Investment of Firms in Brazil: Do Financial Restrictions, Unexpected Monetary Shocks and BNDES Play Important Roles?

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Contents

Abstract · Resumo

Our objective in this paper is to estimate the dynamics of firm investment in Brazil. For this purpose, we built an original database with confidential and public data containing balance sheet and financial information of 4,876 public and private firms from 1995 to 2010. We then classify these firms as financially restricted or not. Our results show that the effects of unexpected monetary shocks and financial restrictions over investment are economic and statistically significant in Brazil. Unexpected monetary contractions and financial restrictions decrease investment, while unexpected monetary expansions increase investment. We also find strong empirical evidence that financing from BNDES, Brazil's development bank, affects positively the dynamics of investment and that this effect is economic and statistically significant. Our results are robust to several model specifications and econometric techniques.

1. Introduction

There is by now a vast literature on investment of firms.[1] It evolved from the neoclassical theory (see, for example, Tobin, 1969, or Hayashi, 1982) to developments that are more recent. These focus on the relations between financial frictions and investment—see, for instance, Kaplan and Zingales (1997), Fazzari, Hubbard, and Petersen (1988), and Campello, Grahan, and Harvey (2010).

The great majority of empirical contributions to this literature are related to OECD countries. In these countries, real interest rate is relatively low and stable, and there are developed capital and credit markets. However important as they may be, financial restrictions should play a relatively less important role in these economies than in emerging market ones. In these, cost of capital is higher and credit and capital markets are much less developed.[2]

Take an emerging economy like Brazil for instance. The country is an important emerging market, with still high levels of capital cost, in which credit restrictions should play a very important role to explain the investment of firms.

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[1]Investment is capital expenditure, Capex.

[2]Mishkin (2001) discusses credit conditions and financial policies in emerging markets.

In the more modern empirical literature that studies firm investment, the usual modeling approach is to include in a reduced form model financial variables that indicate some form of financial restrictions as explanatory variables alongside some variable related to the neoclassical model, such as Q of Tobin.

One can understand this modeling strategy for OECD countries because of their historical low levels of interest rate and relatively stable monetary policies. However, not including as explanatory variables those that give some indication of monetary stance for emerging economies looks as a very important misspecification of these models when applied to emerging economies.

In the specific case of Brazil, there is also another important feature to understand investment. Brazil's development Bank, BNDES, supplies most of the long-term credit for investment in Brazil, as it is well known and documented.[3] Therefore, omitting this information from the model of investment of Brazilian firms may hamper its estimation and interpretation significantly.

Our objective in this paper is to estimate a model that can describe better the investment of private and public firms in Brazil, taking in consideration these particularities, cited above, of Brazil's financial and credit market. In the process, we will estimate the responses of investment of firms in Brazil to unexpected monetary policy, financial restrictions and to BNDES financing.

To achieve our objectives, we use an original and confidential database composed of unbalanced end of the year balance sheet and financial information of 350 public firms and 4,526 private firms. The information of the public firms comes from *Comissão de Valores Imobiliários* (CVM) and Economatica and the information of the private firms comes from *Valor Econômico* and from confidential data of SERASA and Gazeta Mercantil. Our sample period is annual and goes from 1995 to 2010.[4]

When comparing the capex data in our database with the information from the annual survey of industries (*Pesquisa Industrial Anual*) of *Instituto Brasileiro de Estatística*, IBGE, from 1996 to 2010, we observe that our total capex observed during the same sample period is 38.5% of the total reported capex by firms in the IBGE survey.[5] In the IBGE sample, on average 40,000 industrial firms report their capex, a number that is much higher than the number of industrial firms that we have in our database, which is 1,110. However, despite the large difference in these numbers, we consider our database representative of investment of Brazilian firms.

Our results show that the effects of unexpected monetary shocks and financial restrictions over investment are economic and statistically significant in Brazil. Unexpected

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[3]See Lazzarini, Musacchio, Bandeira-de Mello, and Marcon (2015) for an interesting analysis of BNDES financing policies in Brazil in recent years.

[4]SERASA is a privately held company that has one of the largest databases of financial and accounting information of firms and individuals in the world. The data has debt of firms and individuals in Brazil. The information of SERASA is provided to banks, to trade shops, small, medium and large companies, with the goal of giving support to credit decisions and thus make business more cheap, fast and reliable. The data from SERASA goes from 1998 to 2007, and is both quarterly and annual.

The data from Gazeta Mercantil is annual and goes from 1998 to 2007 and is based on the balance sheet information of private firms published in this newspaper.

The information from Valor Econômico is annual and goes from 2008 to 2010 and is based on the balance sheet information available on the *1000 Maiores Empresas* publication.

[5]See *Pesquisa da Indústria Anual* (PIA) at http://www.ibge.gov.br

monetary contractions and financial restrictions decrease investment, while unexpected monetary expansions increase investment. We also find strong empirical evidence that financing from BNDES, Brazil's development bank, affects positively the dynamics of investment and is also economic and statistically significant. Our results are robust to several model specifications and econometric techniques.

