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Abstract

In emerging economies credit constraints are often perceived as one of the most important market frictions hampering firm productivity growth in manufacturing. Huge amounts of public money are devoted to the removal of such constraints but its effectiveness is still subject to an intense policy debate. This paper contributes to this debate by analyzing the effects of the Brazilian Development Bank (BNDES) loans. Exploiting the unique features of a dataset on BNDES loans to Brazilian manufactures, it finds that credit constraints facing Brazilian manufacturing firms are real, in particular for firms that apply to BNDES repeatedly, and BNDES support has allowed granted firms to match the performance of similar unconstrained firms but not to outperform them.

Keywords: Credit constraints. Firm productivity. Public loans. BNDES.

Contents

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1. Introduction

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 new tough competitors. At the same time, manufacturers from those countries feel they are not able to compete on a level playing field with manufacturers from more advanced economies due to all sorts of market failures. In particular, credit constraints are often perceived as 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, their effectiveness is still subject to an intense policy debate. Banerjee and Duflo (2014) is an example of the related recent literature.

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 BNDES, a development bank whose main statutory goal is to improve Brazilian economic competitiveness without neglecting broader social and environmental aspects.[1] 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. Projects are supported through loans at subsidized interest rates. All firms located in Brazil are eligible, including foreign owned ones. Moreover, banks in the private sector tap BNDES resources to provide loans for their clients' long-term projects. As a result, long-term loans in the Brazilian economy are mainly offered by BNDES funds, either by BNDES itself or by other banks using BNDES resources.[2] Unsurprisingly, the importance of BNDES in the Brazilian economy is, therefore, quite sizeable: in 2012 its disbursements reached the amount of US$ 76 billion, representing 20% of aggregate investment.[3] When compared with that of other development banks, the size of BNDES financing becomes even more impressive. For instance, in 2012 the World Bank and the Inter-American Development Bank disbursed US$ 19.8 billion and US$ 6.9 billion respectively.[4] In comparison, BNDES financing reached nearly three times their combined disbursements.[5]

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1 Carvalho (2014) provides a short historical description of BNDES.

2 See De Bolle (2015) for a detailed discussion of how BNDES interest rates are subsidised and their impacts on the credit market.

3 Information accessed on December 22nd, 2016 at BNDES website (www.bndes.gov.br).

4 According to The World Bank (2013) and IADB (2013).

5 In their survey on development banks Luna-Martinez and Vicente (2012) classify BNDES as a "mega-bank" together with other large development banks, such as the China Development Bank and the Kreditanstalt für Wiederaufbau (KfW) from Germany.

While acknowledging that BNDES project analysis involves several other dimensions including social and environmental aspects, this paper focuses on the narrower assessment of the overall impact on the performance of Brazilian firms in terms of productivity. Do BNDES loans help relax credit constraints that hamper productivity growth in Brazilian firms? We address this question by exploiting the unique features of a micro-dataset drawn from a variety of sources: the Annual Industrial Research of the Brazilian Institute of Geography and Statistics; the Annual Social Information Report of the Ministry of Labor; the Foreign Trade Secretary 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; and BNDES itself. The period covered is 1995-2007.[6]

Our focus on productivity is driven by the fact that, as already discussed, for manufacturing projects the stated aim of long-term BNDES loans is essentially to enhance physical productive efficiency through the economies of scope and scale associated with the creation of new plants and the enlargement of existing ones, the restructuring and the modernization of production processes, innovation and technological development. In particular, we consider two measures of productivity: "total factor productivity" (TFP) and labor productivity. TFP is estimated as the firm-level Solow residual following the methodology of Levinsohn and Petrin (2003).[7] It measures how effectively a firm transforms a given amount of inputs into output. Labor productivity is computed as the ratio of firm value added to the number of employees. Hence, TFP is closer to the long-term concept of physical efficiency whereas labor productivity is more of a short-term concept.[8]

Even though there is growing literature evaluating government policies for business support (BRONZINI; DE BLASIO, 2006), there is a relative shortage of papers on the specific impact of government policies on private sector development (MCKENZIE, 2010), especially when it comes to firm productivity (see, e.g., GRILICHES; KLETTE; MOEN, 2000; CRISCUOLO *et al.*, 2016). 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 in labor economics that evaluates to what extent government policies affect individuals' achievements (HECKMAN; LALONDE; SMITH, 1999).

