

Relaxing Credit Constraints in Emerging Economies: The impact of public loans on the performance of Brazilian firms

Gianmarco I.P. Ottaviano

London School of Economics (LSE)

Filipe Lage de Sousa[†]

Universidade Federal Fluminense (UFF)

June 2012

ABSTRACT

The literature evaluating the impact of government business support policies is still in its infancy. This paper contributes to this field by analysing the effects of the Brazilian Development Bank loans on domestic firms' productivity. Results suggest distinguishable results depending on which productivity measure is considered. While labour productivity presents positive association with financial support, TFP shows negative. However, when investigating causality by difference-in-differences, no effect is found.

RESUMO

A literatura de avaliação de políticas públicas para estimular o setor empresarial privado ainda está iniciando. Esse artigo procura contribuir para essa área de estudo avaliando os efeitos dos financiamentos do BNDES na produtividade das empresas. Os resultados sugerem impactos distintos, sendo positivos para a produtividade do trabalho e negativo para PTF. No entanto, ao investigar a causalidade por diferenças em diferenças, nenhum efeito é encontrado.

Keywords: heterogeneous firms, productivity, public policy analysis, credit constraints.

Palavras-chaves: firmas heterogêneas, análise de política pública, restrição ao crédito

Código JEL: O38 e H00

JEL code: O38 and H00

[†] Correspondent Author (email: fl_sousa@id.uff.br)

Very preliminary and incomplete.
Do not cite without authors' permission.

Large emerging economies, such as Brazil, China and India, are considered the markets of the future as promising destinations for sales as well as worrying origins of tough competitors. At the same time, firms from those countries feel they are not able to compete on a level playing field with firms from more advanced economies due to all sorts of market failures. In particular, credit constraints are often perceived one of the most important market frictions constraining innovation, growth and performance as they hamper the entrepreneurial efforts of local firms. While huge amounts of public money are being devoted to the removal of such constraints, a systematic investigation of their effectiveness is still at an infant stage and subject to an intense policy debate.

The aim of this paper is to contribute to this debate by investigating the case of Brazil. The Brazilian government provides long-term loans through the *Banco Nacional de Desenvolvimento Econômico e Social* (henceforth, BNDES), a development bank whose main statutory goal is to improve Brazilian economic competitiveness without neglecting broader social and environmental aspects. BNDES invests in several areas including research and development, infrastructure, export support, regional and urban development. More specifically, in the case of manufacturing, BNDES finances long-term projects aimed at the creation of new plants, the enlargement of existing ones, the restructuring and the modernization of production processes, innovation and technological development, export promotion. Overall, the importance of BNDES in the Brazilian economy is quite sizeable: in 2009 its disbursements reached the value of R\$ 136 billion (or US\$ 78 billion), representing 13.3% of aggregate investment.

Even though BNDES project analysis involves several dimensions including social and environmental aspects, this paper focuses on the assessment of their overall impact on the competitiveness of Brazilian firms. Do BNDES loans help relax credit constraints that hamper the innovativeness and competitiveness of Brazilian firms? A positive answer requires checking that at least two things are true. First, granted firms must change their performance after receiving a loan. Second, after receiving a loan, granted firms must perform better than otherwise identical non-granted firms. To check whether this is indeed the case, the paper will rely on micro-data drawn from a variety of sources: the Annual Industrial Research (*Pesquisa Industrial Anual* – [PIA]) of the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – [IBGE]); the Annual Social Information Report (*Relação Anual de Informações Sociais* – [RAIS]) of the Ministry of Labour; the Foreign Trade Secretary (*Secretaria de Comércio Exterior* – [SECEX]) of the Ministry of Industrial Development and Foreign Trade; the Foreign Capital Census and the Central Bank Register of Brazilian Capital Abroad of the Brazilian Central Bank; BNDES itself.

While there is an increasing literature evaluating government policies for business support (Bronzini and Blasio, 2006), there is a relative shortage of papers on the specific impact of government policies on firms' productivity (see, e.g., Griliches, Klette and Moen, 2000; Criscuolo, Martin, Overman and Reenen, 2007). This is not due to a shortage of methods, since other areas have already developed different ways to deal with the issue. An example can be found in the literature of labour economics that evaluates to what extent government policies affect individuals' achievements (Heckman, LaLonde and Smith, 1999). The role of credit constraints for innovation and growth has been stressed mainly in the development literature. Banerjee and Duflo (2005) provide evidence that firms in many developing countries face credit constraints, using a sample of countries which includes Brazil. More specifically, Terra (2003) provides evidence that Brazilian firms are credit constrained by investigating this issue at a firm level (see also FIESP, 2010). In the case of Brazil, Coelho and Sousa (2010) present a review of all recent studies using evaluation techniques investigating BNDES support on firm performance. In total, six papers address whether firm productivity is related to BNDES loans. However, the majority of them evaluate only labour productivity. These include De Negri, De Negri and Alves (2008), Coelho and De Negri (2010) and Araújo, Esteves and De Negri (2010), which investigates effects of any BNDES' loans on firm performance, including those loans not aimed at improving their productivity. Ribeiro and De Negri (2009) and Coelho and De Negri (2010) look at both labour productivity and Total Factor Productivity (TFP), but the former focus on a specific loan allotted to acquisition of domestic capital goods whereas the latter analyze any BNDES loan. Closer to the spirit of the present paper, Ottaviano and Sousa (2008) and Sousa (2010) investigate the relationship between firms' performance and BNDES

loans allocated to the modernization and enlargement of existing plants or to the creation of new ones. As mentioned previously, both papers look only at labour productivity, while the present paper uses not only labour productivity but also TFP. Another feature that distinguishes the present paper from those previous is the design of an estimation strategy to account for differences in both observable and possibly unobservable differences between firms granted BNDES support and other firms used as control group. This is an important issue, as for instance firms' management skills might be as important as financial information for receiving BNDES financial support.

The empirical results show that on average granted firms do perform differently than non-granted firms after being awarded a BNDES loan. However, it is not clear whether this change in productivity is associated to BNDES loans. In the most naïve models, a positive and negative correlation is found. However, it vanishes when more sophisticated methods are implemented. Generally, no effect of BNDES loans on firms' performance is detected by using difference-in-differences approach after comparing with different groups of similar firms. This may represent that the criterion decision on selecting projects does not focus entirely on economic issues. Other issues, such as social, regional and environmental impacts, might even be as important as economic aspects to select the project, due to the amenities that each project creates. Another interpretation arises from the counterfactual groups used in this paper. As the counterfactual group considers only firms which have made investments during the period, then BNDES loans allows credit constrained firms to perform similarly to those not constrained, since they have made investments despite of government financial support. Additionally, those financial supports might be selecting projects implementing new and old technologies and therefore not being able to affect firms' productivity. Finally, projects selected by BNDES might be not considered the most effective to burst firms' productivity.

The paper is structured as follows. Section 1 begins by showing what happens to firms' productivity when government relax credit constraints for firms to implement new projects. Financial support offered by BNDES to manufacturing firms is detailed in Section 2. Empirical strategy is described in Section 3, followed by which data are required to pursue this investigation. Descriptive statistics as well as selection of counterfactual groups are presented in Section 5. The empirical findings are the focus of Section 6. Finally, Section 7 offers some concluding remarks.

1. Methodological framework

Consider the problem faced by a firm that each period generates a new project of random non-observable quality φ , ranging from $(0, +\infty)$, and is credit constraint in its implementation. For concreteness assume that the firm faces a perceived demand for its output with constant price elasticity equal to $\sigma > 1$:

$$q = A p^{-\sigma} \quad (1)$$

where p is price, q is quantity demanded of the firm's output, and A is aggregate demand, which is unaffected by the firm's behaviour.

Production based on a project of quality φ can start only after paying a fixed cost and then incurs a constant marginal cost. There are two types of technologies available, 'old' and 'new', and they differ in terms of both fixed and marginal costs. Specifically, the old technology requires a smaller initial investment but is also less efficient. This implies that its fixed cost is lower but its marginal cost is higher. All this is captured by the following total cost:

$$TC_T = f_T + \frac{c_T}{\varphi} q, \quad T = H, F \quad (2)$$

where f_T is fixed cost, c_T is marginal cost and, all the rest given, better project quality (larger φ) maps into lower marginal cost (i.e. higher productivity). T is an index of technology, which equals L and H in the case of old and new technologies respectively. Hence, we have $f_H > f_L$ and $c_H < c_L$.

