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# Investment in the Brazilian manufacturing industry and the real exchange rate: An investigation using sectoral-level panel data[†]

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**Abstract:** This paper studies the impact of the real exchange rate on investment in the Brazilian industry. We develop a model that considers the effect of changes in the real exchange rate on the industrial investment. The determinants of the real exchange rate can affect differently the demand for the products and the industrial sectors' competitiveness. The composition of these effects varies among industrial sectors, with different repercussions on investment. A panel data analysis is applied to estimate the model for the different Brazilian industrial sectors from 1996 to 2010 and the main result is that investment responsiveness to exchange rate varies among sectors.

**Key-words:** real exchange rate, investment

**JEL Code:** E2, O5

## 1. Introduction

The Brazilian manufacturing production grew less than the country's GDP after the 1990s' trade liberalisation reforms, which is quite different an outcome when compared to the period of fast industrialization when manufacturing was actually the engine of growth (1930 to 1980). Despite the low manufacturing growth rate, Brazil achieved a period of relatively high economic growth from 2004 to 2008, when the world scenario was favourable (in several dimensions) for the performance of the Brazilian trade balance. However, after the global crisis started in 2008, Brazil has shown difficulties in maintaining a high GDP growth and the manufacturing growth rate has lowered. Despite the short period of relatively higher economic growth, the Brazilian economic performance was considerably worse when compared to other developing economies, such as China.

One explanation for the difficulties to increase the Brazilian manufacturing growth is the structural tendency to a decrease in the real exchange rate, i.e. a currency appreciation, which negatively affects the country's international competitiveness. Therefore, investment is not encouraged, affecting negatively the country's GDP growth rate. However, in the period of higher economic growth from 2004 to 2008, investment increased despite the currency appreciation, thus reinforcing the need to analyse more carefully the impact of the real exchange rate on Brazilian investment.

In this context, the aim of this paper is to investigate the impact of changes in the real exchange rate on investment activity in the Brazilian manufacturing industry after the liberalising reforms. As the (scant) empirical literature on real exchange rate and investment in Brazil has invariably been using aggregate data, this paper contributes to the literature by obtaining sectoral estimates of the investment responsiveness to exchange rate fluctuations to further the understanding of the complex relationship between these economic variables. Therefore, the paper explores whether there is evidence of an impact of fluctuations in the real exchange rate on investment for different sectors of the Brazilian economy.

The paper is organized in five sections, including this introduction. Section two briefly overviews the debate on the performance of Brazilian economy, including the recent discussion on the effects of exchange rate fluctuations on the country's investment activity and economic growth. Section three reviews the empirical literature on the impact of exchange rate fluctuations on investment and economic growth. Section four presents the equations to be estimated, the data and the results for the case of Brazil. Finally, section five concludes the paper.

## 2. Brazilian Evidence

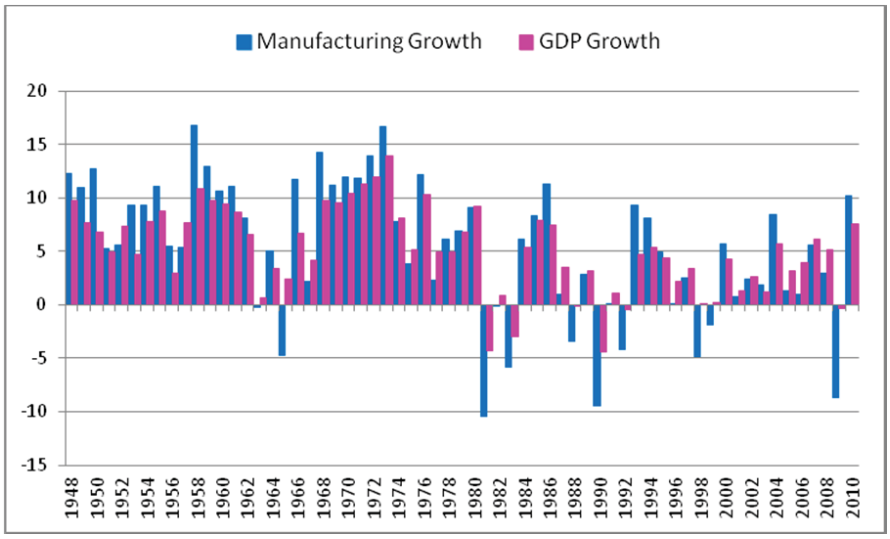
During the Brazilian industrialization process, the so-called Import Substitution Industrialization (ISI) period, from 1930 to 1980, the role of manufacturing for the country's economic growth was essential. According to Serra (1982), the country was able to build a much diversified industry that pulled the country´s economic growth. 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, then, got lagged behind those of the 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). Under this scenario, Brazil liberalizes its trade and finance in the 1990s as a strategy for higher economic growth, replacing the ISI strategy.

The liberalizing reforms started a new development strategy in Brazil, in which international competition has played an important role. According to Laplane and Sarti (1997), Laplane et. al (2003) and Coutinho and Belluzzo (1996), Brazil presented important changes in its manufacturing production due to higher international competition. Parts of the manufacturing production chain were not able to compete with cheap foreign products and

national production was replaced by imports. Moreover, manufacturing growth was much lower when compared to the period of industrialization. In this line of interpretation, lower economic growth was then a result of lower manufacturing growth.

Figure 1 shows the growth rate for manufacturing and GDP from 1948 to 2010 for the case of Brazil, illustrating that Brazil presented much higher GDP growth rates between the 1950s to the end of the 1970s than from the 1980s onwards. The same feature is observed for the case of manufacturing growth, which suggests that the Brazilian industrialization process was interrupted in the 1980s. From the 1980s onwards, GDP growth and manufacturing growth were slower and more unstable when compared to the ISI period. This feature seems to suggest that the Brazilian industrialization process was interrupted by the debt crisis and it has not resumed after the liberalizing reforms, in spite of some signs of better performance in the 2000's (until the crisis) when compared to the 1980's and 1990's.