In the case of long-term BNDES loans, the specific chain of causation we want to analyse goes from relaxing credit constraints on long-term investment to faster productivity growth. Among the relevant categories of long-term investment, the

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6 A full description of our data sources is presented in Section 3.

7 Though the methodology by Levinsohn and Petrin (2003) is a standard procedure in the TFP estimation literature, we provide a description in Appendix VI for completeness.

8 See Bronzini and De Blasio (2006), Criscuolo *et al.* (2016) and Banerjee and Duflo (2014) for assessments in terms of other short-term performance variables such as employment, investment or revenue.

literature has mostly been interested in those concerning R&D and innovation. The link between innovation and productivity growth is well established, with some recent studies showing that as much as 40% of observed productivity growth can be attributed to R&D and innovation (HALL, 2011; REIKARD, 2011; SYVERSON, 2011; HALL; MOHNEN, 2013). However, despite extensive research, empirical findings on the effects of governments' innovation programs are still inconclusive, with results varying a lot across countries (GAO; GUO; JIANG, 2016).[9] 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 including Brazil. In the specific case of Brazil, Terra (2003), Aldrighi and Bisinha (2010) and Ambrozio *et al.* (2017) find evidence of credit constraints by investigating the issue at the firm level. More generally, Aghion *et al.* (2010) show that tighter credit constraints discourage firms' long-term investments by increasing the corresponding liquidity risk. In the trade literature, there is also evidence that credit constraints hamper firms' efforts to export (MANOVA, 2013). According to this paper, there are three mechanisms through which credit constraints affect trade: selection of firms into domestic production; selection of domestic producers into exporting; and last but not least, how much a firm exports. Results show that credit constraints affect these three mechanisms, especially at the level of firms' exports. In the case of Brazil, it has been found that exporters face lower credit restriction in the Brazilian economy, and even small and middle size firms are not credit constrained if they export a relevant part of their sales (AMBROZIO *et al.*, 2017).

BNDES effects on the Brazilian economy have been investigated both in the national and the international literature. Recent examples of the latter include the studies by Bandeira-de-Mello *et al.* (2015), Carvalho (2014) and Bonomo, Brito and Martins (2015). Bandeira-de-Mello *et al.* (2015) evaluate BNDES loans with reference to a range of firm performance indicators, including profitability and investment. Carvalho (2014) investigates whether elections shift investments supported by BNDES towards politically attractive regions. Bonomo, Britto and Martins (2015) study whether BNDES loans affect firms' investment.[10] None of these papers, however, assesses the impact of BNDES financial support on firms' productivity growth, which is the focus of our analysis and one of BNDES policy targets as we argued above.

Closer to the spirit of the present paper, Ottaviano and Lage de Sousa (2008) and Lage de Sousa (2013) investigate the relationship between the performance of firms and BNDES loans allocated to the modernization and enlargement of existing

[9] In the case of Latin American countries, Crespi, Maffiolli and Rastelletti (2014) list a number of papers in which innovation policies are found to have a positive impact on firm performance.

[10] For the national literature, see the references in Lage de Sousa and Ottaviano (2014).

plants or to the creation of new ones.[11] Both papers look only at labor productivity, whereas this paper looks also at TFP. Another feature that distinguishes the present paper is the design of an estimation strategy that not only uses different sets of counterfactual groups but also tests whether granted firms indeed face tougher credit restriction to start with.

Overall, we find that repeatedly granted firms were more credit constrained than comparable nongranted firms before receiving BNDES support. Moreover, with some exception, BNDES support did allow granted firms to match the productivity growth of similar firms that were not credit constrained to start with, but not to outperform them. These findings suggest that government support of the type provided by BNDES may indeed help relax credit constraints that prevent constrained firms from performing as otherwise identical unconstrained ones. On the other hand, they also suggest that BNDES support did not have the effect of making constrained firms select and implement their projects more effectively than unconstrained firms.

The rest of the paper is structured as follows. Section 2 details the financial support offered by BNDES to manufacturers. Section 3 introduces the data together with the alternative "treatment" and "control" groups we use to assess the impact of BNDES support. Credit constraints are investigated in Section 4, while Section 5 looks at the impact of BNDES support on firm productivity. Section 6 concludes.