Profit maximization with constant demand elasticity requires the firm to set its price as a constant mark-up over marginal cost adjusted for project quality:

$$p_T(\varphi) = \frac{\sigma}{\sigma - 1} \frac{c_T}{\varphi} \quad (3)$$

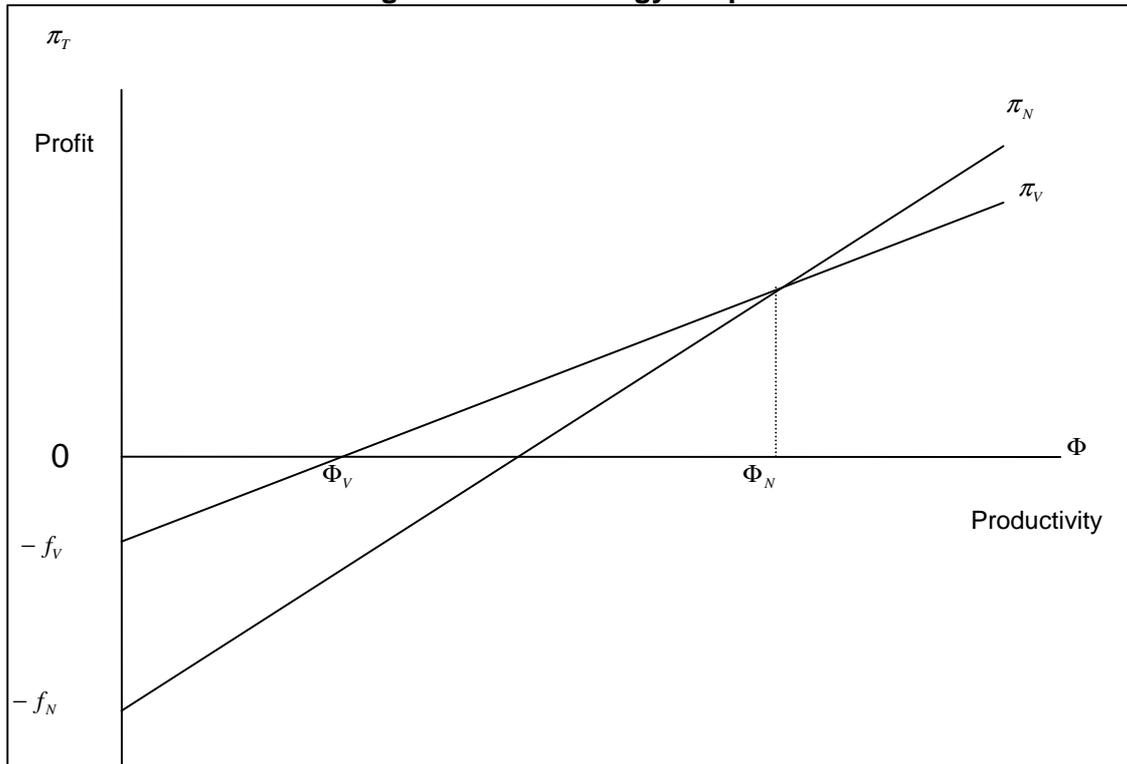
which implies the following expressions for the scale of production, revenues and profits:

$$q_T(\varphi) = A p_T(\varphi)^{-\sigma}, \quad r_T(\varphi) = A p_T(\varphi)^{1-\sigma}, \quad \pi_T(\varphi) = A p_T(\varphi)^{1-\sigma} / \sigma - f_T \quad (4)$$

As σ is larger than one, results (3) and (4) show that, for a given technology, a better project leads to lower price, larger scale of production, larger revenues and larger profits. They therefore foster the adoption of the new technology. To see this, consider Figure 1, which depicts the profits associated with the two technologies as functions of the productivity index $\Phi = \varphi^{\sigma-1}$.

The assumptions of fixed and marginal costs imply that profits have a lower intercept but a steeper slope for the new technology than for the old one. Figure 1 then shows that the projects the firm may come up with are partitioned in three categories: low quality projects ($0 < \Phi < \Phi_L$) do not break even no matter which technology is adopted; intermediate quality projects ($\Phi_L < \Phi < \Phi_H$) generate larger profits when the old technology is adopted; high quality projects ($\Phi > \Phi_H$) yield larger profits when the new technology is adopted instead.¹

Figure 1 – Technology adoption



Credit constraints affect the cost of initial investment: the more stringent they are, the larger f_H and f_L . Accordingly, by reducing f_H and f_L , their relaxation shifts both Φ_L and Φ_H to the left with an increase of both the overall share of projects that break even (lower Φ_L) and the overall share of projects implemented through the new technology (lower Φ_H). Credits constraints may, however, affect the two fixed costs asymmetrically. For instance, if they affected disproportionately the adoption of the new technology, their relaxation would decrease f_H more than f_L , increasing the relative number of projects implemented through the more efficient new technology and thus improving firm productivity. On the contrary, if credit constraints affected disproportionately the adoption of the old technology, their relaxation would decrease f_L more than f_H , increasing the relative number of projects implemented through the less efficient old technology and thus reducing firm productivity. Last, but not least, if credit constraints for both technologies are reduced proportionately, some firms might adopt new technology while others old technology and overall results might be no effect on productivity in the economy.

To summarize, the theoretical framework implies that, if BNDES loans relaxed the credit constraints faced by Brazilian firms, this would map into more projects being adopted. Moreover, if these

¹ This holds provided that the fixed costs of the new technology are large enough. The exact condition is $f_H > f_L(c_L/c_H)^{\sigma-1}$.

projects were implemented using new technologies, firms would become more productive after receiving the loans. They could nonetheless become less productive if their new project were implemented using old technologies instead. If some uses new and others old technology, net effect might be null.

2. Overview of BNDES schemes

BNDES provides a wide range of financial tools to support Brazilian manufacturing firms: FINEM, Automatic BNDES, FINAME, Leasing FINAME, International Competition FINAME (BNDES-Exim) and Subscription of Securities.

FINEM (“Financing and Endeavours”) is a direct or indirect support scheme for projects with financial needs over R\$10 million (equivalent to US\$ 5.7 million). Projects with financial needs below this threshold are instead supported solely indirect through retailing banks under the Automatic BNDES scheme. Both schemes contemplate several categories of expenses covering the creation of new plants, the enlargement of existing ones, the restructuring and the modernization of processes, innovation, and technological development.²

Through the FINAME (“Machines and Equipment”) and the Leasing FINAME schemes, BNDES supports the acquisition of new domestically produced machines and equipments either buying them (FINAME) or leasing them (Leasing FINAME). Finally, the aim of BNDES-Exim is to provide financial support for exports while the aim of Subscription of Securities is to facilitate changes in firm ownership.

Our focus is on FINEM and Automatic BNDES as they are more focused on supporting the discovery and the implementation of promising projects. Differently, FINAME and Leasing FINAME do not contemplate investments in innovation and technological development.³ Nonetheless, it is necessary to account for them in order to isolate the role of FINEM and Automatic BNDES. BNDES-Exim and Subscription of Securities have, instead, rather different objectives.⁴ FINEM and Automatic BNDES are therefore loans which might affect firms’ productivity since their expansion may be guided by improvements in production and/or creation of new and/or more sophisticated goods.⁵

In order to receive any of these two loans, either FINEM or Automatic BNDES, firms need to send a supporting application form with some brief information of their projects to a retailing bank or BNDES itself. The banks evaluate whether their projects are in line with the purpose of the mentioned loans. After having their application approved, firms ought to send a complete and detailed project plan to be evaluated by the financial institution. This project plan is analysed by investigating whether they are economically viable, what collateral can be used to guarantee the loan and so forth.

The analysis culminates in a formal contract proposal where the terms and conditions of the loan are established, including amount, period, and interest rate. After negotiations have finished, the loan contract is signed. It is important to note two crucial points here. First, firms do not receive their loan in only one instalment after signing the contract; they receive it gradually according to the development of the project. It is hence during negotiations that disbursements are scheduled over the years of project’s implementation. Second, there is a limit for BNDES participation in any project, which varies overtime yet it is generally around 80%. A project is not therefore fully financed by BNDES, only a part of it is.

Once the loan has been approved, firms receive their first disbursement and those remaining are made after an evaluation of the project’s progress. Before the second disbursement, the company should prove whether the money of the first disbursement was invested in the items informed by their project plan. Any violation of the loan terms leads to a further investigation and disbursements are interrupted until justifications are given. If no problems emerge, disbursements continue until the end of the project. Since these are long-term projects, the period between contract signing and the end of disbursements takes on average 5 years. Generally only after all disbursements have been made, firms start to amortize their loans.

² A complete list is available at <http://www.bndes.gov.br>.

³ Its impact on firms’ productivity is investigated by Ribeiro and De Negri (2009)

⁴ Although changes of ownership might affect firms’ performance, we are interested in how productivity might be affected by implementation of projects. Additionally, all firms being supported by this scheme are discarded.

⁵ Regarding their importance, those two loans are quite representative in BNDES budget as they were on average 46% of the total disbursements over the last ten years (2000 to 2009).

3. Empirical Strategy

In order to assess the impact of BNDES schemes on firm performance, ideally one would like to compare granted and non-granted firms which were identical in any respect when loans were awarded to the former. Those characteristics should be related to whether a firm is eligible to this financial support, which includes not only observable to the researcher, but also unobservable ones.⁶ This paper tries to address both types of characteristics, since it is not possible to rely on only one of them.⁷

For unobservable characteristics, two particular issues should be considered before trying to evaluate which characteristics are important to be eligible for this government financial support. First, entry and exit of firms in any market are very common in every economy. However, it is important to follow firms which have entered in the market before the beginning of the dataset as well as able to survive during a reasonable time period. This indicates that firms might have similar management skills to overcome unexpected uncertainty in the market.⁸ Therefore, it is important to consider only existing firms before the analyzed period and have been able to survive during all those years investigated.

Secondly, as granted firms are those interested in making investments, any group of non-granted firms which have made investments during a similar period should be considered. In other words, non-granted firms considered as comparable of those granted should be investing; otherwise we might end up selecting firms which are not so similar. This may show similar unobservable characteristics regarding their strategy to remain competitive in the market and/or expanding their market share. Summing up, only firms which have invested and survived should be considered in a counterfactual group, since they might represent unobservable characteristics, such as management skills, which need to be similar between granted and non-granted firms.