**Figure 1: Manufacturing Growth and GDP Growth Rates for Brazil (%)**




Source: Own calculation with information from the Brazilian Institute of Geography and Statistics. GDP and Manufacturing Growth are calculated at constant prices. Manufacturing refers to the value added in the industry.

The recent debate on the challenges for higher and sustained economic growth in Brazil has focused on potential de-industrialization of the domestic economy. Palma (2005) argues that Brazil is going through a de-industrialization process due to the new development model implemented in the country with the liberalising reforms. Palma (op. cit.), Nassif (2006) and IEDI (2007) all identify a process of de-industrialisation as a lower share of manufacturing in the country's GDP or in the total employment as well as changes in the

production structure of the manufacturing. In the latter, the de-industrialization process would be identified as higher share of sectors intensive in natural resources vis-à-vis sectors intensive in capital, knowledge and technology.

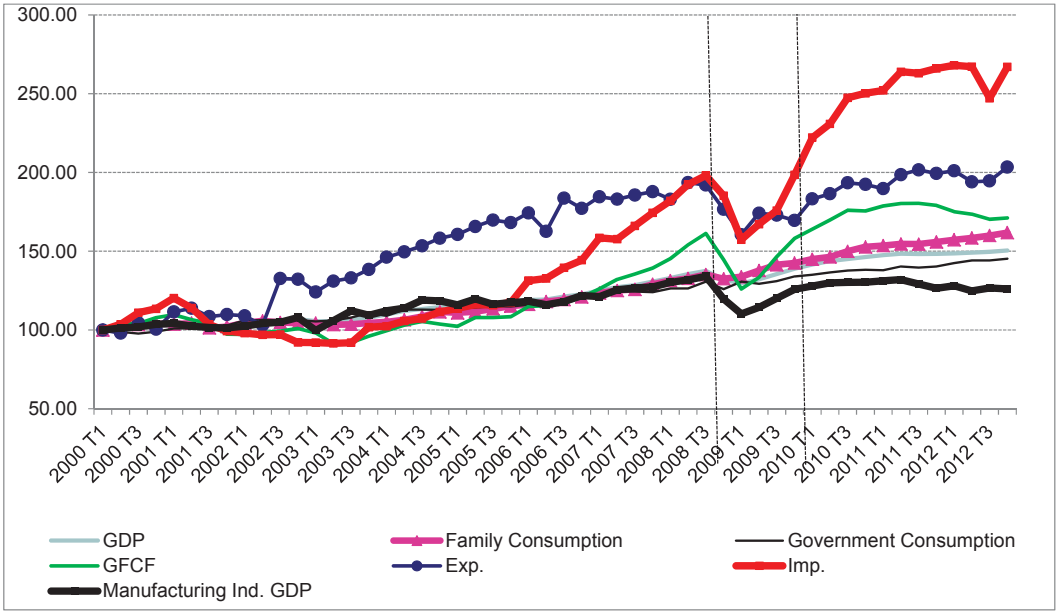
A more recent debate stresses the problem of currency appreciation and favourable prices for production and exports of commodity, together with the already existing Brazilian comparative advantage in these sectors. Bresser-Pereira and Gala (2010) point out this problem and define it as a chronic currency over-appreciation. This chronic over-appreciation could start a process of 'regressive specialization'[1] in the production structure. The high competitiveness of these commodity sectors would generate excessive trade surpluses. Such surpluses, along with capital inflows, would then appreciate the national currency and increase the disadvantages of the manufacturing sector in the external competition. The low dynamism of the manufacturing production would then explain the lower GDP growth rate. Accordingly, this currency appreciation would prevent Brazil to develop its manufacturing structure, thus blocking the technological development of tradable goods sectors. Additionally, IEDI (2012) points out that the increasing globalisation of the manufacturing production along with misalignments in the real exchange rate are likely to cause irreversible losses in the manufacturing structure of countries with an overvalued currency.

Sarti and Hiratuka (2010), on the other hand, argue that despite the long period of stagnation and the interruption of the industrialization process in the 1980s, and decreases in the density of some industrial chains during the 1990s, the Brazilian manufacturing still maintains a diversified structure. This structure is then able to generate dynamism for the economy as a whole. Rocha (2011), in the same line of interpretation, argues that the Brazilian manufacturing showed resistance to the de-industrialization process in the period after the liberalising reforms, thus maintaining the industrial diversification of the economy. According to Sarti and Hiratuka (2010), the available evidence is not compelling enough to allow one to characterize this process as one of definitive de-industrialization in Brazil and they refer to the recent process as 'interrupted industrialization'. The rationale for this term is that despite the long period of low economic growth, Brazil was able to keep a relatively complex industrial structure that is diversified and integrated, especially when compared to other countries' experiences in Latin America, and that there was no absolute limit to recover the role of manufacturing as engine of economic growth, in spite of the challenges posed by changes in the global manufacturing scenario.

[1] The term 'regressive specialization' was suggested by Coutinho (1997). Regressive specialization is understood in the Brazilian economy as a decrease in the degree of diversification and integration of the productive system with loss of density in several production chains due to higher imports of components and capital goods.

The global crisis that started in 2008 has brought some further challenges to the Brazilian manufacturing industry. Figure 2 shows the country's GDP, manufacturing GDP, gross fixed capital formation, consumption, exports and imports from 2000 to 2012. One important feature revealed in the figure is that before the crisis, GDP and manufacturing GDP increased at the same path; however, after the crisis, manufacturing GDP falls below the growth rate of GDP. Moreover, imports have increased since 2006, actually increasing even further after the 2008 crisis, to surpass exports. Another important feature of the recent performance of the Brazilian economy is that gross fixed capital formation starts increasing after 2003 and especially after 2006, when the Brazilian economy was under a positive economic scenario. This increase was interrupted by the crisis, but recovered and kept on until 2011, when the signs of stagnation were shown.