2. Overview of BNDES schemes

BNDES provides a wide range of financial tools to support Brazilian manufacturing firms: BNDES Finem, BNDES Automatic, BNDES Finame, Finame Leasing, International Competition Finame (BNDES Exim) and Subscription of Securities. BNDES interest rates are subsidized, which means that BNDES reduces firms' marginal cost of investment. We focus on BNDES Finem and BNDES Automatic as these are the most important moneywise as well as the most relevant for productivity enhancing long-term investments.[12] BNDES Finem ("Financing and Endeavours") is a support scheme for projects with financial needs over US$ 5 million offered by BNDES directly or indirectly through retail banks. Projects with financial needs below this threshold are supported instead solely indirectly through retail

[11] Coelho and Lage de Sousa (2010) review all previous studies evaluating the effects of BNDES support, including those on productivity. These studies, however, either evaluate BNDES intervention as a whole or types of financial support different from the ones we target.

[12] See Lage de Sousa and Ottaviano (2014) for a detailed discussion of the other types of BNDES financial support; Ribeiro and De Negri (2009) for their effectiveness. Although the other types of financial support are less relevant for our purposes, it will be necessary to account for them in order to isolate the role of BNDES Finem and BNDES Automatic.

banks under the BNDES Automatic scheme. Both schemes consider 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.[13] BNDES Finem and BNDES Automatic loans are the main types of BNDES financial support, jointly representing nearly half of all BNDES resources.[14]

In order to receive BNDES Finem or BNDES Automatic loans, firms need to send a supporting application form with some brief information of their projects to a retail bank or BNDES itself. The banks evaluate whether the projects are in line with the purpose of the loans. After having their application approved, firms have to send complete and detailed project plans for in-depth evaluation in terms of whether they are economically viable, what collateral can be used to guarantee the loan, balance sheet and other financial information, and so forth.[15] All these items of information are used to determine whether applicants meet the eligibility criteria for selection as beneficiaries of BNDES support.

If successful, the evaluation process culminates in a formal contract proposal in which the terms and conditions of the loan are established, including amount, period, and interest rate. After negotiations are completed, the loan contract is signed. It is important to note two crucial points here. First, there is an upper limit for BNDES participation in any project. This varies over time but is generally around 80%. A project is thus never fully financed by BNDES. Second, firms receive their loan in instalments according to the development of the project and following a schedule decided during negotiation.

In particular, firms receive the first instalment when the loan is approved and the remaining ones only after an evaluation of the project's progress. Before the second instalment, the firm should prove whether the money of the first disbursement was invested as dictated by the project plan. Any violation of the loan terms leads to a further investigation and instalments are interrupted until justifications are given. If no problems emerge, instalments continue until the end of the project. Since these are long-term projects, the period between contract signing and the end of instalments takes on average five years. Generally, only after all instalments have been paid, firms start amortizing their loans. The "conditionality" of instalments

[13] Any type of process and/or product innovation is considered an innovation for BNDES. A concrete example of a project supported by BNDES Finem and BNDES Automatic during our period of observation is the development of a new dual fuel engine for cars that can run on gasoline or ethanol. BNDES financed not only research and engineering but also process implementation at the plant. In this case, BNDES financed innovation aimed at reducing carbon dioxide emissions.

[14] From 2000 to 2009, BNDES Finem and BNDES Automatic represented on average 46% of the total BNDES's disbursements.

[15] We will exploit these items of information for the construction of the counterfactuals for beneficiaries.

to the projects' progress and completion implies that granted firms have to invest according to the approved plans so that their credit constraints (if they had any) are almost by definition relaxed by institutional design. An interesting issue then becomes whether they were credit constrained to start with.

3. Treatment and control groups

Do BNDES Finem and BNDES Automatic loans help relax credit constraints that hamper the productivity of Brazilian manufacturers? We address this question from a specific angle investigating what would have happened to the granted firms had they not been supported by BNDES but their credit constraints had been nonetheless otherwise removed, making them similar ex post to the nongranted noncredit-constrained firms in the control group also in this respect.[16] Answering this question requires, first of all, identifying the group of granted ("treated") firms for which enough information is available. Then, it is crucial to define a "valid" counterfactual. Compared with the counterfactual, one has to establish whether firms granted BNDES loans were indeed credit constrained, and then check whether their productivity actually changed differentially after receiving the BNDES loans. Checking that they have implemented their projects is, instead, redundant given that, as already discussed, BNDES funds are transferred to firms in installments and, except for the first one, these are made conditional on firms having successfully followed the agreed implementation plan.[17]

Our analysis relies on micro-data drawn from a variety of sources already used in the papers described by Coelho and Lage de Sousa (2010). In particular, our dataset combines information from: the Annual Industrial Research (Pesquisa Industrial Anual – PIA) of the IBGE;[18] the Annual Social Information Report (Relação Anual de Informações Sociais – Rais) of the Ministry of Labor; 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.[19]

[16] This targets the differential effects of BNDES loans with respect to other sources of finance. From an alternative angle one could investigate what would have happened to the granted firms had they not been supported by BNDES, which would require a comparison group of firms that were not granted but were ex ante similar to the granted firms also in terms of credit constraints. We leave this alternative angle to future research.