Because asymmetric information prevents interest rates and securities prices from fully adjusting to allow firms to undertake all desired investment, internal finance and interest expense constrain investment directly, rather than indirectly through financial effects on firms' cost of capital. If financial restrictions are important, this implies that the supply of investment finance is not perfectly elastic for firms that face asymmetric information problems in capital markets.

FHP (1988) link the neoclassical models of investment to findings from the research on market imperfections, such as contract theory and models of adverse selection and moral hazard. The authors extend the neoclassical model based on Tobin's Q including the cash flow of the firm to capture the sensitivity of investment to changes in its capital structure. The main findings indicate that there is a significant relationship between investment and changes in the levels of cash flow of a firm.

As suggested by Jensen and Meckling (1976) and Myers and Majluf (1984), the existence of moral hazard and adverse selection problems hamper the ability of constrained firms to raise external funds. Therefore, in comparing to financially unconstrained firms, investment of constrained firms would be more dependent on internal cash flow even in the periods of overvaluation.

We believe that our findings are consistent with the view that the credit and financial market in Brazil have many imperfections, related to high capital costs and undeveloped stock market. Thus, the problems faced by Brazilian firms to obtain credit from financial institutions have significant negative impacts on their capacity to invest.

Our paper relates to the literature on the macroeconomic effects of financial constraints. Theoretical works such as Bernanke and Gertler (1995) and Kiyotaki and Moore (1997) argue that under asymmetric information, agency costs force firms to use collateral to borrow capital in the credit market. The value of collateral thus limits the extent to which a firm can finance its investment projects through external funds.

Our paper also contributes to the ongoing discussion about the importance of BNDES's financing for the real sector of Brazil. Very few papers in the literature discuss this. Some of the few papers that do are Wegelin and Coelho (2014) and Lazzarini et al. (2015). The former is a very interesting paper that takes a different approach from ours, as it is more concerned with growth aspects of BNDES's financing. Wegelin and Coelho show that in 2006 BNDES established a credit policy designed to stimulate economic growth in municipalities with certain characteristics in Brazil. They use propensity score matching (PSM) estimators and find that GDP and per capita GDP growth of treated units increased while their employment and income were not affected by BNDES credit policy.

Lazzarini et al. (2015) is more in line with our paper, because it looks, also, at how investment of firms reacts to financing from BNDES. However, our results related to BNDES are very different from theirs. The authors find no effect of BNDES on investment in Brazil. To us, this is very surprising and unexpected. We think that differences may occur due to different sample of firms—as we have private firms in our database and they do not—and different sample periods, as the authors use a more recent period that may be contaminated by financing policies of BNDES, which seem to have a strong political component.

The rest of this paper is the following. In section 2, we describe the data. In section 3, we present our classification of financially restricted and non-restricted firms and the identification of unexpected monetary policy shocks. In section 4, we present the empirical analyses. In section 5, we discuss our results and in section 6 we conclude.

2. Data

We built an original and confidential database of an unbalanced panel of end of the year balance sheet information of 350 public firms and 4,526 private firms from the 1995 to 2010.[6] The information of the public firms comes from Comissão de Valores Imobiliários (CVM) and Economatica and the information of the private firms comes from Valor Econômico and confidential data of SERASA and Gazeta Mercantil.

As we mentioned before, total capex in our database is around 38.5% of total capex of industrial firms of the database of IBGE from 1996 to 2010. Most capex in our database comes from the public firms, around 56.7%. We can also compare total EBITDA in our database with that of IBGE. The total EBITDA of our database is around 27.6% of total EBITDA of the database of IBGE from 1996 to 2010.

These numbers show clearly a predominance of large firms in our database. Except for these two variables, we are not able to compare any other firm characteristic of our sample of firms with that of IBGE or any other source. We cannot identify the great majority of private firms in our database and we are not aware of any other database in Brazil that has financial and economic information of both private and public firms in the levels of details that our database has.

The definition of Q of Tobin follows Fazzari et al. (1988). The Q of Tobin is

$$Q = \frac{V + B - N}{K}, \tag{1}$$

where V, B, N, and K correspond, respectively, to market share of firms stocks, debt, inventories and stock of capital at the beginning of the period.

The variable cash flow in turn is the sum of net income of the firm (after interest and taxes) and all deductions levied on non-financial revenue, as depreciation and amortization.

Table A-1 shows the number of firms in our database separated in private and public. As one can see, the services sector is predominant for public firms (14%), and private firms (24%).

Table A-2 shows financial characteristics of all firms in our database. One can see that the mean value of capex as a percentage of total assets is 1.8%. Firms in our database have also a high mean of Q Tobin, 1.16, and median of payout ratio at 27%.

Table A-3 shows financial characteristics of industrial firms in our database. The mean value of capex as a percentage of total assets is higher than for all firms, 2.22%. These firms have also higher mean of Q Tobin, 1.23, and median of payout ratio at 28%.