**Figure 2: GDP, Manufacturing GDP, Gross Fixed Capital Formation, Consumption, Exports and Imports (Index 2000 T1=100)**

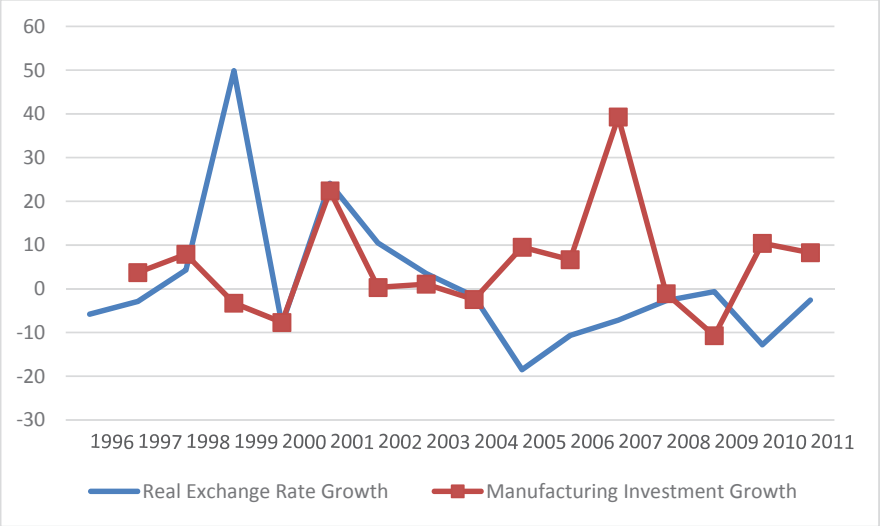



Source: IE/NEIT Elaboration with datafrom the Brazilian Institute of Geography and Statistics.

Therefore, the increase in the Brazilian GDP from 2003 onwards seems to be associated with increasing consumption as well as exports and gross fixed capital formation, but the latter has decreased after 2011 and imports have increased considerably. This increase in imports affects negatively the country's GDP growth rate and may be associated with the decrease in manufacturing GDP.

Figure 3 shows the growth rate of manufacturing investment[2] and the growth of the real exchange rate, in which an increase in the latter means the Brazilian production is more competitive internationally. The figure shows that the growth rate of manufacturing investment oscillated considerably from 1996 to 2011, increasing in the period of higher economic growth (2004 to 2008). But this growth rate was not maintained after the global crisis that started in 2008, and the country has presented modest manufacturing investment growth since then.

**Figure 3: Growth Rate of Manufacturing Investment and Growth of Real Exchange Rate (%)**




Source: Own Calculation with Data from the Brazilian Central Bank and the Annual Survey of Manufacturing Industry (PIA).

One important feature presented in Figure 3 is that the real exchange rate decreases when manufacturing investment increases after 2004. After that, the national currency still appreciates, but at lower rates. After the crisis, when Brazil recovered its manufacturing investment level existing in 2010, the real exchange rate decreased again. Therefore, manufacturing investment has increased, despite the currency appreciation, especially in the period 2004-2008, when the world scenario was favourable to the Brazilian economy. The question is whether the difficulties to sustain the Brazilian manufacturing investment are

[2] The Manufacturing investment was calculated with information from the Brazilian Annual Survey of Manufacturing Industry (PIA) and refers to the annual change in the Property, Plant and Equipment (PP&E) account.

related to the fluctuations on the Brazilian real exchange rate and to the tendency to currency appreciation and which are the main transmission channels.

## 3. Empirical Literature

There is some consensus in the literature that the real exchange rate matters for economic growth. Rodrik (2008) uses an index of undervaluation (measure of the domestic price level adjusted for the Balassa-Samuelson effect[3]) to explain economic growth. The index indicates whether the currency is appreciated or depreciated, making domestic production more expensive in dollar terms in the first case or cheaper in the second case. Rodrik (op. cit.) estimates the relationship between undervaluation and economic growth for several countries and the results confirm that a currency depreciation affects economic growth depending on the country's level of development. Moreover, the author also shows that currency depreciation has a positive effect on the relative size of the tradable sector, especially on manufacturing, and the effects of the real exchange rate on economic growth operates partially through the associated change in the relative size of tradables.

Vaz and Baer (2014) advances Rodrik's (2008) work by providing a disaggregated industrial sector analysis to investigate to what extent the industrial sectors in Latin America, from 1995 to 2008, have been negatively or positively affected by the recent currency appreciation. The authors point out four ways in which the real exchange rate appreciation may affect manufacturing sectors performance: manufactured goods become more expensive internationally; imported manufacturing goods become cheaper; imported intermediate goods become cheaper, reducing production costs; and, if such appreciation is due to an increasing demand of primary commodities, the income effect may raise the domestic consumption of manufactured goods. Vaz and Baer (op. cit.), then, investigate which one of the four effects has prevailed in Latin America in the considered period.

Other studies investigate more specifically the relationship between exchange rate and investment. Accordingly, firms make capital accumulation plans described by the following implicit investment function:

$$g^i = g^i(\alpha, \pi, u, e) \qquad (1)$$

[3] The undervaluation index is computed in three steps. First, the real exchange rate is calculated using the purchasing power parity conversion factor. Then, the real exchange rate is regressed on per capita GDP to obtain the estimated Balassa-Samuelson effect. Finally, the undervaluation index is obtained by the ratio of the real exchange rate to the predicted value from the Balassa-Samuelson-adjusted rate.

where $g^i$ is investment as a proportion of the capital stock, α is a parameter describing autonomous investment governed by (say) Keynes' animal spirits and $g^i_\alpha, g^i_\pi, g^i_u > 0$, where π is the profit share in income and u is (capital) capacity utilization. Following Marglin and Bhaduri (1990), investment depends positively on the profit share. A broader rationale for this specification is that, given capacity utilization, the current profit share is an index of expected future earnings and both provides internal funding for investment and makes it easier to raise external funding. Meanwhile, following Rowthorn (1981) and Dutt (1984, 1990), who in turn follow Steindl (1952), capital accumulation plans depend positively on capacity utilization due to accelerator-type effects.