[17] This would also make it redundant to check whether granted firms are no more credit constrained after receiving BNDES support as long as by design they receive the cash needed to implement their projects.

[18] This survey is our main data source. It contains the majority of the variables useful for this analysis, including those needed to measure firm productivity.

[19] The construction of the dataset has followed procedures that guarantee the confidentiality of information so that individual data cannot be related to any specific firm.

3.1 Treatment groups

We select our "treated" firms as follows. First, we use BNDES data to identify granted firms from 1995 to 2007.[20] During this period, 756 new firms on average were "treated" annually in that they at least once received one of the two targeted BNDES financial schemes (BNDES Finem and/or BNDES Automatic).[21] Nevertheless, it is unfortunately impossible to use all these manufacturers as some of them are not available from PIA, especially small firms. The reason is that PIA covers only around 30,000 firms with more than 30 employees. In total, our beneficiaries represent only 11% of all manufacturers existent in PIA but around 2/3 of overall manufacturing employment.[22] Hence, the fact that we have to focus only on PIA firms reduces the number of firms granted in our sample by half. Third, the size of the "treated" group is further reduced because we want to evaluate only the productivity of *manufacturing firms* granted loans to implement projects in the manufacturing sector. BNDES records, however, concern all *manufacturing projects*. They thus report also manufacturing projects by nonmanufacturing firms (e.g., those of large food retailers investing in the development of their own brands) and do not cover nonmanufacturing projects of manufacturing firms (e.g., those implemented in agriculture). Fourth, some firms appear or disappear from records due to mergers. For example, if Firm A received a loan in 1997 and in 2000 merged with Firm B creating a new Firm C, the initial loan should be registered for firm C. As the past records of Firm C are impossible to reconstruct, we drop all information on loans projects granted to firms like A and B.[23] Finally, there is a time lag of generally two to three years before a firm enters the Census part of PIA.[24] Hence, some granted firms with more than 30 employees are not recorded by PIA at the moment they receive BNDES loans.

Further issues potentially affect the size of our "treated" group. Some firms are exposed to other government interventions apart from BNDES loans. Since BNDES is the largest financial institution in Brazil offering loans for long-term projects, we assume that its loans are the main type of policy tools affecting firms'

[20] Data on 1995 are used only to exclude any firm that received 'financial treatment' in that particular year. Data on 2007 are used to choose one of the counterfactual groups, as described later in the paper.

[21] More precisely, 9,828 firms were granted during these 11 years.

[22] Firms with less than 30 employees are also considered by PIA, but they are selected randomly for the survey each year. Since their sample varies annually, and is thus impossible to follow, we have decided to discard them. As we will show in Section 3.2.1, BNDES beneficiaries tend to be larger firms. See Bonomo, Brito and Martins (2015) for further analysis on this particular issue.

[23] All firms that have received financial support through Subscription of Securities are deleted from our sample as our focus is on firms implementing projects. Moreover, only a very limited number of firms have received support through Subscription of Securities, which does not provide enough information for any econometric investigation.

[24] IBGE receives information on the size of firms (number of employees) for a particular year only at the end of the following year.

productivity. In addition, there may be a time lag for any impact to be detected, since outcomes do not necessarily appear immediately after the loans have been granted or arguably before they are fully implemented. As some projects last at least five years, we need a period beyond the five-year horizon to assess their impacts not only during but also after implementation. 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, as we will discuss later, to construct the "control" group for firms treated in a certain year, one needs at least two years before treatment. Hence, only for firms granted BNDES Automatic and BNDES Finem loans in 1998 can the impacts of these BNDES schemes be scrutinized both during implementation (from 1998 to 2003) and after implementation (from 2004 to 2006).[25] Excluding all firms treated before 1998 leaves us with 227 firms which have received the first loan in this specific year (1998).[26] Among these, 86 firms are not present in the PIA dataset for the whole period investigated.[27] In the end, we have two initial "treated" groups: 141 firms and 227 firms, groups 1 and 2 listed in Table 1, depending on whether we focus only on "survivors" or not.