Although granted and non granted firms might become much more alike when comparing only those survived and made investments, unobservable characteristics might still be very heterogeneous between both firms' groups. Therefore, it is important to refine even more the control group to reduce this heterogeneity. Considering unobservable characteristics, any granted firm might be similar to each other. Therefore, selecting some firms, which have received BNDES' loans but not during the investigated period, might create a reasonable counterfactual group regarding unobservable characteristics. Before the investigated period is not reasonable strategy, since firms have already been affected by this government financial support. Thus, we are left to firms being granted after the analysed period. Then, firms granted after this period might be eligible candidates to be considered as similar firms regarding unobservable characteristics. In other words, considering that information used to test whether BNDES financial support has any impact begins in 1996 and ends in 2006. Then granted firms in 2007 for the first time might be similar in unobservable characteristics to those granted in any period between 1996 and 2006, otherwise they would not be granted in 2007. Therefore, those firms granted in 2007 might be considered as a reasonable control group.

Although reducing differences between granted and non granted firms regarding unobservable characteristics is important, it may be interesting to diminish heterogeneity on observable issues. In order to do that, it is important to investigate which observables characteristics are important for being eligible to a BNDES financial support. Propensity Score Matching (PSM) allows one to pursue an ideal comparison by matching each granted firm with non-granted exhibiting similar observable characteristics. This artificially generates a "control group" of non-granted firms to be compared with the "treated group" of granted firms in order to assess the impact of "treatment" by BNDES schemes. There are different ways to implement it⁹ and this paper uses the one-to-one method. This method creates a counterfactual group by pairing each granted firm with one similar firm. The main advantage of this method is that only

⁶ What defines observable is whether a researcher may be able to observe a characteristic. For the bank, all of those are observable, since they are able to evaluate not only observable characteristics (such as revenue), but also what we are calling unobservable (such as management).

⁷ Due to data restrictions, it is not possible to consider both jointly as it will be showed later on in this paper.

⁸ For instance, Brazil has experienced a real depreciation of its currency in 1999 which have changed business environment.

⁹ More details are presented in Arnold and Javornik (2005), where PSM is used to evaluate the impact of foreign investment on firm productivity in Indonesia.

firms which can be considered comparable are used and all those which are not possible to find a similar firm are discarded. In other words, only treated and non-treated firms which can be considered similar are included.

Matching is based on pre-treatment observable characteristics considered relevant to be eligible for the financial support. Those characteristics should include not only performance indicators such as whether they are increasing their revenue but also some indicators level as their size and whether there is collateral to be offered for the loan.¹⁰ For investigating which characteristics are important for being eligible, we used a Probit model using observable ones. This model provides us the probability of each firm to get a financial support from BNDES. Then, it is possible to compare probability of the granted firm to a non-granted one. Having the probability of a granted firm, we find one non-granted firm mostly similar to this granted one. The difference in probability is considered in this paper starts at the seventh decimal case and finishes at the second decimal case, where if at that point a granted firm can not find a similar non-granted, then this firm is discarded, since it is a firm with completely different patten from any other non-granted.

After having control groups, it is relevant to assess whether BNDES schemes are related to firms performance after the treatment. Two venues are explored in this paper: Structural Break (OLS) and Causality Specification (Difference-in-differences).

3.a Method 1 – Structural break

The starting point is to check whether the productivity improvement of granted firms is associated with BNDES loans after controlling for other observable characteristics of firms. For that, the simplest specification is the following:

$$y_{it} = X_{it}\beta + \delta D_{it} + \varepsilon_{it} \quad (1)$$

where y_{it} is productivity measure, D_{it} is a dummy variable for all years after the loan being given, X_{it} is a vector of control variables, ε_{it} is the error term and the rest are parameters to be estimated. In particular, the impact of BNDES loans on firm productivity is measured by the estimated value of δ . The control variables include various firm characteristics.¹¹

There are some potential problems with specification (1) that may lead to biased estimation of the coefficients. First, there may be unobserved characteristics affecting both dependent and independent variables. Second, the linear relation between y and X may not be the most appropriate. Third, D and X may be endogenous. All those drawbacks are reduced by using a counterfactual group similar to those granted.

3.b Method 1 – Causality Specification

One drawback of the previous specification resides on the fact that D could be endogenous. If endogeneity comes from a time-invariant fixed effect, then difference-in-differences (DID) approach eliminates this shortcoming. DID estimates whether the difference in productivity of the treated group over time can be distinguishable from the difference in the counterfactual group over the same period. Therefore, DID presents more reliable results in order to assure whether a difference in productivity performance is related to the financial support. Difference-in-differences approach used in this paper follows a specification described in Bronzini and Blasio (2006):

$$y_{it} = \beta BNDES_i + \sum_t \alpha_t D_t + \sum_t \delta_t (BNDES_i \cdot POST_t) + X_{it}\gamma + \varepsilon_{it} \quad (2)$$

where y_{it} is again productivity measure, $BNDES_i$ is a dummy variable indicating whether the firm received any loan in the period of observation, D_t is a year dummy, $POST_t$ is a set of dummies for each

¹⁰ More details of each variable are available in Section 5.

¹¹ A full description of these variables is available in Section 6.

year after receiving the loan and X_{it} is the vector of control variables. The parameter of interest is δ_t , whose estimated value measures the impact of BNDES schemes on firm productivity over time. Note that the estimation of (2) allows one to assess not only whether BNDES loans affect firm productivity but also when the impact materializes.¹²

4. Description of the dataset

As described by the empirical strategy, micro-level data are required to perform such analysis. Therefore, micro-data are drawn from a variety of sources already used by papers described in Coelho and Sousa (2010). The dataset combines information from: the Annual Industrial Research (*Pesquisa Industrial Anual* – [PIA]) of the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística* – [IBGE])¹³; the Annual Social Information Report (*Relação Anual de Informações Sociais* – [RAIS]) of the Ministry of Labour; the Foreign Trade Secretary (*Secretaria de Comércio Exterior* – [SECEX]) of the Ministry of Industrial Development and Foreign Trade; the Foreign Capital Census and the Central Bank Register of Brazilian Capital Abroad of the Brazilian Central Bank; BNDES itself.¹⁴

BNDES data are used to identify firms given loans. Information is available from 1995 to 2007.¹⁵ In this period 9,828 firms borrowed under both loans (FINEM and Automatic BNDES schemes), which represents nearly 4% of all manufacturing firms in Brazil.¹⁶ However, it is not possible to use all firms since some of them are not available from PIA, especially small firms. The reason is that PIA covers all firms with more than 30 employees, which represents around 30 thousand firms.¹⁷ Then, information is lost not only with treated firms, since the number of firms granted Automatic BNDES in our sample by half as some are smaller than that threshold (30 employees), but also with non-treated firms, as firms over 30 employees comprehend only 11% of all manufacturing firms in Brazil. Although, there is a huge reduction on the number of firms, they represent substantially the Brazilian manufacturing sector, since around 2/3 of manufacturing employment are in those firms.

Our treated sample is further reduced by three additional issues. First, the focus of this paper is on *manufacturing firms* while BNDES records concern all *manufacturing projects*. In other words, they report manufacturing projects by non-manufacturing firms (e.g., those of large food retailers investing in the development of their own brands) and do not cover non-manufacturing projects of manufacturing firms (e.g., in agriculture). Hence, we end up evaluating only the performance of manufacturing firms granted loans to implement projects in the manufacturing sector. A second issue is related to mergers. For example, if Firm A received a loan in 1997 and in 2000 merged with Firm B creating a new Firm C, and then the initial loan would be registered to firm C. As the past records of Firm C are impossible to reconstruct, all information on loans projects granted to firms like A and B are dropped.¹⁸ Finally, there is a time lag of generally two to three years before a firm enters the Census part of PIA.¹⁹ Hence, some granted firms with more than 30 employees are not recorded by PIA at the moment they receive BNDES loans.

¹² It is also feasible to evaluate time-effect in previous specifications, but they would say only when association occurs. In this method, knowing when treatment effect materializes seems to be more interesting.

¹³ This is our main data source, since it contains the majority of the variables useful for this analysis, including for measuring productivity.

¹⁴ The construction of the dataset has followed procedures that guarantee the confidentiality of information so that individual datum cannot be related to any specific firm.

¹⁵ Data on 1995 is used only to exclude any firm which received treatment in that particular year. Data on 2007 is used for choosing a counterfactual group, as mentioned in Section 3.

¹⁶ More precisely, there were 274,515 active firms in the Brazilian manufacturing sector in 2007 (source PIA/IBGE).

¹⁷ Firms with less than 30 employees are also considered in this survey, but they are selected randomly in the market each year. Since this group varies annually, making it impossible to follow, we decided to discard all those firms.

¹⁸ All firms which have received financial support through Subscription of Securities are deleted from our sample.

¹⁹ IBGE receives information of firms' size (number of employees) from a particular year only at the end of the following year. Thus, any new firm for the census part will provide information only after two or three years having become eligible to be computed.