There are reasonable theoretical and empirical grounds for including the real exchange rate, e, as a separate argument in the investment function above, even if the sign of the corresponding partial derivative, $g^i_q$, cannot be unambiguously ascertained. For instance, on theoretical grounds, a change in the exchange rate have an impact on the price competitiveness of firms (both at home, given the competition of imported substitutes, and abroad, due to the change in export prices) and on the cost of imported inputs. Yet most available theoretical models provide no clear indication as to which effect is dominant, and the overall effect of exchange rates on investment remains an empirical question. The empirical evidence seems to be more favourable to the assumption that investment varies positively with the real exchange rate, so we assume $g^i_q > 0$.

Goldberg (1993) finds that a real depreciation (appreciation) of the U.S. dollar was likely to generate an expansion (reduction) in investment in the 1970s, but that the opposite pattern prevailed during the 1980s. Meanwhile, Campa and Goldberg (1995) attribute this difference in investment response between the 1970s and 1980s to the decline in industry export exposure as U.S. firms progressively increased their reliance on imported inputs. Also, they find distinct investment patterns across industries with different markups ratios, with investment in high-markup industries with an oligopolistic market structure being less responsive to exchange rates. Campa and Goldberg (1999) compare the investment sensitivity to exchange rate in the United States, United Kingdom, Japan, and Canada for the period 1970-93, and find investment in Canada to be the least responsive to exchange rate movements. Indeed, Harchaoui, Tarkhani and Yuen (2005) employ industry-level data for Canadian manufacturing industries for the period 1981–97 just to find the overall effect of exchange rates on total investment to be statistically insignificant.

Nucci and Pozzolo (2001) investigate the relationship between exchange rate fluctuations and the investment decisions of a sample of Italian manufacturing firms. The results support the view that an exchange rate depreciation rate has a positive effect on investment through the price competitiveness channel, but a negative effect through the cost

of imported inputs channel. Expectedly, the magnitude of these effects varies over time with changes in the firm's external orientation, as measured by the share of foreign sales over total sales, and the dependence on imported inputs. The impact of exchange rate changes on investment is stronger for firms with lower degree of monopoly power (proxied by lower price-cost margins), facing a high degree of import penetration in the domestic market, and of a small size. Besides, they find evidence that the degree of substitutability between domestically produced and imported inputs influences the impact through the expenditure side.

Meanwhile, Blecker (2007) analyses the effects of the real value of the U.S. dollar on aggregate investment in the U.S. domestic manufacturing sector, using annual time-series data for 1973-2004. The main result of the econometric estimation is a negative effect that is much larger than those found in previous studies. Moreover, the exchange rate is found to affect investment mainly, although not exclusively, through the channel of financial or liquidity constraints, rather than by affecting the desired stock of capital. Interestingly, counterfactual simulations show that U.S. manufacturing investment would have been 61% higher in 2004 if the dollar had not appreciated after 1995. In an empirical study on Mexico, Blecker (2009) finds the real value of the peso to have a positive direct effect on investment. However, this effect is offset by contractionary effects that the exchange rate has on Mexico's growth rate.

In a different approach, Landon and Smith (2006) estimate the impact of exchange rate movements on the industry-level price of investment goods using a panel of OECD countries. They find that an exchange rate increase (decrease) causes a significant rise (fall) in the prices of the investment goods used by most industries. However, the magnitude of this effect differs greatly across sectors, with a currency depreciation causing a stronger increase in the price of investment goods used by industries that produce high-technology products and employ a larger proportion of imported capital. As a result, changes in the exchange rate may affect both the level and distribution of investment across sectors.

After deriving a theoretical framework to tackle the issue of the real exchange rate as an instrument of development policy, Razmi, Rapetti and Skott (2009) test its predicted positive relationship between real exchange rate undervaluation and investment growth. Using panel data for 184 countries with 5-year time periods spanning 1960-2004, they find that real exchange rate undervaluations are (statistically) significant drivers of investment growth, but only in developing countries, this result being robust to different specifications, controls, and econometric methods. Meanwhile, Bahmani-Oskooee and Hajilee (2010) investigate the effect of currency depreciation on domestic investment using a time-series model of 50 countries for the 1975–2006 period. Though they find significant positive short-

run effects of currency depreciation on domestic investment in 43 out of the 50 countries, it is only in 21 countries that there are also long-run effects. This latter evidence is inconclusive, though, as a depreciation results in an increase in domestic investment in 10 countries, and results in a decrease in the remaining 11 countries.

Finally, though it is the level of the real exchange rate which is included in equation 1, it is worthy reporting results found in a related literature on the relationship between exchange rate volatility (mainly as a source of uncertainty) and investment. Darby, Hallet, Ireland and Piscitelli (1999) develop a formal model in which exchange rate uncertainty may or may not depress investment, as there are threshold effects which define when rising exchange rate volatility would increase or decrease investment. However, Atella, Atzeni and Belvisi (2003) use a large panel of Italian firms to find that exchange rate volatility reduces investment (with a decreasing sensitivity the greater the firm market power). The intuition is that a volatile exchange rate reduces investment due to its compromising the evaluation of marginal benefits of new capital goods. However, Byrne and Davis (2005) estimate the impact of exchange rate uncertainty on investment using panel estimation featuring a decomposition of exchange rate volatility. For a subsample of EU countries, they find that it is the transitory and not the permanent component of volatility which adversely affects investment. Meanwhile, Ramirez (2008), using data on private investment spending in Latin America during the 1980–2001 period, find that the standard deviation of the real exchange rate has a negative effect on private capital formation.