Table 1. Number of treated firms in 1998

Group name	Description	Survived?	Number of firms
Group 1	Firms granted for the 1st time in 1998	Yes	141
Group 2		No	227
Group 3	Firms only granted in1998	Yes	75
Group 4		No	143
Group 5	Firms only granted BNDES Automatic	Yes	112
Group 6		No	190

Source: Elaborated by the authors.

On the other hand, it may be useful to further distinguish the firms in these "treated" groups. First, to see whether there are any differential impacts between

[25] Targeting only projects of which the possible impacts can be monitored both during and after implementation (rather than also projects for which monitoring is possible only during implementation) limits the size of the treated groups, and thus the power to detect those impacts. Nevertheless, we have made this choice because full implementation is what is assumed at the project selection stage, and thus the impacts of fully implemented projects are arguably what BNDES support should be eventually held accountable for. Ottaviano and Lage de Sousa (2008) and Lage de Sousa (2013) look only at the effects during implementation (and, as pointed out in the Introduction, only in terms of labor productivity) with treatment year 1997. Their findings are consistent with the ones in the present paper.

[26] Considering that on average 756 firms receive BNDES financial support per year, our reduced sample to 227 firms does not seem to be exceedingly small, especially once we consider that only around half of the granted firms (circa 378 firms) are available in PIA, our main dataset for productivity estimation.

[27] There are three possible explanations for why a firm leaves the PIA dataset: first, it goes bankrupt; second, its employment level falls short of the threshold of 30 employees; third, the main part of its revenue does not come anymore from manufacturing.

BNDES Finem and BNDES Automatic, we consider firms that have received only BNDES Automatic whether surviving (Group 5) or not (Group 6). Second, to investigate the effects of nonrepeated treatment, we also trim our sample to firms that were awarded BNDES support only in 1998 and not afterwards, whether surviving (Group 3) or not (Group 4).[28]

3.2 Control groups

As highlighted above, we want to investigate what would have happened to the granted firms had they not been supported by BNDES but still their credit constraints had been otherwise removed. How can we build a "valid" counterfactual for the selected groups of "treated" firms? Short of natural experiments or randomized control trials, the answer is not straightforward. We therefore try various alternatives in order to control for observable as well as unobservable characteristics using our judgement to identify "control" groups that are likely to share similar pre-treatment characteristics with the "treated" ones. Clearly, for the specific purpose of our investigation, credit constraints should not be part of the pre-treatment characteristics we consider and this is made possible by the fact that eligibility to BNDES funding does not require firms to prove they face any credit constraint to start with. We will thus be able to compare ex post "treated" and "nontreated" firms that are ex ante similar in several key dimensions apart from credit constraints.

3.2.1 Granted versus *nongranted*

The first naïve control group (Group A) consists of all 21,380 Brazilian firms (above 30 employees) that did not receive any BNDES loans during the period of analysis. Firms, however, are not randomly selected by BNDES and systematic differences between granted and nongranted firms do exist. Table 2 summarizes the main characteristics of granted and nongranted firms before BNDES intervention.[29] First, credit constraints seem indeed to be stricter for "treated" than "nontreated" firms: whereas cash flow over capital is lower for the former than the latter, the reverse holds for the investment rate (investment over capital). While this is consistent with "treated" firms facing stricter constraints, it may also be due to the fact that granted firms are more present in riskier sectors, as evidenced by the Organisation for Economic Co-operation and Development (OECD) technological classification.

[28] We have also investigated different treated groups (such as firms financed through BNDES Automatic only in 1998), but results were similar to those presented for the chosen treated groups.

[29] Descriptive statistics for the variables in Table 2 can be found in Table A.2 in Appendix II. Variable descriptions and sources are reported in Table A.1 in Appendix I. Similar results are obtained with nonsurviving firms (groups 2, 4 and 6).

Table 2. Average of granted and nongranted firms one year before treatment

Groups	Nongranted firms	Granted firms		
Variables	All firms over 30 employees	All first time in 1998	BNDES Automatic 1st time 1998	All only in 1998
Labor Productivity	26.6	35.5	29.7	31.8
Labor Productivity growth	30.3%	31.7%	27.6%	34.6%
TFP Levinhson-Petrin	100	115	107	106
TFP growth	-3.2%	0.5%	-1.6%	0.0%
Number of Employees	175	620	332	468
Investment/Capital	3.7%	6.6%	6.9%	5.5%
Cash flow/Capital	12.3%	10.5%	10.4%	11.2%
Export Status	32.2%	58.9%	54.5%	49.3%
OECD Classification				
High & Medium-High Tech	22%	32%	32%	35%
Low & Medium-Low Tech	78%	68%	68%	65%
Number of Firms	21,380	141	112	75

Source: Elaborated by the authors.