Table A-4 presents information about outstanding loans of firms in our sample of firms with BNDES during our sample period. There are 106 firms (21.09%) with outstanding loans. Most come from the food and beverages sector (16.98%).[7]

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[6]In the case of public firms, we use their consolidated balance sheet information.

[7]To obtain the information on BNDES we looked at off balance sheet information of public firms as well as information disclosed on the homepage of BNDES at the Internet.

In the following section, we show how we classify firms with respect to their access to the financial markets, as well as how we identify unexpected monetary shocks.

3. Classifications of Financially and non-Financially Restricted Firms and Identification of Monetary Shocks

3.1 Classification of Financially and non-Financially Restricted Firms

We classify a firm as financially constrained if its cost of external funds exceeds its cost of internal funds (Kaplan & Zingales, 1997). A large literature examines the impact of capital market imperfections on corporate behavior. In this literature, the standard empirical approach (and the one we will follow in this paper) is to gather historical data and use indirect metrics such as asset size, ownership form and credit ratings among others to characterize a firm as either financially constrained or unconstrained. Our empirical analysis employs book value of total assets (Gilchrist & Himmelberg, 1995) as our measure of financially constrained or not.

We take size, measured by total assets, as one of our classification criteria for financial restriction following Gertler and Gilchrist (1994). We observe that size is highly correlated with other financial variables that indicate the capacity firms have to access the financial markets. We classify firms in small and large. A large firm is considered unrestricted and a small firm restricted. We will show that our small firms have relatively less access to the financial markets than large firms.

Our interest in separating firms in large and small ones is that, as Gertler and Gilchrist (1994) point out, by doing this we can infer the level of access to the financial markets of the corporations. In theory, small firms will depend much more on bank loans than large firms. The latter will also issue shorter and long-term debt and have more inventories.

We consider a firm small if its logarithm of total assets is less or equal to 30th percentile in all years of our sample period. A firm is large if its logarithm of total assets is greater or equal to 70th percentile in all years of our sample period. By doing this, we obtain 136 large or unrestricted firms and 243 restricted firms.

Table A-5 shows the financially restricted (small) and unrestricted (large) firms. As one can easily verify by looking at the data and the t statistics of the mean tests, non-financially restricted firms have as a percentage of total assets greater capex, and long and short-term debt on average than financially restricted ones. Non-financially restricted firms also have more fixed assets and net operational revenues as a percentage of total assets and higher average Tobin's Q. Finally, 40 non-financially restricted firms have outstanding loans at BNDES compared to only 12 financially restricted ones.

3.2 Identification of Unexpected Monetary Shocks

After having classified firms in financially restricted and non-financially restricted, we now move to explain how we define an unexpected monetary shocks. We document the reactions of firms in Brazil with respect to monetary contractions and expansions.

A prerequisite for all our tests is a good indicator of monetary policy. Bernanke and Mihov (1998) point out there is no consensus in the literature as to the best indicator of

monetary stance.[8] Bernanke and Blinder (1992) advocate that the interest rate set by the Central Bank in its open market operations is a good indicator of monetary policy.

We use the quarterly series of the real ex-post SELIC rate using the variation of IPCA as the measure of inflation. Nominal Selic rate is the interest rate that the Central Bank of Brazil sets as its target in open market operations.

We define an unexpected monetary contraction and unexpected monetary expansion by looking at the first difference of real ex-post real SELIC rate. A monetary contraction occurs in the year in which we observe in the first quarter of that year that the first difference of the ex-post real selic rate is greater than the mean of the series plus one standard deviation. A monetary expansion happens in the year in which we observe in the first quarter that the first difference of ex-post real selic rate is lower than the mean of the series minus one standard deviation.

Table A-6 shows descriptive statistics of the series of the first difference of the ex-post SELIC rate and the quarters of expansion or contraction. Using this criterion, we observe 2 years in which there was a monetary contraction: 2000 and 2003; and 2 years in which there was a monetary expansion, 1997 and 1999.

After describing our sample of financially and non-financially restricted firms, as well as unexpected monetary shocks, we proceed to our empirical analysis in the next section.

4. Empirical Analysis

4.1 Main Empirical Analysis

We estimate equation (2) below, which is a reduced form investment equation. This equation is an adaptation for Brazil of Fazzari et al. (1988). In this equation, the dependent variable is $Capex_{it}/Assets_{it}$. As explanatory variables, we have: Q_{it}, where Q of Tobin defined as in equation (1);[9] $Cashflow_{it}/Assets_{it}$; FR_i is a dummy variable equal to 1 is the firm is financially restricted and 0 otherwise; $Shock_t$ is equal to 1 if there is an unexpected monetary or expansionary shock in year t and 0 otherwise; $BNDES_i$ is equal to 1 if the firm had outstanding loans with BNDES during our sample period and a_i is the cross section fixed effect. The Hypothesis concerning the error are: $\mathbb{E}\left[\varepsilon_{it}|X\right] = 0$ e $\mathrm{Var}[\varepsilon_{it}X] = \sigma^2$.

