implemented in Brazil with the liberalising reforms made it possible to lower inflation but GDP growth became highly dependent on international trade and finance. The results of the model show that when Brazil has higher economic growth, it is associated with an appreciated exchange rate. This is because the appreciation of the national currency helps to

lower inflation and together with the accumulation of reserves, a favourable environment is created, thereby stimulating consumption and investment. Under these conditions, the financial system modifies the composition of financial assets, lowering public debt assets and increasing private loans to firms and especially to families. Hence, GDP growth rate is favoured even if part of the effective demand goes abroad through imports.

Thus, when the national currency appreciates, internal absorption (consumption and investment) is high, but investment is not necessarily induced to develop exports and to compete with imports. Consequently, investment may only reinforce the existing productive structure without contributing to decrease the existing productive delay. Therefore, increases in imports are high and part of the augmented effective demand is transferred abroad. The current account of the balance of payments is then negatively affected. Exports are still dependent on the international scenario without developing the productive capacity that produce exports of new products with higher demand in the international market. Even if part of the effective demand is transferred abroad, GDP growth rate can be high in the short-run. However, the country's performance becomes dependent on a favourable international scenario and the conditions for a better performance under an unfavourable international scenario are not created. Consequently, even if the country experiences short periods of relatively higher economic growth, this growth rate is unstable and the long-run growth trend is weak.

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