Although this treated group has a reasonable size, potential drawbacks of conducting a policy analysis with this treated group should be addressed. First, any of these firms (granted or not) might be affected by other government interventions apart from BNDES loans. Second, there may be a time lag for any impact to be detected, since outcomes do not necessarily appear immediately after the loan has been granted. For the former problem, it will be assumed that BNDES loans are the main type of subsidies to affect firms' productivity, since this is the largest financial institution in Brazil offering loans for long-term projects. For the latter shortcoming, BNDES loans encompass six months before the project may be considered eligible for analysis. Then when the loan is approved, the project is generally being implemented, and considering the effects on the current and subsequent period is not a strong assumption.²⁰ Actually, some extra time should be allowed in order to check the full effect of the treatment. Since some projects last for at least five years, then it deserves a period beyond a five-year horizon to check its impact. This allows the model to check BNDES' effects not only during but also after the treatment. Given the time spanned by our dataset (1996 to 2006), that is clearly not feasible for loans granted from 1999 onwards. On the other hand, to build the control group for firms treated in a certain year, one needs to have at least two previous year of observation to be used for PSM. Hence, the impact of BNDES schemes can be scrutinized through PSM only for firms granted Automatic BNDES and FINEM loans in 1998, which therefore define our treated group. Moreover, to avoid concerns regarding repeated treatment, all firms treated before 1998 were excluded.²¹ In the end, 141 treated and 6,344 thousand non-treated firms are left to construct a counterfactual group.²²

5. Descriptive Statistics and Selection of Counterfactual Groups

Before presenting any statistics, it is relevant to define which groups are considered for analysis. First, among treated firms, there are four subgroups considered in this analysis. First, considering both schemes 141 firms were granted. As Automatic BNDES is the most popular, then a sample of only firms financed by this scheme is considered (112 firms in total). As firms might have been financed more than once, 75 firms were treated solely in 1998 and not after. At last, 69 firms were granted Automatic BNDES for the first time and only in 1998. A summary is available at Table 1.

Number of Treatment	Automatic BNDES	Both Schemes
Once	69	75
More than Once	43	66
Total	112	141

On the other side, there are other three groups eligible for counterfactual group which are going to be considered for comparison so far: all firms with more than 30 employees (21,280 firms); firms which have survived and have made investments from 1996 to 2006 (6,344 firms); and firms granted first loan in 2007 (128 firms).

A summary of the main characteristics of treated and non-treated firms is available at Table 2.²³

²⁰ Firms are credit constrained to implement the whole project. However, BNDES does not finance the full project and rather a part of it as explained in Section 1. Some projects might start before credit has been given with their own funds.

²¹ For firms treated in 1998 and any other period after, two strategies are taken which will be explained in Section 6.

²² Actually, there were 1,127 firms treated in 1998, but due to those data restrictions, we ended up by having only 141 firms to perform an impact evaluation.

²³ Table A.II presents results with all variables in Appendix II. Description and sources are shown at Table A.I in Appendix I. Since some TFP values are negative, we used TFP of all firms in 1996 as a basis for better understanding.

Table 2: Average of Some Variables from Financed Firms in 1998 and Non Financed Firms
All values from 1997 – One Year Before Treatment

Variables	Non Treated Firms			Treated Firms			
	All Firms over 30 employees Group A	Survived and Invested Group B	First Treated in 2007 Group C	All First Time in 1998 Group I	Automatic BNDES First Time in 1998 Group II	All only in 1998 Group III	Automatic BNDES only in 1998 Group IV
Labour Productivity	26,6	26,8	27,0	35,5	29,7	31,8	27,4
TFP Levinhson-Petrin	99,3	101,8	89,1	97,7	100,7	104,7	102,5
Number of Employees	175	196	255	620	332	468	285
Total Revenue	17,0	16,6	25,2	80,7	22,7	82,0	18,3
Capital Stock	31,6	19,6	34,9	84,4	29,0	53,9	24,1
% Skilled Worker	5,8%	6,8%	5,7%	9,2%	8,1%	9,2%	8,4%
Investment	1,17	0,86	1,24	5,45	1,58	4,79	1,13
Market Share	0,09%	0,11%	0,12%	0,33%	0,11%	0,31%	0,09%
Profitability	5,9%	6,7%	7,9%	5,7%	5,9%	6,4%	6,1%
Financial Status	3,9%	3,6%	3,2%	4,7%	4,5%	5,0%	4,9%
Solvency	3,9%	3,0%	2,2%	2,8%	2,8%	3,1%	3,1%
Employees Growth	0,1%	4,3%	1,8%	8,8%	10,3%	6,2%	6,3%
Revenue Growth	22,1%	20,6%	16,9%	17,5%	13,7%	13,8%	11,9%
Labour Productivity Growth	30,3%	26,0%	14,3%	31,7%	27,6%	34,6%	33,8%
% Multinationals	5,1%	8,0%	5,5%	14,9%	11,6%	10,7%	8,7%
% Rich Region	85%	87%	93%	88%	87%	81%	81%
OCDE Classification							
High & Medium-High Tech	22%	26%	18%	32%	32%	35%	32%
Low & Medium-Low Tech	78%	74%	82%	68%	68%	65%	68%
Number of Firms	21.380	6.344	128	141	112	75	69

On average, treated firms present a higher labour productivity. This is mostly explained by their capacity to create value-added. In other words, there are advantages of economies of scale which might explain why those firms have higher productivity. This argument is not reinforced with TFP estimated by Levinhson-Petrin. It reduces dramatically depending on which comparison group is considered. While labour productivity of all granted firms for the first time in 1998 (Group I) is more than 30% higher than those non-granted who have survived and invested (Group B), TFP of granted firms is lower than those non-granted by 4%. In other words, it is not possible to infer that TFP of treated firms are greater than all firms over 30 employees and those who have survived and invested.

Treated firms' size corroborates this interpretation of labour productivity, since granted firms are larger in many aspects, ranging from number of employees to capital stock, revenues and market share. Investment level shows a striking result, as firms financed by Automatic BNDES have made investments similar to those non-treated before the loan, but FINEM granted firms have invested nearly five times what non-financed had previously the loan. The percentage of skilled workers in granted firms are reasonably higher than non-granted firms.

Two indicators reinforce the hypothesis of credit constraint of treated firms. Granted firms present lower profitability compared to those invested and survived as well as those granted in 2007. Compared to all firms, difference is lower. This provides some evidence that granted firms are able to generate less profit to finance their investment and growth plan. Additionally, the importance of financial expenses over total costs (Financial Status) is lower for non-treated firms than for treated. In other words, they were facing more costs to finance their business than non-treated firms. As granted firms generate less resources and face higher financial costs, they are much more credit constraint than those non-granted.

Regarding their capacity to repay the debt, three different interpretations emerge. First, granted firms have more capacity to repay than all firms over 30 employees (solvency) but very similar to those

surviving and investing. This comparison inverts when considering those financed first in 2007, which shows that those granted only in 2007 might have been eligible candidates for the loans in 1998, as this is an important issue when analyzing any loan request.

In terms of growth, granted firms increased employment much more than non-granted firms, but this inverts when revenue growth is the case. This capacity of increasing jobs, which means expanding their production allied to raise revenue at a lower level, reinforce the idea that granted firms are credit constraint. The increase in labour productivity of treated over non-treated firms presents further evidence on performing well before the loan.

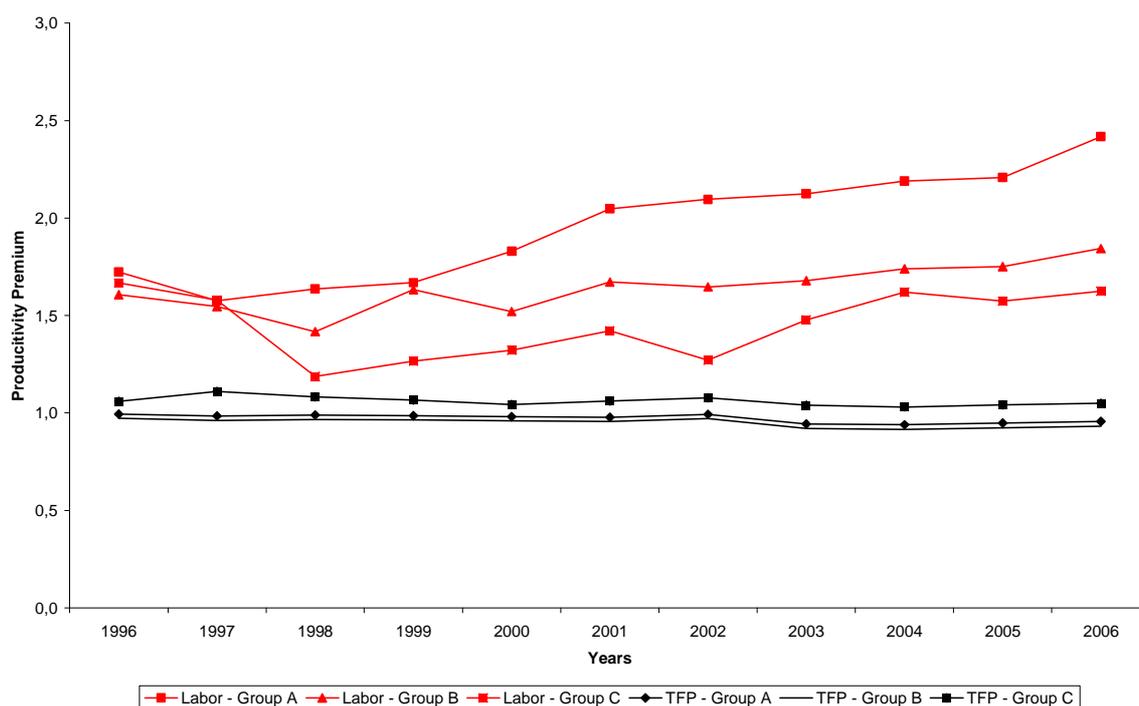
Regarding qualitative measures, it is feasible to notice that multinationals are more representative in granted firms than non-granted. Granted firms located in poor regions are more representative when they were financed solely in 1998. Nevertheless, the most striking results appear in the technological intensity. According to the figures, loans were much more pointed toward high and medium-high technological intensity firms.