$$\frac{Capex_{it}}{Assets_{it}} = \beta_0 + \beta_1\frac{Cashflow_{it}}{Assets_{it}} + \beta_2 Q_{it} + \beta_3 BNDES_i + \beta_4 FR_i + \beta_5 Shock_t + \beta_6\left(FR_i\frac{Cashflow_{it}}{Assets_{it}}\right)$$

$$+ \beta_7\left(Shock_t\frac{Cashflow_{it}}{Assets_{it}}\right) + \beta_8\left(BNDES_i\frac{Cashflow_{it}}{Assets_{it}}\right) + a_i + \varepsilon_{it}. \quad (2)$$

Following the modern literature on investment, the coefficient of $Cashflow/Assets$ as well as Q of Tobin should be positive and statistically significant, and the coefficient of FR_i should be negative. Additionally, we want to test if the coefficient of shock is negative in the

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[8] Bernanke and Mihov (1998) propose another form of identifying monetary shocks, in particular monetary contractions. They build a flexible VAR model that nests previous VARs based on more specific assumptions about FED's monetary policy, such as funds rate target, and non-borrowed reserves target. The methodology is useful for calculating high frequency monetary shocks or as indicator of the overall stance of monetary policy.

[9] There are at least two problems in measuring Q that might affect the econometric results for cash flow. First, to the extent, the stock market is excessively volatile; Q may not reflect market fundamentals. Second, the replacement capital stock in Q may be measured with error.

case of monetary contractions and positive in the case of monetary expansions; finally, we would like to test if the coefficient related to the *BNDES* is positive.

In the case of interactions, we want to test if the coefficient of the interaction of *Cashflow/Assets* with *BNDES* is negative and significant, meaning that BNDES helps to mitigate the negative effects of financial restrictions on capex. We also want to test if the coefficients of the interactions of shock and *FR* with *Capex/Assets* are positive and significant, meaning, on the contrary, that these variables help to amplify the negative effects of financial restrictions on capex.[10]

Equation (2) extends very standard regressions in investment theory—see Fazzari et al. (1988) or Kaplan and Zingales (1997), among many others. It encompasses the neoclassical theory of investment with the inclusion *Q* of Tobin. It also includes the more recent theory that studies financial restrictions by the including cash flow and dummy variable indicating financial restrictions as regressors. Due to Brazil particularities, as we discussed before, we include additional regressors, related to unexpected monetary shocks and to the financing of investment policies by BNDES.

The current state of literature on the subject suggests that the results in favor of the proposed methodology by Fazzari et al. (1988) reveal significant evidence of a strong relationship between investment and cash flow. Some other papers also look for evidence of other variables in the explanation of financial investment. Fazzari and Petersen (1993), for example, investigate the role of working capital as the first option to balance the levels of investment firms in the presence of financial constraints.

It is also important to mention the work of Ness and Esteves Filho (2005). They investigate the possibility of financial constraints to investment in a sample of Brazilian companies traded using the fundamental model of Fazzari et al. (1988) including working capital as an independent variable.

Blundell, Bond, Devereux, and Schiantarelli (1992) analyze the extent to which neoclassical investment models using Tobin's *Q* framework provide empirical representative for the investment decisions of firms in general. The results suggest a high sensitivity of the *Q* indicator to errors of measurement and its specification. Furthermore, the authors conclude that these restrictions compromise the use of the average *Q* as a proxy for marginal *Q*.

We performed Haussman tests in all estimations. In all regressions, fixed effects were rejected in favor of random effects, so all estimations were performed using random effects. We used White cross section to correct for heterocedasticity. We also performed several Wald tests to confirm the relevance of financial restrictions, unexpected monetary contractions or expansions and BNDES for investment in Brazil.

Tables A-7 and A-8 present the results of estimation of equation (2) and several other simpler specifications derived from equation (2). Table A-7 presents the estimations for unexpected monetary contractions, while Table A-8 presents the estimation for unexpected expansionist monetary shocks. The coefficients have the expected sign and are in most cases statistically significant.

Unexpected contractionist monetary shocks decrease *Capex/Assets*. The coefficients are statistically significant and vary from −0.00053 (p-value 0.01 Eq(1)) to −0.00083 (p-value 0.00 Eq(5)). This means that *Capex/Assets* varies from 2.94% to 4.61% of average *Capex/Assets*.

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[10]See Fazzari et al. (1988) for a discussion of the economic importance of the variable *Cashflow/Assets* to explain capex.

Unexpected monetary expansions increase average *Capex*/*Assets*. The coefficients range from 0.0002 (p-value 0.07 Eq(10)) to 0.0004 (p-value 0.01 Eq(9)). These coefficients mean that in the presence of these monetary expansions *Capex*/*Assets* increases respectively from 1.11% to 2.22% of average *Capex*/*Assets*. In terms of magnitude, one can see that an unexpected monetary contraction affects more investment in absolute terms than unexpected monetary expansions.