## 4. Estimation

### *4.1. Econometric Model*

In this paper, we use the equations specified by Nucci and Pozzolo (2001) to evaluate the effect of exchange rate fluctuations on investment for different sectors of the Brazilian manufacturing industry. The equations specified by Nucci and Pozzolo (op. cit.) are particularly useful in this context given that they decompose the effect of the real exchange rate on investment decisions. The influence of the exchange rate on investment takes place through tradable goods, i.e. goods that are exported and/or imported. In this sense, the effect of exchange rate fluctuations on investment decisions occurs through the impact on costs of imported input and/or on the revenue of exported goods. Nucci and Pozzolo (op. cit.) combine these two effects in their equation for investment in the following way:

$$\Delta I_{t,i} = \beta_1 \Delta I_{t-1,i} + \beta_2 \Delta S_{t,i} + \beta_3 \chi_{t-1,i} \Delta e_t + \beta_4 \alpha_{t-1,i} \Delta e_t \qquad (2)$$

where $I_{t,i}$ is investment at constant prices, $S_{t,i}$ are total sales at constant prices, $\chi_{t-1}$ and $\alpha_{t-1}$ are the export and import coefficients, measured in constant prices to avoid the influence of the exchange rate on the value of these coefficients, $e_t$ is the real exchange rate, t is time and i refers to the manufacturing firms. Variables are in logarithm so the variation ($\Delta$) provides the growth rate of these variables.

According to equation (2), a decrease in the real exchange rate, i.e. a currency appreciation, would make imported inputs cheaper, thus stimulating investment, but at the same time it would negatively affect exports by reducing exports revenues. Therefore, firms with a high import coefficient would be more affected through the cost channel, while firms with a high export coefficient would be more affected through the revenue channel. In our analysis, given that our units of analysis are sectors[4], the import coefficient also includes imports of final goods. In this case, a decrease in the real exchange rate affects negatively investment decisions because the national production becomes less competitive relatively to imports and affects positively investment decisions because costs are reduced. An increase in the import coefficient, therefore, may represent a reduction in costs and/or an increase in the competition with imports.

Nucci and Pozzolo (2001) also include in the estimated equations the firms' mark-up, to capture their market power. In this case, a high mark-up means that the firm (or sector in our case) has more favourable financial conditions to face an adverse international competitiveness, and therefore the influence of exchange rate fluctuations on their investment decisions would be reduced. To get this effect, the mark-up is defined as:

$$mkup = \left(\frac{Value\ of\ Sales + \Delta Inventores - Payroll - Cost\ of\ Materials}{Value\ of\ Sales + \Delta Inventories}\right) \qquad (3)$$

So, the new equation estimated is:

$$\Delta I_{t,i} = \beta_1 \Delta I_{t-1,i} + \beta_2 \Delta S_{t,i} + \beta_3 (1 - mkup_{t-1,i}) \chi_{t-1,i} \Delta e_t + \beta_4 (1 - mkup_{t-1,i}) \alpha_{t-1,i} \Delta e_t \qquad (4)$$

The lagged value of mkup is used to avoid the bias induced by possible correlation between the mark-up index and exchange rate variations.

### *4.2. Data and Estimation Method*

Equations (2) and (4) are estimated for Brazil from 1996 to 2011, a period for which there are available information for sectoral investment. The data source is the Annual

[4] The Brazilian Institute of Geography and Statistics (IBGE) provide public information on manufacturing firms' data only at the sectoral level.

Industrial Research (PIA), provided by the Brazilian Institute of Geography and Statistics (IBGE) which makes available information for 25 different sectors of the Brazilian mining and manufacturing industry. The PIA database is built with the aim of identifying structural characteristics of the Brazilian industrial activity structure. The economic activity sectors are classified according to the National Classification for Economic Activity (CNAE), which standardizes the national economic activities. This classification is used for all economic agents engaged in the production of goods and services.

Investment at constant prices is calculated by summing up acquisitions to improvements on property, plants and equipment (PP&E), and then subtracting the sales on the same account. These three variables are at current prices, so they are deflated using the gross fixed capital formation index. Total sale at constant prices is calculated by deflating total revenue with the wholesale price index. The export and import coefficients are provided by the National Confederation of Industry (CNI) that calculate these coefficients at constant prices. CNI built export and import coefficients in which the volume is analysed and changes in price are eliminated. The 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. All variables to build the mark-up variable are provided by PIA.

The estimation method applied is the GMM panel data developed by Arellano and Bond (1991) in order to account for endogeneity of regressors. This method is efficient within the class of instrumental variable procedures. GMM estimation is based upon the assumption that the disturbances in the equations are uncorrelated with a set of instrumental variables.

### *4.3. Results*

Table 1 shows the results for equations (2) and (4) when lumping all sectors together. The estimation of equation (1) is dubbed basic estimation and the estimation of equation (3) includes the mark-up.

**Table 1: Estimation Using All Sectors of the Brazilian Manufacturing Industry**

GMM estimates of a dynamic investment model for panel data
(sample period: 1996-2011); Number of sectors: 25; Number of observations: 300

| Dependent Variable: $\Delta I_{ti}$ | basic specification | including mark-up |
|---|---|---|
| constant | 12.8* | 11.9* |
| $\Delta I_{t-1,i}$ | -0.23* | -0.22* |
| $\Delta S_{ti}$ | 0.86* | 0.91* |
| $\chi_{t-1,i}\Delta e_t$ | -0.01 | |
| $\alpha_{t-1,i}\Delta e_t$ | 0.03* | |
| (1-markup)$\chi_{t-1,i}\Delta e_t$ | | -0.06** |
| (1-markup)$\alpha_{t-1,i}\Delta e_t$ | | 0.06* |
| Wald test | 42.08(p=0) | 43.54(p=0) |
| Instruments: (two and three-period) lagged variables | | |
| Note: *significant at 1%, **significant at 5% | | |

The results of the estimation show that the effect of exchange rate fluctuations on investment is significant in the basic specification only through the import channel. In this case, the coefficient is positive (though small), which means that a decrease in the real exchange rate (a currency appreciation) affects investment negatively. One possible interpretation for this result is that a currency appreciation stimulates imports of final goods, thus making domestic production of these goods less competitive. In other words, a currency appreciation, despite cheapening imports of capital goods, ultimately affects investment negatively through the import channel. When we include the mark-ups in the estimation, both coefficients that measure the influence of the real exchange rate on investment are significant, but the exports' channel appears with a non-expected sign. It is important to note that in both cases, with or without the inclusion of the mark-up, the coefficients of the impact of exchange rate fluctuations on investment are small.