Summing up, results presented here are biased toward some characteristics, such as high tech and larger firms, for example. These biases should be addressed when trying to address BNDES schemes contribution to firms' productivity performance after the loan.

Aside biases' issues, the key question is whether BNDES loans are instrumental in relaxing the financial constraints faced by Brazilian firms. A positive answer to this question requires checking first whether granted firms improve their performance after receiving a loan and not only how they differ from non-granted before being treated.

Two different productivity measures (labour productivity and total factor productivity estimated by Levinshon&Petrin) are used as measures of firm performance. For better understanding, all values are normalized by productivity measures of all firms over 30 employees in 1996. Moreover, a measure of "productivity premium" of granted firms is calculated as the ratio of the average productivity of these firms to that of non-granted firms. Graph 1 reports how both productivity premiums (labour and TFP) have develop from 1996 to 2006. Three different counterfactual groups are used: all firms with more than 30 employees (Group A); survived firms which have made investments (Group B); and firms granted BNDES schemes for the first time in 2007 (Group C). For simplicity only all firms granted first in 1998 are used in this graph, however, interpretation do not differ substantially when another group of granted firms are taken into account.²⁴

Graph 1: Productivity of Granted (Group I) over Non-Granted Firms



All other feasible comparisons are shown in Appendix III.

The graph shows that granted firms are generally more productive than non-granted by looking at labour productivity. Within two years before loans were approved, productivity premium of granted firms ranges from 1.55 to 1.71. In other words, labour productivity of granted firms is at least 55% higher compared to non-granted firms before receiving BNDES loans. When firms are granted, in 1998, labour productivity premium differs substantially depending on which comparison group is considered. While the gap narrowed to only 19% higher compared to Group C, productivity premium increase to 1.64 contrasting to Group A. It seems that when starting a new project firms tend to reduce their gap to others, especially to those which are also making investments. After the loan, productivity gap increases in all cases being at least 62% more than any counterfactual group in 2006.

Although it is possible to observe labour productivity gap and growth relative to some comparison groups, TFP premium presents a distinguished outcome. Not only productivity premium of granted firms are quite similar to any comparison group before BNDES loans, both groups, treated and non-treated firms, seem to perform completely similar through time. There is not a single year where TFP productivity of granted firms is anyhow different from non-granted firms.

So far, any counterfactual group mentioned does not control for observable characteristics. As mentioned in Section 3, PSM allows us to construct a control group with similar observable characteristics. After having control and treated group similar regarding those features, a comparison can then be made in terms of productivity levels. Before finding the control group, it is essential to find which observable characteristics are relevant for getting BNDES financial support by using a Probit model, for example. For selecting which pre-treatment measures to perform a Probit model, it is important to include those relevant for being eligible to those loans. As it is a bank, those characteristics should be related to whether a firm is able to repay interest and principal as well as what kind of collateral is able to offer in case of default.

Starting with the last, capital stock is used as a proxy for warranties offered, thus it is included in the Probit model. Many variables are included to assess firms' ability to repay the loan. First, there should be variables related to firms' size, since larger firms might generate more revenues in order to pay loans back, then revenues, number of employees and market share are used for this purpose. According to descriptive statistics, profitability and solvency show discrepancies between granted and non-granted firms.²⁵ As they are also important for eligible criteria, they are included in the estimation. How firms are performing previously is not only important for having a loan granted, but also they show a different pattern of both types of firms as presented in Table 2. For this particular issue, growth of profit, revenue and employment are used in Probit model. As there is a bias towards technological sectors, international manufacturing classification dummies are used to capture any type of sector tendency.²⁶ As it seems to have a bias towards rich regions and multinational firms, dummies are included to capture those effects. In total, there are 32 parameters to be estimated in a Probit model.²⁷ Results are shown in Table 3.

²⁵ Financial Status presents different pattern as well, but it is not considered here, since most important is their capacity to generate revenue to pay (solvency) and not their proportion of financial issues on their cost.

²⁶ This international standard classifies manufacturing sector into 23 sets.

²⁷ For robustness check, other variables were included, yet they did not distort overall results.

Table 3: Probit Model Results

Probit Model	Employees	Revenues
Dependent Variable: BNDES Dummy	(i)	(ii)
Capital Stock	0.08 (0.04)**	0,06 (0.04)
Number Employees	0.17 (0.06)***	
Revenue		0,15 (0.05)***
Solvency	-0.96 (0.85)	-0,86 (0.84)
Profit	-0.58 (0.54)	-0,71 (0.55)
Profit Growth	0.07 (0.04)*	0,08 (0.04)*
Employees Growth	0.28 (0.16)*	0,38 (0.16)**
Revenue Growth	-0.10 (0.14)	-0,17 (0.14)
Market Share	190.87 (87.14)**	182.76 (87.58)*
Multinational Status	-0.10 (0.14)	-0.17 (0.14)
Rich Region	0.14 (0.13)	0,12 (0.13)
Observations	5,550	5,550
Percent Concordant	76%	76.2%
Hosmer and Lemeshow Statistic	0.86	0.74

* significant at 10%, ** at 5% and *** at 1%

Before interpreting any parameter, it is important to notice that model has a reasonable fit. Percent concordant, number of expected and actual values, is over 75% in both models. Additionally, Hosmer and Lemeshow test figures is not able to reject the null hypothesis that fitted and real values are the same for both treated and non-treated observations. Regarding parameters estimated, capital stock is relevant to explain firms' capacity to get financial support from BNDES only when number of employees is considered. When using revenue instead of number of employees, capital stock is not statistically significant. One explanation might be related to the fact that revenue and capital stock might be reasonably correlated. Then, it might be important for a firm to have collateral to offer when applying for any of those schemes. Size variables, such as market share, number of employees and revenues, are important for getting those loans. Although solvency and profitability show the expected sign according to descriptive statistics, they do not present statistical significance. Regarding firms' growth before getting the loan, employment and profit increase appear to be important for those loans, but revenue seems not to be relevant, as it is not significant. Last, any dummy variable, such as rich region, sector classification and multinational status, does not present any significance. However, sector classification taken as a whole is statistically significant.

Overall, we end up stating that having a property to offer as a warranty might be relevant to get a loan. Capacity for repaying BNDES loans seems to be also relevant for being eligible for any scheme, not only by size variables (such as number of employees, revenues and market share), but also by previous performance (employment and profit growth). Sectors might be also important as a whole, but there is not a specific one to nominate.

That information are relevant to create a counterfactual group by pairing granted firms to non-granted which might be similar according to those observable characteristics through PSM. As said previously, this paper uses the one-to-one method. This method creates a counterfactual group by pairing

each granted firm with only one non-granted firms similar. In other words, only granted firms able to find a counterfactual “twin” will be considered for impact evaluation. The main advantage of this method resides on the fact that counterfactual and treated group should be minimally similar, all others are discarded. Considering only firms which have invested during this period (6,344 firms) for non-treated and performing PSM, we find four different control groups depending on each treated group. A summary of how many firms are matched is shown in Table 4.

	Group I	Group II	Group III	Group IV
Treated Matched	118	99	65	61
Treated Not Matched	23	13	10	8
Percentage Matched	84%	88%	87%	88%

As it can be seen, there is reasonably number of firms matched to perform any impact evaluation. According to this table, more than 80% of treated firms are able to find a similar non-treated firm. Having those information, question changes to whether matched firms are now similar in relation to observable characteristics. Table 5 shows average of each relevant variable for this analysis, as well as t-statistics and p-value corresponding to test of the means from matched firms.²⁸

	Non-Treated		Treated		Testing Matched Firms	
	Not Matched	Matched	Matched	Not Matched	t Value	P-value
Capital Stock	19	53	66	179	-0.55	58.0%
Number of Employees	192	420	526	1.103	-1.03	30.2%
Solvency	3.0%	2.5%	2.7%	3.2%	-0.44	66.0%
Profit	6.7%	6.2%	6.4%	2.0%	-0.20	84.3%
Profit Growth	49%	82%	38%	125%	1.78	7.8%
Employment Growth	4%	5%	8%	14%	-0.71	47.6%
Revenue Growth	21%	21%	20%	7%	0.18	85.7%
Market Share	0.10%	0.10%	0.20%	0.90%	-1.91	5.8%
Multinational Status	8%	11%	16%	9%	-1.14	25.6%
Rich	87%	87%	89%	83%	-0.40	68.9%
Labour Productivity	26.8	30.3	35.1	37.6	-1.21	22.7%
TFP Productivity	101.7	97.1	97.1	103.3	0.04	97.1%
Number of Firms	6226	118	118	23		