The BNDES effect is also statistically and economic significant to explain investment, varying from 0.0042 (p-value 0.00 and Eq(7)) to 0.00832 (p-value 0.01 Eq(4)). These coefficients mean that in the presence of BNDES *Capex*/*Assets* increases respectively from 23.33% to 46.22% of average *Capex*/*Assets*.

As one can see by the sign of the FR coefficient, financial restrictions play a relevant role to explain investment. Controlling for other regressors, the negative effect of the dummy financial restrictions on *Capex*/*Assets* is statistically and economic significant significant and varies from −0.00093 (p-value 0.10 and Eq(8)) to −0.00113 (p-value 0.03 and Eq(3)). These coefficients mean that in the presence of financial restrictions, *Capex*/*Assets* decreases respectively from 5.16% to 7.22% of average *Capex*/*Assets*.

The coefficients of the regressors that are interactions are in general terms are statistically significant and have the expected signs. The coefficients of the BNDES interactions show that loans with BNDES and unexpected monetary expansion decrease the importance of financial restrictions for investment, while unexpected monetary contractions and financial restrictions increase this importance.

Our results indicate strongly that financial restrictions, monetary shocks and BNDES financing are important in explaining investment in Brazil in recent years. In the next section, we will present some robustness tests to verify how consistent these results are.

We performed several other robustness tests, whose results we do not present due to space restrictions. We classified firms using size in financially restricted, when the logarithm of total assets was lower or equal o percentile 30 in any year and financially non-constrained when the logarithm of total assets was higher or equal to percentile 70 in any year. We estimated equation (2) using the lag of the dependent variable as a regressor. We changed the cutoff percentile of our financially restricted and non-restricted classification from 70th (30th) to 80th (20th) percentile. We used only firms with complete data in our sample period. We estimated equation (2) with two stage least squares, using as instruments for Q of Tobin leverage, sales, cash reserves and EFP, and estimated equation (2) using different sample periods. In general, our results did not change. They point to the relevance of financial restrictions, unexpected monetary shocks and BNDES for investment of private and public firms in Brazil.

5. Discussion of the Results

Our results presented above indicate strongly the importance of BNDES, financial restrictions and unexpected monetary shocks to explain the dynamics of investment (capex) in Brazil. The statistical significance and magnitude of the coefficients in our estimated regressions leave no room, in our opinion, to model investment in Brazil not taking in consideration these variables. We believe that this is an important contribution of our paper.

Around 5% of the firms in our database are government firms. Most of these firms come from the public utility sectors of the economy and for some of them we were able to identify if they had outstanding financing from BNDES. Our results are independent of the fact that

firms are government firms or not. These government firms showed very much the same response of investment to our explanatory variables as private firms.

As we stressed before, the market cost of capital in Brazil is huge. Just to give an idea, if we take the period from 2001 to 2010—in which the Central Bank of Brazil informs average monthly lending rates of firms—the average real ex-post lending rate for firms was around 35% a year. If this were a nominal interest rate, it would already be absurd. However, it is a real interest rate. This makes things even more absurd. It is difficult, if not impossible, to think of any project anywhere that can give yearly real returns as high as this. Of course, many firms with high credit ratings can take loans with lower interest rates. However, we do not think this changes the fact that market cost of capital in Brazil is extremely high comparing with international standards.

The decision to invest is a medium to long-term one. As it is well known, it takes normally many years for investment to mature and for firms to enjoy its benefits, increasing its efficiency. With such high real interest rate, no wonder that firms in Brazil look, when investing, to alternative forms of financing than those coming from private financial institutions in Brazil.

There are several other financing alternatives in Brazil. Firms can demand external lines of credit, issue debentures in the domestic market, even issue bonds in the external market, or even obtain funds from private equities, among other alternatives. However, in one way or another, all these financing alternatives relate to the market cost of capital in Brazil. This is where BNDES steps in and plays an important role.

In our view, by lending with subsidized rates BNDES helps to mitigate the credit market imperfections in Brazil. To see why this occurs, let us look at the interest rate BNDES charges on its loans. It is called TJLP. If we take again the same period, from 1995 to 2010, the average real ex-post TJLP (using IPCA as the inflation index) is 2.23% a year. This is much less than the average real ex-post market rate that we mentioned above. This is an astounding difference. No wonder, anecdotal evidence points to BNDES as the most important long-term lender in Brazil.

The financing of BNDES is important for investment to a great number of firms, mostly small or medium in size, which would have great difficulty to invest if BNDES did not exist. Moreover, even large financially unrestricted firms can benefit very much from BNDES financing considering the difference between TJPL and market rates.

Of course, there are other indirect costs when firms apply for loans at BNDES. They must give collaterals and other sorts of guarantees, but even doing so we conjecture that the cost of capital is still much less than the market cost of capital.[11]

In the case of unexpected monetary contractions, we ponder that it caused the balance sheet of constrained firms to deteriorate due to a reduction in their revenues and asset prices. A reduction in revenues meant a lower capacity to use internal financing which is very relevant for these firms. A reduction in asset prices reduced the value of their collateral.