After analysing the results for all sectors lumped together, we have splitted the sectors in two groups, those with mark-ups above and below the mean. It is important to note that in general, the sectors with mark-ups above the mean are associated with the mining sector and sectors that use intensively natural resources inputs. Therefore, sectors with high mark-ups (above the mean) are sectors that experienced very favourable

conditions in terms of international prices in the 2000's, with more favourable financial conditions to face an adverse international competitiveness. Therefore, their investment decisions are expected to be less affected by exchange rate fluctuations. Table 2 shows the results for this estimation.

**Table 2: Estimation Splitting Sectors of the Brazilian Manufacturing Industry According to their Mark-ups**

GMM estimates of a dynamic investment model for panel data
(sample period: 1996-2011); Number of sectors: 25; Number of observations: 300

| Dependent Variable: $\Delta I_{ti}$ | Markup - Below Average | Markup - Above Average |
|---|---|---|
| constant | 12.3* | 12.3* |
| $\Delta I_{t-1,i}$ | -0.22* | -0.22* |
| $\Delta S_{ti}$ | 0.87* | 0.87* |
| $\chi_{t-1,i}\Delta e_t$ | -0.06** | -0.01 |
| $\alpha_{t-1,i}\Delta e_t$ | 0.03** | 0.03 |
| Wald test | 42.18(p=0) | 43.54(p=0) |
| Instruments: (two and three-period) lagged variables | | |
| Note: *significant at 1%, **significant at 5% | | |

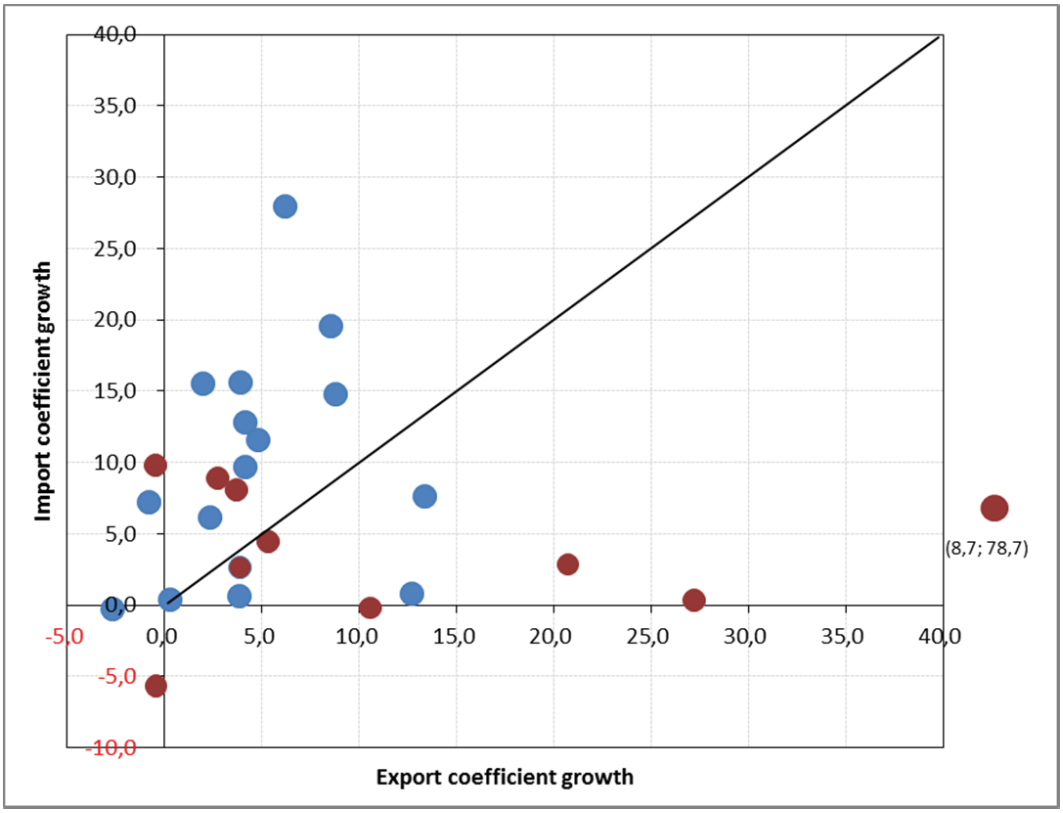
In fact, the results of Table 2 show that the influence of exchange rate fluctuations on investment decisions is significant only for sectors with mark-ups below the mean, as expected. As it turns out, sectors with high mark-ups have higher ability to (self-)finance investment, so the influence of the exchange rate fluctuations on their investment decisions is not captured in the estimation.

In the case of sectors with relatively lower mark-ups and ability to (self-)finance investment, the impact of exchange rate is significant and the imports' channel again operates through the competition with imports. In this case, the importance of exchange rate as a determinant for investment may have increased due to the higher competition and the

increased role of China and other developing Asian countries as large suppliers of manufactured products in the recent years.

Figure 4 shows all sectors' export and import coefficients growth between 1996 and 2011. The horizontal axis measures the change in export coefficients and the vertical axis measures the change in import coefficient in percentage points. Sectors in red are the sectors with mark-ups above the mean and sectors in blue are sectors with mark-ups below the mean.