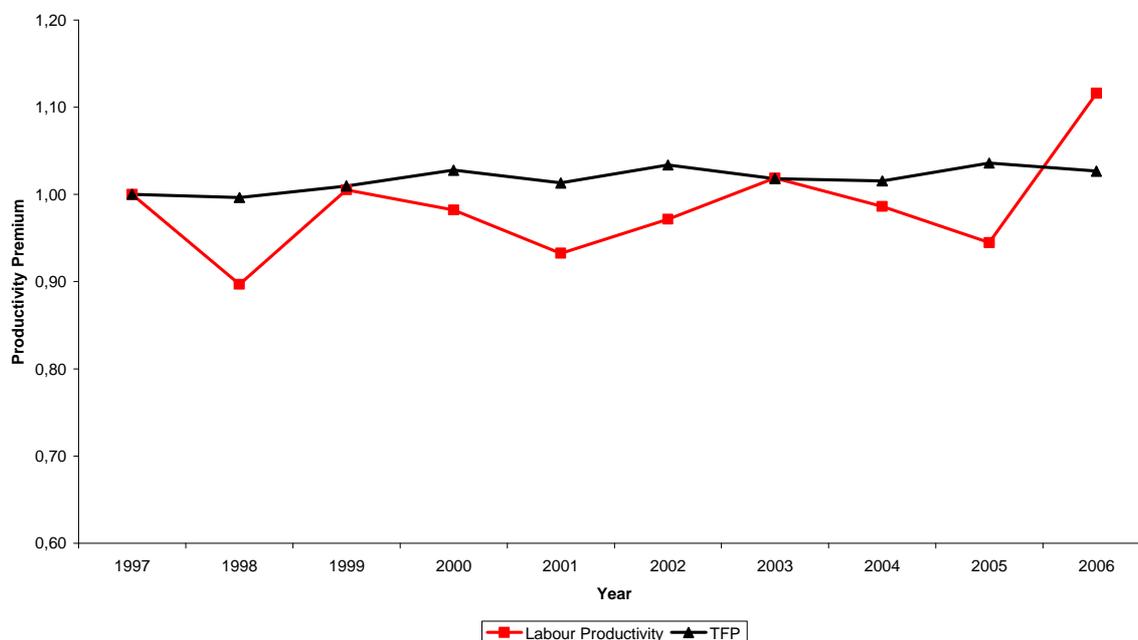
Generally, it is possible to observe that matched firms are much more alike than before. If we use 5% as a level of significance, all averages can be considered similar, since they do not present statistically difference. There are only two which could not be considered similar if 10% is used instead: Profit Growth; Market Share. For Market Share, it is possible to affirm that matching has discarded the largest firms (0.9%) within treated firms. Although they might have some differences, those are lower than before matching. As regarding profit growth, non-treated matched firms tend to have higher profitability compared to treated matched firms.

The most important part is related to productivity measure. Although none productivity measure is taken into account in the Probit model, paired firms present similar productivities measures before treatment. This is an essential indicator, since it is the investigated outcome of performance, thus it is advisable that financed and non financed firms are similar before any treatment.

²⁸ It is important to notice that for performing the Probit model, all continuous variables are in logs, where averages reported in Table 5 as well as test of means are in levels. Additionally, for parsimony, we are presenting only results related to Group I. Results using the other three groups are presented in the Appendix IV.

Previously, treated firms are compared to non-treated, but those comparisons do not take into consideration whether both groups are similar according to their observable characteristics. For simplicity and better understanding on how firms behave after the loan, we have established productivity premium from 1997 as a baseline. Graph 2 presents productivity premium pattern of those 118 paired firms, not only one year before being granted (1997) but also through all years after credit was conceded.

Graph 2: Comparing 118 Paired Firms (Treated / Non-treated)



It is important to notice that TFP pattern remains stable over years, similarly as shown in Graph 1. Labour productivity pattern changes. Before, financed firms tended to increase their labour productivity compared to non-financed firms. After controlling for observable characteristics, labour productivity of treated firms seems to perform much more similar to non-treated. If we consider 1998 as starting point, it is possible to see labour productivity increasing 10% on average from 1999 to 2006. However, it is not possible to infer much on this issue, since they just return to the level achieved before getting the loan.

6. Empirical Results

Results from descriptive statistics seem therefore consistent with the idea that BNDES financial support has helped Brazilian firms to relax their credit constraints since granted firms performed at least similar to other non-granted firms, regardless which productivity measure is considered. Those interpretations are however very rough evidence that may not survive closer econometric scrutiny, since there might have other factors affecting firms performance aside bank's financial support. This section presents results of methods, OLS and difference-in-differences, mentioned previously in Section 3.

Before presenting results, one issue discussed in Section 5 requires some further attention. As shown in Table 1, some firms have received more than once financial support from BNDES. Two strategies are taken to overcome multiple treatments. One considered only those firms which are supported only once, then all firms which have received government support more than once are discarded. Although this strategy presents outcomes more efficiently, drawback emerges and we are not making the most of opportunities for further investigation. For the first issue, number of treated firms reduces by nearly 50%, since it reduces from 141 to 75 of both schemes.²⁹ This shortcoming increases since when pairing to non-financed firms, number of treated firms finding a similar is even smaller. In general terms, Table 6 shows a summary of how many are matched.

²⁹ If only BNDES Automatic is considered, number of treated firms reduces from 112 to 69.

	Treated		Non treated	
	Not Matched	Matched	Matched	Not Matched
Both Schemes Multiple	23	118	118	6226
Both Schemes Once	10	65	65	6279
Automatic BNDES Multiple	13	99	99	6234
Automatic BNDES Once	8	61	61	6272

As it can be seen, the number of matched firms reduces to over 60, while it could be possible to have at least nearly 100 firms to compare. Additionally, opportunities to investigate how multiple treatments might affect firms' performance are not considered. Balancing those, a different approach is also considered.

The second strategy is to include additional dummies to capture multiple treatments. As half of firms with multiple treatments have received only twice, just two dummies are included.³⁰ One dummy assumes value one after the second treatment, another assumes value one if a firm is supported three times or over.

Aside multiple treatments, an additional feature should be considered in order to isolate the effects of those financial supports. Productivity might increase due to acquisition of machineries and equipments, in other words, by improving its capital stock. Therefore, two additional variables are included as controls to capture any capital acquirement which might have burst firms' productivity. One is the ratio of capital import over total investment, thus capturing any effect of foreign capital acquisition. The other was using information of acquisition of domestic capital. As mentioned in Section 2, FINAME is a financial support for acquiring capital goods produced domestically. As mentioned in Ottaviano and Sousa (2008), 80% of Brazilian manufacturing firms were financed by FINAME from 1996 to 2003. Then, we create a dummy assuming value one if a firm was financed by any type of this loan during the period analyzed. Aside those controls, others are also considered when estimating the equations 1 and 2. A full list of those controls is available at Appendix VI.

Table 7 presents results of equation 1 using the three different counterfactual groups and two distinguishable productivity measure. The first 6 outcome columns present results using Labour Productivity, while the last 6 show using TFP. Difference between columns depends on how many controls are included and which group is considered as counterfactual group. Group B comprehends all firms which have survived and made investments during the analyzed period. While observable characteristics are controlled for Group D using PSM, non observable characteristics are considered in Group C. First column of each group is estimating using only dummies for domestic capital and years. Second column considers all controls mentioned in Appendix VI, including imported capital measure. There are also two types of results, first set of results, called Just Once, shows results of firms which have received bank's financial support only in 1998 and not after of both schemes (75 treated firms). The second set of results presents outcomes of firms financed first in 1998 (141 granted firms).³¹

³⁰ Precisely, 32 out of 66 from both schemes have received just twice this financial support, while for Automatic BNDES 23 out of 43.

³¹ Results with all controls are presented in the Appendix VI as well as results using only Automatic BNDES for robustness check.