In such circumstances, loans may have been recalled. As a result, these firms may have been forced to use up cash to meet their obligations. When they ran short of cash, they might have been forced to raise additional funds by selling assets at lower price than fundamental price. This could have depressed asset prices even further. These effects reduced their net worth. Lower net worth meant that firms that have relatively poor access to credit markets

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[11]We do not have access to the loans contracts of BNDES so we do not know exactly the effective rates BNDES charges on its loans.

had less collateral to pledge against their loans. These firms' potential losses from agency problems may have led them to cut investment.

Unexpected expansionist shocks may have had the opposite effects of those described above. However, our results show that in terms of magnitude, in absolute terms, they were less important than unexpected monetary contractions. We do not have a clear explanation for this.

We suspect that this may have relation with the perception by Brazilian economic agents in general and Brazilian firms in particular that inflation has high persistence in Brazil and that the Central Bank of Brazil has still a long way to go to keep inflation under control. Therefore, economic agents are more reticent and careful in demanding investment when monetary policy is expansionist, because they fear that inflation will not take long to increase and that the Central Bank of Brazil will have to increase interest rate to stop the inflationary process.

In the case of financial restrictions, we ponder that non-financially restricted firms in Brazil respond to an unanticipated decline in cash flows in a different manner from restricted firms. They can at least temporally be able to maintain their levels of production and employment in the face of higher interest costs and declining revenues through other sources of short-term and long-term financing. However, this is not the case for financially restricted firms. These firms, which have more limited access to the financial markets, tend to lose inventories and revenues and to cut work hours and production.

As we pointed out in the Introduction, our results related to BNDES are very different from Lazzarini et al. (2015). The authors find no effect of BNDES on investment in Brazil. To us, this is very surprising and unexpected. We think that differences may occur for two reasons. The first is that we have many private firms (whose investment expenditures may be more dependent on BNDES for example) in our database and a longer sample period (Lazzarini et al. have only public firms and a smaller sample period). The second is that maybe the results of Lazarini et al are contaminated by the more recent financing policies of BNDES, which seem to have a strong political component.

Our paper is a positive analysis. We understand that there are relevant fiscal costs of BNDES loans. We are not stating in any way that these loans are the more efficient way to finance investment in Brazil. We are also not claiming that the present situation cannot change and that better or new alternatives for financing investment will not exist in the future. Our paper is silent about all this normative questions. Maybe future papers can look into these directions.

6. Conclusion

This paper analyzed empirically firm investment in Brazil the presence of market imperfections, unexpected monetary shocks and BNDES financing by applying an extending an empirical model derived from Fazzari et al. (1988).

Our results show that the effects of unexpected monetary shocks and financial restrictions over investment are economic and statistically significant in Brazil. Unexpected monetary contractions and financial restrictions decrease investment, while unexpected monetary expansions increase investment. We also find strong empirical evidence that financing from BNDES, Brazil's development bank, affects positively the dynamics of investment and is also economic and statistically significant.

Our results are robust to several model specifications, classification schemes of financially restricted and non-restricted firms and econometric techniques. They are also impressive. In the great majority of our estimations, the coefficients have the sign that economic theory would predict, and are statistically and economically significant.

These differences in access to financial markets between firms more and less financially constrained in Brazil have many possible reasons. Among them, we can mention bankruptcy legislation that makes it difficult for lenders to resume lending; the high spreads that prevail in Brazil, especially for companies with tighter credit and long-term financing for investment coming primarily from the BNDES, which is easier for large companies, in principle, those that are less financially constrained.

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Appendix.

Descriptive Analysis of the Database (tables A-1 to A-4)

Our sample of firms is composed of 350 non-financial public corporations and 4,526 private firms. Our sample period is annual and goes from 1995 to 2010. The information on the public corporations comes from the Brazilian Securities and Exchange Commission (CVM), and Economatica and the information on the private firms comes from Valor Econômico and confidential information from SERASA and Gazeta Mercantil. Table A-1 shows the number of firms in our database separated in private and public. Table A-2 shows financial characteristics of all firms. Table A-3 shows financial characteristics of industrial firms in our database. Table A-4 presents information about outstanding loans of firms in our sample of firms with BNDES during our sample period.

Table A-1. Total Number of Firms Classified by type (private or public) and sectors.

	Public	Private
Chemical/Petroleum	36	273
Foods and Beverage	40	90
Mining/Metalurgy	8	31
Eletrical/Eletronic	19	92
Transportation	18	268
Public Services	30	91
Textile	40	75
Services	49	1,100
Others	110	2,506
Total	350	4,526

Table A-2. Financial Characteristics: All Firms.