**Figure 4: Comparing Export and Import Coefficients by Sector (in growth rates)**



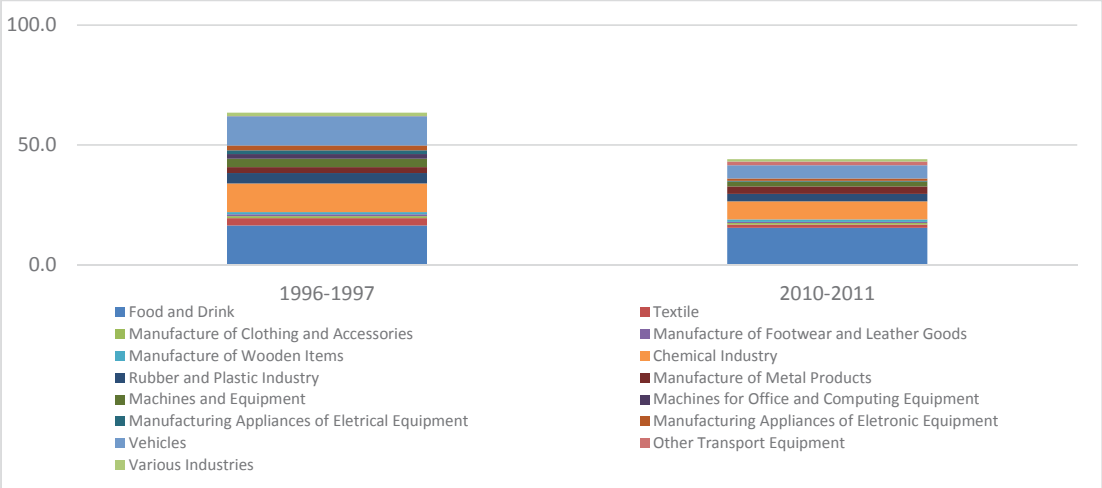

Source: National Confederation of Industry. Own calculations.

We note in the figure that most sectors are concentrated is the area where the growth in the import coefficient was higher than the export coefficient. At the same time, the sectors for which the change in export coefficient was greater are, in general, sectors with higher market power, i.e. sectors for which we cannot find any influence of fluctuations on

the real exchange rate on their investment decisions. Most of sectors with mark-ups below the mean have shown import coefficient changes which are higher than the export coefficient change, which helps to understand why the estimation detects better the import channel.

The sectors with mark-ups below the mean, for which the estimations detect an influence of fluctuations on the real exchange rate on their investment decisions, are very diverse. Within this category, there are both traditional labour-intensive sectors (clothing, footwear, food and drink), and medium (machinery and equipment, vehicles, electrical material, chemical) and high-technology (electronics and computing equipment's, other transport equipment) sectors. Moreover, these sectors reduced their share in total investment in the period under consideration. Figure 5 shows these sectors' share in total investment.

**Figure 5: Share in Total Investment – Average Period for Sectors with Mark-up Below the Mean**




Source: PIA. Own Calculation.

Sectors with mark-ups below the mean had a significant decrease in the share of total investment. The sectors driving such decrease were chemical industry, food and drink and vehicles. However, the diversity of sectors involved permits to conclude that an important part of the investment of the Brazilian manufacturing industry has suffered the negative impacts of the exchange rate appreciation. The estimations reported here suggest that the exchange rate fluctuations seem to be important for these sectors' investment

decisions, but the coefficient is small, and the effect of a currency appreciation is related to the competition with imports, which discourages investment. This competition may be held responsible for the decrease in the share of these sectors in total investment.

## 5. Conclusion

In this paper, we have empirically tested an investment model that incorporates different channels through which changes in the real exchange rate are likely to affect manufacturing sectors. The determinants of the real exchange rate can affect differently the demand for industrial goods and the industrial sectors' competitiveness. The composition of these effects varies across industrial sectors, with different implications for sectoral investment, depending on the characteristics of the industrial sector.

The main results are that the investment responsiveness to changes in the exchange rate takes place mainly through imports, especially due to the effect of currency appreciation on imports of final goods. In general, the higher competition with imported products has offset the positive effect caused by cheaper imported inputs or capital goods.

However, the empirical test applied in this paper also showed that the impact of changes in the exchange rate was not uniform across all analysed sectors. When we splitted the sectors according to their mark-ups relatively to the mean mark-up, we found that the influence is found in sectors with mark-ups below the mean. These sectors have, in general, experienced changes in import coefficients which are higher than their export coefficients, and reduced their share in total investment in the period under consideration. In this sense, the estimation confirms that for these sectors, real exchange rate fluctuations are an important variable to be considered in their investment decisions, though this influence is small. For the sector with mark-ups above the mean, there was no evidence that changes in the exchange rate impacts investment decisions. These sectors are associated with the mining sector and natural resource-based industries, which have experienced high profitability regardless the level of exchange rate.

An important policy implication for the Brazilian case is that an exchange rate devaluation could have positive impacts on an important set of industries, by inducing investment and capacity expansion. It should be pointed out that, despite the increased competition for manufactured products with the emergence of strong Asian competitors in the global scenario, the synchronized global economic growth has mitigated the effects of

this process in the Brazilian economy. However, the post-crisis scenario has been quite different, with a much more fierce competition, which makes it necessary a favourable, competitive exchange rate to foster domestic production and encourage investment.

To conclude, our results contribute to a better understanding of the connection between exchange rate and industrial investment, considering that investment decisions affect and are affected by the competition dynamism. Ultimately, important elements were unveiled for the debate on industrial and employment policies to promote higher growth rates of investment production and employment in the manufacturing sector.

**References:**


Atella, V., Atzeni, G. E. & Belvisi, P. L. (2003): "Investment and exchange rate uncertainty", Journal of Policy Modeling, 25, 811–824.

Arellano, M. and Bond, S.R. (1991) "Some Tests of Specification for Panel Data: Monte Carlo evidence and an application to Employment Equations". *Review of Economic Studies*, 58, pp. 277-297.