Table 7: Results of OLS Estimation (Equation 1)

Dependent Variable Control Group	Labour Productivity						Total Factor Productivity					
	Group B - 6344		Group D - 118		Group C - 128		Group B - 6344		Group D - 118		Group C - 128	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
Just Once												
1998's Loan	0.211 (4.64)**	0.103 (5.96)**	0.037 (0.60)	0.055 (2.25)*	0.222 (3.40)**	0.145 (3.40)**	0.269 (1.82)	-0.127 (4.02)**	0.653 (2.84)**	0.066 (1.43)	0.745 (4.16)**	-0.351 (5.95)**
Domestic Capital	0.135 (13.24)**	-0.022 (3.41)**	0.344 (5.67)**	0.068 (2.71)**	-0.197 (2.85)**	-0.148 (3.08)**	-0.373 (13.59)**	-0.039 (6.01)**	-0.723 (3.35)**	0.037 (0.88)	-0.144 (0.83)	0.035 (0.66)
Imported Capital		0.012 (1.00)		0.042 (1.29)		0.089 (2.11)*		0.022 (1.61)		-0.057 (1.10)		-0.054 (1.14)
Observations	70,207	58,207	1,424	1,215	2,227	1,855	63,645	57,247	1,329	1,197	2,032	1,833
R-squared	0.01	0.71	0.03	0.89	0.01	0.67	0.001	0.95	0.02	0.97	0.01	0.94
More than Once												
First Loan (1998)	0.296 (7.67)**	0.112 (7.26)**	0.140 (2.17)*	0.170 (4.66)**	0.320 (5.20)**	0.150 (3.71)**	0.045 (0.35)	-0.090 (3.28)**	0.321 (1.66)	-0.126 (2.89)**	0.494 (3.00)**	-0.327 (6.01)**
Second Loan	0.308 (3.09)**	-0.026 (0.54)	0.290 (2.85)**	-0.041 (0.77)	0.325 (3.14)**	-0.004 (0.08)	-0.274 (0.74)	0.247 (3.00)**	-0.333 (0.83)	0.147 (1.53)	-0.195 (0.52)	0.284 (3.18)**
Multiple Loans	0.773 (13.10)**	-0.003 (0.12)	0.502 (8.08)**	-0.018 (0.61)	0.782 (12.96)**	0.039 (1.30)	-1.068 (4.48)**	-0.191 (4.41)**	-0.994 (3.56)**	-0.285 (5.12)**	-1.011 (4.19)**	-0.149 (3.46)**
Domestic Capital	0.136 (13.39)**	-0.023 (3.57)**	0.233 (4.27)**	-0.032 (0.99)	-0.133 (2.24)*	-0.171 (4.31)**	-0.382 (13.93)**	-0.038 (5.91)**	-0.354 (2.03)*	0.129 (2.88)**	-0.458 (2.78)**	0.061 (1.31)
Imported Capital		0.011 (0.99)		0.036 (1.53)		0.073 (2.20)*		0.025 (1.85)		0.034 (0.64)		0.046 (0.98)
Observations	70,933	58,836	2,589	2,229	2,953	2,484	64,340	57,876	2,452	2,210	2,727	2,462
R-squared	0.01	0.71	0.04	0.79	0.06	0.70	0.01	0.95	0.01	0.96	0.02	0.95

Robust t statistics in parentheses

* significant at 5%; ** significant at 1%

Before focusing in banks' loans, it is relevant to analyze whether acquisition of capital goods is related to firms' productivity. Considering both sets of treated firms, those financed only or first in 1998, there is not a definitive answer towards domestic capital, since results are idiosyncratic and there is not a single pattern considering different control groups. Regarding imported capital, outcomes suggest that firms' productivity tend to not be related to acquisition of foreign capital either. There are two results showing a positive relation, but only when using labour productivity and just with Group C. Overall, results over acquisition of capital goods are not robust to assure whether they are related to firms' performance or not.

Focusing now on the phenomenon investigated, BNDES loans and firms productivity, our first set of results suggest there is a positive association between labour productivity and financial support, regardless which comparison group is considered. At first, outcomes suggest that there is a higher association with Group C (0.15), then Group B (0.10) and finally Group D (0.05), yet those are not different when confidence interval is considered. When using TFP instead, outcomes change substantially. Although there is a positive association when a limited number of controls are considered, it changes to significantly negative in two Groups and non significant to the other one. Therefore, it seems that there is a negative association between firms TFP and BNDES financial support, even though results are not as robust as with labour productivity.

Considering more than one treatment, outcomes corroborate what we investigated taking into consideration solely those financed only once by BNDES. Overall, results regarding labour productivity remain significantly positive for the first loan, our main interest. Therefore, it is possible to reinforce that there might a positive association between firms' labour productivity and those loans. The difference in relation to treated only once resides on the fact that different groups have now much more similar effect

than treated only once. As before the lowest association was 1/3 and 1/2 compared to the others, now those differences shrink substantially.

An additional investigated feature now is the feasibility of analyzing whether multiple treatments are related to firms' performance. Taking into consideration only labour productivity, it is possible to see that when estimating with a very limited number of controls, we might find that there is a positive effect of financial support in firms' performance, regardless which group is considered and whether it was the second or multiple treatments. However, those results are biased due to omitted variables. When controlling for other measures which might affect firms' labour productivity, a different interpretation emerges, since second and multiple treatments do not present significant outcomes independently which group is considered.

When using TFP as a dependent variable, results corroborate what is found with firms financed just once. It is possible to observe that there is a negative association between firms TFP and BNDES 1998 loan, regardless which control group is considered. Additionally, it is possible to see that this effect is much more prominent with Group C than any other control group (Groups B and D). Regarding multiple treatments, two different outcomes emerge. First, it seems that there might be a positive association between productivity of treated firms and second loan, at least when unobservable characteristics are considered (Groups B and C). On the other side, more than two treatments seem to be negatively related to firms' TFP independently to which control group is used.

Overall, it is possible to observe there might be a positive correlation of those financial supports with labour productivity but negative with TFP. Regarding more than one financial support, it seems that they are not related to labour productivity, while TFP presents a positive correlation with second treatment and negative with more than two treatments.

As mentioned previously, OLS is the most naïve model to show whether there is any association between firms' performance and financial support. If interest resides on whether BNDES loans are able to impact firms' performance, difference-in-differences approach presents an answer to that question. Table 8 presents outcomes of equation 2.³²

Starting with capital goods, there is not a significance difference with OLS estimates. Overall there might be some positive association between imported capital goods and firms labour productivity, but only when comparing with Group C. Domestic capital presents more results showing negative relation with firms' performance, but positive and non-significant outcomes are also found. Ribeiro and De Negri (2009) investigated the effect of FINAME on firms' productivity and they have not found any impact of this loan on firms' performance. This might explain the existence of those idiosyncratic results of domestic capital. Regarding multiple treatments, outcomes are very similar to OLS. Second loans seem to be positively associated with labour productivity, but its effects vanish when controls are included. Multiple treatments remains positive correlated to labour productivity even when other variables are included and when unobservable characteristics are controlled for. This result contradicts to what is found previously with OLS. Using TFP as a measure of performance, outcomes are even more similar to OLS. Multiple treatments remain negatively related to TFP. Second loan present less relation to firms' performance, since only once firms performance seems to be positively related to the second treatment.

Focusing on the BNDES loans investigated (those provided in 1998), although a positive impact is found solely in 2002 and when a limited number of controls are considered, overall results show that no impact is found by those loans on firms' productivity, since not a single parameter estimated appears different from zero either from labour productivity or TFP. Therefore, it is not possible to reject the hypothesis that the Bank has any impact, negative or positive, on firms' productivity. It is important to notice that the impact is evaluated not only while the project is being implemented, but also some time after it has finished. It is assumed that all projects end their implementation after five years (the average loans' duration at this bank), which enables this paper to see the impact four years after implementation

³² For simplicity, results of only three years investigated are presented here, but those not presented do not show any different pattern from those shown in Table 8. Results of all variables are presented in Appendix VII.

has been completed. Even considering this ex-post period of projects, no significant result is found. Thus, projects selected might not be those most promising, especially considering productivity.

Table 8: Results of Dif-in-Dif Estimation (Equation 2)

Dependent Variable	Labour Productivity						Total Factor Productivity					
	Group B - 6344		Group D - 118		Group C - 128		Group B - 6344		Group D - 118		Group C - 128	
Control Group	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
Just Once												
Effect in 1998	-0.004 (0.03)	-0.008 (0.10)	-0.014 (0.07)	0.039 (0.42)	-0.063 (0.21)	-0.015 (0.09)	0.042 (0.13)	-0.005 (0.05)	0.010 (0.01)	0.051 (0.28)	0.106 (0.17)	0.068 (0.36)
Effect in 2002	0.228 (2.47)*	0.061 (0.89)	0.051 (0.24)	0.026 (0.28)	0.064 (0.32)	0.288 (1.49)	0.059 (0.18)	0.029 (0.30)	0.363 (0.43)	-0.003 (0.02)	-0.165 (0.27)	0.010 (0.06)
Effect in 2006	0.146 (1.55)	0.073 (1.21)	-0.314 (1.37)	-0.003 (0.03)	-0.218 (1.08)	0.021 (0.15)	-0.160 (0.50)	-0.005 (0.05)	0.317 (0.39)	-0.068 (0.37)	-0.547 (0.89)	-0.106 (0.57)
Domestic Capital	0.126 (12.28)**	-0.021 (3.31)**	0.315 (5.07)**	0.074 (2.92)**	0.059 (0.73)	-0.121 (2.05)*	-0.363 (13.19)**	-0.041 (6.32)**	-0.762 (3.43)**	0.026 (0.61)	0.015 (0.07)	-0.094 (1.44)
Imported Capital		0.012 (1.02)		0.042 (1.29)		0.093 (2.28)*		0.021 (1.58)		-0.061 (1.16)		-0.077 (1.63)
Observations	70,207	58,207	1,424	1,215	2,227	1,855	63,645	57,247	1,329	1,197	2,032	1,833
R-squared	0.01	0.71	0.04	0.89	0.03	0.67	0.001	0.95	0.02	0.97	0.01	0.94
More than Once												
Effect in 1998	-0.010 (0.10)	0.002 (0.03)	0.087 (0.40)	0.090 (0.87)	-0.062 (0.24)	-0.032 (0.25)	0.014 (0.05)	0.001 (0.02)	-0.066 (0.10)	-0.036 (0.21)	0.028 (0.05)	0.061 (0.37)
Effect in 2002	0.217 (2.75)**	0.086 (1.54)	0.079 (0.47)	0.057 (0.78)	0.045 (0.26)	0.294 (1.66)	0.031 (0.11)	0.014 (0.18)	0.224 (0.35)	-0.021 (0.12)	-0.212 (0.38)	-0.009 (0.06)
Effect in 2006	0.133 (1.62)	0.067 (1.36)	-0.172 (1.02)	0.078 (1.04)	-0.231 (1.35)	-0.017 (0.15)	-0.217 (0.75)	-0.025 (0.32)	0.056 (0.09)	-0.078 (0.47)	-0.623 (1.10)	-0.107 (0.65)
Second Loan	0.251 (2.60)**	0.047 (0.97)	0.296 (2.87)**	-0.029 (0.52)	0.265 (2.58)**	0.042 (0.75)	0.063 (0.17)	0.153 (1.87)	-0.346 (0.85)	0.134 (1.39)	0.165 (0.43)	0.211 (2.30)*
Multiple Loans	0.698 (12.67)**	0.070 (2.54)*	0.464 (7.40)**	-0.011 (0.38)	0.705 (11.32)**	0.082 (2.47)*	-0.810 (3.57)**	-0.280 (6.86)**	-1.039 (3.70)**	-0.299 (5.49)**	-0.771 (3.19)**	-0.223 (4.62)**
Domestic Capital	0.126 (12.34)**	-0.022 (3.45)**	0.205 (3.62)**	-0.036 (1.06)	0.117 (1.82)	-0.144 (3.26)**	-0.371 (13.51)**	-0.040 (6.25)**	-0.390 (2.19)*	0.126 (2.74)**	-0.463 (2.45)*	-0.020 (0.39)
Imported Capital		0.012 (1.01)		0.036 (1.55)		0.077 (2.33)*		0.025 (1.82)		0.034 (0.63)		0.030 (0.64)
Observations	70,933	58,836	2,589	2,229	2,953	2,484	64,340	57,876	2,452	2,210	2,727	2,462
R-squared	0.01	0.71	0.05	0.79	0.08	0.71	0.01	0.95	0.01	0.96	0.01	0.95