	N	Mean	Median	Standard Deviation
Log(Assets)	4,876	22.66	22.01	5.62
Operational revenues/Assets	4.876	0.32	0.19	0.21
Financial Expenses/Assets	4,876	0.14	0.12	0.03
Fixed Assets/Assets	4,876	0.32	0.28	0.08
Short-term Debt/Assets	4,876	0.39	0.25	0.12
Long-term Debt/Assets	4,876	0.28	0.17	0.13
Capex/Assets	4,876	0.018	0.02	0.0089
Q	4,876	1.16	1.32	0.01
Cash Flow/Assets	4,876	0.12	0.15	0.06
ROA	4,876	0.12	0.1	0.03
Payout ratio	4,876	0.2	0.27	0.14
BNDES Loans	106			

Table A-3. Financial Characteristics: Industrial Firms.

	N	Mean	Median	Standard Deviation
Log(Assets)	1,110	22.83	22.09	6.62
Operational revenues/Assets	1,110	0.41	0.23	0.18
Financial Expenses/Assets	1,110	0.14	0.12	0.03
Fixed Assets/Assets	1,110	0.4	0.28	0.11
Short-term Debt/Assets	1,110	0.38	0.26	0.15
Long-term Debt/Assets	1,110	0.31	0.16	0.08
Capex/Assets	1,110	0.022	0.019	0.0093
Q	1,110	1.23	1.12	0.04
Cash Flow/Assets	1,110	0.15	0.18	0.03
ROA	1,110	0.1	0.12	0.07
Payout ratio	1,110	0.25	0.28	0.11
BNDES Loans	76			

Table A-4. BNDES Loans Outstanding during Sample Period.

Sector	Number of Firms
Foods and beverages	18
Retail	7
Construction	6
Electro-electronics	3
Industrial Machinery	3
Mining	4
Non-metallic minerals	0
Pulp and paper	5
Oil and gas	6
Chemical	11
Metallurgy and steelmaking	11
Textile	9
Transportation	6
Vehicles and Spare Parts	3
Agriculture and fisheries	0
Others	17
Total	106

Financial Characteristics of Restricted and Non-Restricted Firms Classified by Size (Table A-5)

Our sample of firms is composed of 350 non-financial public corporations and 4,526 private firms. Our sample is period is annual and goes from 1995 to 2010. The information on the public corporations comes from the Brazilian Securities and Exchange Commission (CVM), and Economatica and the information on the private firms comes from Valor Econômico and confidential information from SERASA and Gazeta Mercantil. We classify a firm as being non-restricted (large) when its logarithm of its total assets is above or equal to the 70th

percentile in all years of our sampling period. We classify a firm as being restricted (small) when the logarithm of its total assets is below or equal to the 30th percentile in all years of our sampling period.

Table A-5. Financial Characteristics of Restricted and Non-Restricted Firms Classified by Size.

Financial Characteristics	Non restricted (A)				Restricted (B)				P-Value Mean Tests
	N	Mean	Median	Standard Deviation	N	Mean	Median	Standard Deviation	
Log(Assets)	136	22.9600	22.7200	2.3400	243	22.2300	22.2100	3.4600	(0.01)
Operational revenues/Assets	136	0.6500	0.5600	1.5200	243	0.3800	0.4500	0.2000	(0.00)
Financial Expenses/Assets	136	0.1800	0.1100	1.2900	243	0.2000	0.1900	0.0800	(0.07)
Fixed Assets/Assets	136	0.6700	0.5400	0.1200	243	0.4800	0.2300	0.1800	(0.00)
Short-term Debt/Assets	136	0.4500	0.3200	0.4800	243	0.3800	0.4300	0.2300	(0.03)
Long-term Debt/Assets	136	0.3600	0.1600	0.1500	243	0.2100	0.2400	0.1200	(0.01)
Capex/Assets	136	0.0230	0.0210	0.0030	243	0.0160	0.0018	0.0030	(0.00)
Q	136	1.1100	1.1000	0.0450	243	0.8200	0.7600	0.0350	(0.00)
Cash Flow/Assets	136	0.1600	0.1800	0.1000	243	0.1000	0.1100	0.0800	(0.10)
BNDES Loans	40				12				

Monetary Shocks (Table A-6)

To define an unexpected monetary contraction (expansion) we use real ex-post SELIC rate. We identify a quarter of monetary contraction (expansion) when the first difference of ex-post real SELIC rate is greater (lower) than the average of the first difference of the ex-post real SELIC rate plus one standard deviation and occurs in the first quarter of the year.

Table A-6. Monetary Shocks.

	1995/1 to 2010/4
Mean of First Difference	−0.0333
Standard deviations First Differences	0.4549
Median of First Difference	−0.0152
Quarters of Monetary Contractions	2000Q1;2003Q1
Quarters of Monetary Expansions	1997Q1;1999Q1

Investment of Firms: Financial restrictions, Unexpected Monetary Shocks and BNDES (Tables A-7 and A-8)