Bahmani-Oskooee, M. & Hajille, M. (2010): "On the relation between currency depreciation and domestic investment", Journal of Post Keynesian Economics, 32(4), 645—660.

Belluzzo, L. G. and Almeida, J. G. de (2002) *Depois da Queda: a economia brasileira da crise da dívida aos impasses do Real*. Rio de Janeiro: Civilização Brasileira.

Blecker, R. (2007) "The Economic Consequences of Dollar Appreciation for US Manufacturing Investment: A Time Series Analysis". *International Review of Applied Economics*, No. 21 (4), pp. 491-517.

Bresser-Pereira, L.C. (2009) "The Tendency to Overvaluation of the Exchange Rate". In: Bresser-Pereira, L.C. (ed.) *Globalization and Competition*, Cambridge University Press.

Bresser-Pereira, L.C. (2011) *A Taxa de cambio no Centro da Teoria do Desenvolvimento*. Escola de Economia de São Paulo.

Bresser Pereira, L.C. and Gala, P.S.O.S (2010) "Macroeconomia Estruturalista do Desenvolvimento". *Revista de Economia Política*, vol. 30, n.4(120), p. 663-686.

Byrne, J. P. & Davis, P. E. (2005): "The impact of short- and long-run exchange rate uncertainty on investment: a panel study of industrial countries", Oxford Bulletin of Economics and Statistics, 67(3), 307—329.

Campa, J. & Goldberg, L.S. (1995): “Investment in manufacturing, exchange rates and external exposure.” Journal of International Economics, 38 (3–4), 297–320.Campa, J.M. e Goldberg, L. (1999) “Investment, Pass-Through, and Exchange Rates: a cross-country comparison”. *International Economic Review*, No. 40 (2).

Coutinho, L. and Belluzzo, L.G. (1996) “Desenvolvimento e Estabilização sob Finanças Globalizadas”. *Economia e Sociedade*, nº 07.

Darby, J., Hallett, A. H., Ireland, J. & Piscitelli, L. (1999): “The impact of exchange rate uncertainty on the level of investment”, Economic Journal, March, 109, C55–C67.

Dutt, A. K. (1984) “Stagnation, income distribution and monopoly power”, *Cambridge Journal of Economics*, 8(1), pp. 25-40.

Harchaoui, T., Faouzi, T. & Yuen, T. (2005): “The effects of the exchange rate on investment: evidence from Canadian manufacturing industries”, Bank of Canada Working Paper 2005-22, August.IEDI (2007) *Empresa Nacional: A Atratividade da Empresa Brasileira*. Análise IEDI. URL: www.iedi.org.br.

IEDI (2012) *Comércio e Indústria*. Análise IEDI, Novembro. URL: www.iedi.org.br.

Landon, S. & Smith, C. E. (2006): “Exchange rates and investment good prices: a cross-industry comparison”, Journal of International Money and Finance, 25, 237—256.

Laplane, M. And Sarti, F. (1997) “Novo Ciclo de Investimentos e Especialização Produtiva”. In Velloso, J.P.R. (Ed.) *Brasil, Desafios de um Pais em Transformação*. Rio de Janeiro: Jose Olympio.

Laplane, M., Coutinho, L. and Hiratuka, C. (2003) *Internacionalização e Desenvolvimento da Indústria no Brasil*. São Paulo: Editora Unesp; Campinas, SP: Instituto de Economia da Unicamp.

Marglin, S. and Bhaduri, A. (1990) “Profit squeeze and keynesian theory”. In: S. Marglin and J. Schor (eds.) *The Golden Age of Capitalism*, Oxord, Clarendon Press.

Nassif, A. (2006) “Há evidências de Desindustrialização no Brasil?”. *Discussing Papers* BNDES, n° 108, Rio de Janeiro.

Nassif, A., Feijo, C. And Araujo, E. (2011) “The trend of the real exchange rate overvaluation in open emerging economies: the case of Brazil”. *Discussing Papers* UFF/ECONOMIA.

Nucci, F. e Pozzolo, A. (2001) “Investment and the exchange rate: An analysis with firm-level panel data”. *European Economic Review*, 45, pp. 259-283.

Palma, G. (2005) “Four Sources of ‘De-industrialisation’ and a New Concept of the ‘Dutch Disease’”. In Ocampo, J.A. (Ed.) *Beyond Reform: Structural Dynamics and Macroeconomic Vulnerability*. Stanford: Stanford University Press, pp. 71-116.

Ramirez, M. (2008): “What explains Latin America’s poor investment performance during the 1980-2001 period?: a panel unit root analysis”, International Review of Applied Economics, 22(1), 1–15.

Razmi, A., Rapetti, M. & Skott, P. (2009): “The real exchange rate as an instrument of development policy, Working Paper 2009–07, Department of Economics, University of Massachusetts Amherst.

Rocha, I. (2011) *Reestruturação Industrial no Brasil: uma análise da dinâmica comercial e produtiva da economia*. Campinas, SP: Unicamp (Master Dissertation).

Rodrik, D. (2008) *The Real Exchange Rate and Economic Growth*. Brookings Papers on Economic Activity, Fall.

Rowthorn, B. (1981) “Demand, real wages and economic growth”, *Thames Papers in Political Economy*, Autumn.

Sarti, F. and Hiratuka, C. (2010) *Perspectivas do Investimento na Industria*. Projeto-PIB – Perspectivas do Investimento no Brasil, vol. 2.

Serra, J. (1982) “Ciclos e mudanças estruturais na economia brasileira do pós-guerra”. In *Desenvolvimento Capitalista do Brasil: Ensaios Sobre a Crise*. Vol.1 São Paulo: Brasiliense.

Steindl, J. (1952) “Maturity and stagnation in American capitalism”, *Monthly Review Press*, New York.

Vaz, P.H. and Baer, W. (2014) “Real Exchange Rate and Manufacturing Growth in Latin America”. *Latin American Economic Review*, vol. 23 (2).

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