Robust t statistics in parentheses

* significant at 5%; ** significant at 1%

As we have seen in Section 1, if some firms adopt a new technology and others an old one, net effect might be null. Therefore, projects supported by BNDES might be using both types of technology which culminates by not being able to affect firms' productivity. If they want to improve Brazilian firms' competitiveness, then more emphasis should be given to projects using new technologies, which means higher fixed cost, but lower marginal costs. As shown by previous sections, most of those loans are selected by the retailing banking system which might be aiming other targets and not firms' productivity. Therefore, if this development bank wants to improve firms' productivity might have to change their rules regarding indirect and direct (especially the first) loans in order to tackle this economic variable.

Based on those results, another interpretation resides on the fact that treated firms perform basically similar to those non-financed. Therefore, it means that BNDES loans are able to relax credit constraints of treated firms to develop similarly to those not credit constrained. As mentioned in the introduction, there is a literature showing that Brazilian firms are credit constrained and most of their investments are supported by their own funds. Therefore, firms in the counterfactual group are able to

finance their investments aside any financial support. Considering pre-characteristics of treated and non-treated firms, it was possible to see that non-granted firms are more profitable and present lower levels of financial expenditures over total revenue. Thus, that evidence provides us some information that non-treated firms are able to finance their investments without government support. Therefore, firms receiving financial support might be those credit constraint; moreover, they are able to perform similarly to those not constraint.

Another possible explanation might be related to what is important to receive financial support. As seen, economic factors are crucial to being granted as well as to whether a supported project is economically viable; otherwise firms would not perform similarly to those non-financed. However, as it is a government institution aimed to potentialize externalities to society, perhaps those externalities might be at least as important as economic development. In other words, economic reasons are relevant to decide which project should be supported as firms perform at least similar to those non supported. However, other non economic factors, such as social and environmental issues, might be as crucial to select projects as economic factors.

Last, but not least, it is safe to conclude that BNDES loans are not able to burst firms' productivity regardless which characteristics are controlled for, either observables and non-observables. Therefore, those financial supports are unable to promote economic growth. Although they increase competition in the market by allowing credit constraint firms to invest. This outcome is not an isolated case in the literature. Criscuolo et al (2007) investigated the effect on industrial policy in the UK. Their results show no significant impact on firms' productivity, even though they found effects on employment and investment. Nevertheless, it is important to notice that similar outcomes are found in Ottaviano and Sousa (2008) and Sousa (2010) when investigating same schemes using different empirical strategies.

6 Concluding remarks

Overall, granted firms perform at least similar to non granted after receiving BNDES loans. At first, firms improve on average their labour productivity after being treated compared to non-treated firms similar to unobservable characteristics. When comparing to similar firms in terms of observable characteristics, firms' performance remains similar. TFP of granted firms develops nearly identical to non granted firms independently to which counterfactual group is considered, either controlling for observable or unobservable characteristics.

When examining whether any association between firms' performance and BNDES loans, they are found solely in naïve models, being positive to labour productivity and negative to TFP. Moving towards more sophisticated models, this association vanishes. No evidence was found related to effect of BNDES financial support on firms' productivity, as evidenced by other similar paper. As identical non-granted firms perform similarly to those supported, then perhaps the criterion decision on selecting projects does not focus entirely on economic issues, at least productivity measures. Other issues, such as social, regional and environmental impacts, might even be as important as economic aspects (or perhaps more) to select any project, due to the externalities that each project creates. Finally, if BNDES schemes are reducing proportionally the implementation of both new and old technologies and therefore not improving Brazilians firms' competitiveness, then policy should focus on selecting more projects using new technologies. Only financing more promising projects, those loans would be able to burst firms' productivity and improving their performance to face more challenging competition with foreign firms.

This no treatment effect results may be similar to a controversial issue of educational grants, where academics question whether scholarships improve research's quality or higher skills researchers are selected for financial support. Despite that, further work should be pursued with better information with regards to the loans, such as amount, maturity period and so forth, in order to investigate whether government interventions are able to improve firms' productivity.

Bibliography

Araújo, B., Esteves, L.A. e De Negri J.A. (2010) “BNDES, Inovação Tecnológica e Desempenho das Empresas Industriais Brasileiras” mimeo.

Arnold, J.M. and B.S. Javorcik (2005) Foreign acquisitions and plant performance in Indonesia, World Bank Working Paper No. 3597.

Banerjee, A. V. and E. Duflo (2005). “Growth Theory Through the Lens of Development Economics.” Economics Handbook of Economic Growth. Vol. 1, Part A: pages 473-552.

Bronzini, R. and G. d. Blasio (2006). "Evaluating the impact of investments incentives: The case of the Italian Law 488/1992." Journal of Urban Economics Vol. 60 (no. 2): pages 327-349.

Coelho, D. and De Negri, J. (2010). “Impacto do Financiamento do BNDES sobre a Produtividade das Empresas: Uma Aplicação do Efeito Quantílico de Tratamento” mimeo.

Coelho, D. and Sousa, F.L. (2010) “Os Efeitos dos Financiamentos do BNDES sobre o Desempenho das Empresas Industriais Brasileiras” in Estrutura Produtiva Avançada e Regionalmente Integrada: Desafios do Desenvolvimento Produtivo Brasileiro, Livro 5, Vol. 1, organized by De Negri, F. and Almeida, M., IPEA, Brasília.

Criscuolo, C., R. Martin, H.G. Overman and J.V. Reenen (2007). “The effect of industrial policy on corporate performance: Evidence from panel data.” mimeo. London. UK.

De Negri, J. , De Negri, F. e Alves, P. (2008). “Os Financiamentos do BNDES têm Impacto Positivo sobre a Tecnologia, o Emprego e o Faturamento das firmas?” mimeo.

Grilliches, Z., T. J. Klette and J. Moen, et al. (2000). "Do subsidies to commercial R&D reduce market failures? Microeconomic evaluation studies." Research Policy Vol. 29 (no. 4&5): pages 471-495.

Heckman, J. J., R. J. LaLonde and J.A. Smith (1999). “The Economics and Econometrics of Active Labour Market Programs.” in Handbook of Labour Economics. organized by O. Ashenfelter, D. E. Card and D. Card, Elsevier. Vol. 3: pages 1865-2097.

Krugman P. (1997) “The Age of Diminishing Expectations: U.S. Economic Policy in the 1990s” 2ª Edição, MIT Press, Cambridge, Massachusetts.

Melitz, M. (2003) “The impact of trade on intra-industry reallocations and aggregate industry productivity.” Econometrica Vol. 71 (no. 6): pages 1695-1725.

Ottaviano, G. e Sousa, F. (2008). “O efeito do BNDES na Produtividade das Empresas” in Políticas de Incentivo à Inovação Tecnológica organized by De Negri, J. and Kubota, L., IPEA, Brasília.

Ribeiro, E. P. e De Negri, J. (2009). “Public Credit Use and Manufacturing Productivity in Brazil” mimeo.

Sousa, F.L. (2010). “BNDES, Custos e Produtividade” Menção Honrosa no V Prêmio DEST, Brasília.

Terra, M. C. (2003). “Credit constraints in Brazilian firms: evidence from panel data.” Revista Brasileira de Economia Vol. 57 (no. 2): pages: 443-464.