Our sample of firms is composed of 350 non-financial public corporations and 4,526 private firms. Our sample period is annual and goes from 1995 to 2010. The information on the public corporations comes from the Brazilian Securities and Exchange Commission (CVM), and Economatica and the information on the private firms comes from Valor Econômico and confidential information from SERASA and Gazeta Mercantil. We classify a firm as being non-restricted when its logarithm of its total assets is above the 70th percentile in all

years of our sampling period. We classify a firm as restricted when the logarithm of its total assets is below the 30th percentile in all years of our sampling period. The dependent variable is $Capex_{it}/Assets_{it}$. As explanatory variables, we have: Q_{it}, where Q of Tobin defined as in equation (1); $CF_{it}/Assets_{it}$, where CF is cash flow divided by lagged book assets; FR_i is a dummy variable equal to 1 is the firm is financially restricted and 0 otherwise; $Shock_t$ is equal to 1 if there is an unexpected monetary or expansionary shock in year t and 0 otherwise; $BNDES_i$ is equal to 1 if the firm had outstanding loans with BNDES during our sample period. Table A-7 presents the results for contractionist monetary shocks, while Table A-8 presents the results for unexpected expansionist monetary shocks. P-values are under parenthesis.

Table A-7. Investment of Firms: Financial restrictions, Unexpected Monetary Shocks and BNDES — Contractionist Shock.

	$Capex_{it}/Assets_{it}$				
	Eq (1)	Eq (2)	Eq (3)	Eq (4)	Eq (5)
$Cashflow_{it}/Assets_{it}$	0.24	0.14	0.20	0.21	0.10
	(0.02)	(0.10)	(0.03)	(0.01)	(0.18)
Q_{it}	0.12	0.24	(0.13)	0.19	0.15
	(0.00)	(0.03)	(0.06)	(0.00)	(0.02)
$Shock_t$	−0.00053			−0.00063	−0.00083
	(0.01)			(0.06)	(0.00)
$BNDES_i$		0.00742		0.00832	0.00721
		(0.04)		(0.01)	(0.01)
FR_i			−0.00113	−0.00143	−0.00102
			(0.03)	(0.05)	(0.01)
$Shock_t \times Cashflow_{it}/Assets_{it}$	0,001				0.0019
	(0.12)				(0.43)
$BNDES_i \times (Cashflow_{it}/Assets_{it})$		−0,00032			−0.09
		(0.02)			(0.16)
$FR_i \times Cashflow_{it}/Assets_{it}$			0,0002		0.0015
			(0.12)		(0.10)
Wald Tests					
$(Cashflow/Assets + Shock \times Cashflow/Assets)$	(0.18)				(0.02)
$(Cashflow/Assets + BNDES \times Cashflow/Assets)$		(0.00)			(0.00)
$(Cashflow/Assets + FR \times Cashflow/Assets)$			(0.00)		(0.00)
F test Joint Significance	(0.00)		(0.00)	(0.00)	(0.00)
Hausman Test	(0.18)	(0.18)	(0.18)	(0.24)	(0.18)
R^2	0.19	0.23	0.16	0.31	0.49
Number of Restricted Firms	243	243	243	243	243
Total Number of Firms	4876	4876	4876	4876	4876
Sample Period	1995–2010	1995–2010	1995–2010	1995–2010	1995–2010

Table A-8. Investment of Firms: Financial restrictions, Unexpected Monetary Shocks and BNDES — Expansionist Shock.

	$Capex_{it}/Assets_{it}$				
	Eq (6)	Eq (7)	Eq (8)	Eq (9)	Eq (10)
$Cashflow_{it}/Assets_{it}$	0.04	0.06	0.08	0.06	0.01
	(0.21)	(0.03)	(0.02)	(0.18)	(0.43)
Q_{it}	0.15	0.28	0.24	0.21	0.24
	(0.01)	(0.12)	(0.01)	(0.00)	(0.12)
$Shock_t$	0.0003			0.0004	0.0002
	(0.02)			(0.01)	(0.07)
$BNDES_i$		0.0042		0.00546	0.00376
		(0.00)		(0.01)	(0.06)
FR_i			−0.00091	−0.001003	−0.000921
			(0.10)	(0.08)	(0.15)
$Shock_t \times Cashflow_{it}/Assets_{it}$	0.00002				0.0010
	(0.28)				(0.10)
$BNDES_i \times (Cashflow_{it}/Assets_{it})$		−0,00031			−0.00024
		(0.01)			(0.20)
$FR_i \times Cashflow_{it}/Assets_{it}$			0,00018		0.00011
			(0.01)		(0.08)
Wald Tests					
$(Cashflow/Assets + Shock \times Cashflow/Assets)$	(0.13)				(0.01)
$(Cashflow/Assets + BNDES \times Cashflow/Assets)$		(0.00)			(0.02)
$(Cashflow/Assets + FR \times Cashflow/Assets)$			(0.00)		(0.04)
F test Joint Significance	(0.00)	(0.00)	(0.00)	(0.09)	(0.09)
Hausman Test	(0.18)	(0.18)	(0.18)	(0.34)	(0.34)
R^2	0.15	0.10	0.22	0.30	0.61
Number of Restricted Firms	243	243	243	243	243
Total Number of Firms	4876	4876	4876	4876	4876
Sample Period	1995–2010	1995–2010	1995–2010	1995–2010	1995–2010