Note: All values from 1997.

Turning to productivity, on average "treated" firms are larger and tend to exhibit higher productivity. This is so in terms of both total factor productivity (TFP) and labor productivity (value added per worker), though the difference is more pronounced for the latter. While the labor productivity of firms granted for the first time in 1998 is more than 30% higher than that of nongranted firms, the TFP of the former is only 2.6% higher than that of the latter. Compared with the period before treatment, both measures of productivity grow faster for treated than nontreated firms.

3.2.2 Observable characteristics

Differences shown in the previous section suggest a presence of selection bias. By minimizing the differences between "treated" and "nontreated" groups in terms of the observable characteristics shown in Table 2, our intention is to reduce this selection bias. In so doing we use a "mixture" of caliper and one-to-one Propensity Score Matching (PSM).[30] In pure caliper, matched and nonmatched firms are selected with a tolerance defined by the investigator and with replacement. In pure one-to-one PSM, firms are selected as the closest matches without replacement. We "mix" the two approaches, finding the closest nontreated match for each treated firm without replacement but also imposing a similarity threshold (with tolerance at the 2nd decimal). This method creates a counterfactual group by pairing each granted firm with a similar nongranted one. Treated firms that cannot be paired with any nongranted firm are discarded.

[30] See Caliendo and Kopeinig (2008) as well as Heinrich, Maffioli and Vazquez (2010) for further details on how to implement a PSM. See also Arnold and Javorcik (2009) for an example of a paper using PSM to evaluate the impact of foreign investment on firm productivity in Indonesia.

Ideally, to avoid any selection bias, for our specific purposes one would like to compare granted credit-constrained firms with nongranted noncredit--constrained yet eligible firms. First, as our dataset allows for the observation of the characteristics of firms that BNDES actually uses to evaluate applications, we can exploit such characteristics. However, characteristics other than those used by BNDES may affect firm productivity growth., To reduce the possible implied bias, as suggested by Caliendo and Kopeinig (2008) and Heinrich, Maffioli and Vasquez (2010), we also check whether beneficiaries and nonbeneficiaries differ in terms of other observable characteristics, related to firm productivity but different from those relevant for eligibility. Furthermore, there is the issue that unobserved characteristics may drive the decision to apply as well as any ensuing differential productivity growth for granted firms. In this respect, Caliendo, Mahlstedt and Mitnik (2014) argue that the unobservable bias can be reduced by increasing the number of covariates. In addition to that, for the evaluation of BNDES effects on productivity we also adopt difference-in-differences conditional on variables that might affect productivity. Finally, as eligibility to BNDES funding does not require applicants to prove they are actually credit constrained, a correct interpretation of results calls for a preliminary check that firms in the treatment groups are indeed more credit constrained than firms in the corresponding control groups before treatment.

As for eligibility criteria, these are unsurprisingly related to the various dimensions through which the lender can try to assess the borrower's ability to repay the loans. A first type of indicator of this ability is the availability of collateral. As firms generally collateralize tangible assets, we measure the availability of collateral through firm capital stock. A second type of indicators relies on the availability of cash flow, which we measure through: revenues; profit over total sales; the ratio of financial costs minus financial revenue to total revenue ("solvency"); and the number of employees as a proxy for firm size alternative to revenue. To control for pre-treatment time trends that Arráiz, Meléndez and Stucchi (2014) and Castillo *et al.* (2014) have shown to differ between granted and nongranted firms, we also include the growth rates of revenue, profit and employment. Other indicators considered by BNDES are firms' market share, multinational status and location in terms of whether firms are located in the most developed ("rich") regions of Brazil. These are the South and the Southeast, which jointly represent nearly 85% of Brazilian manufacturing production. Multinational status and location are captured through dummies. Finally, a sectoral dummy is introduced to account for the fact that the BNDES operational structure is divided by sectors.

To identify the indicators that are indeed associated with successful BNDES applications, we use a Probit model in which the outcome is the ex-ante probability of success. The corresponding results are shown in Table 3 for treated Group 1 as

defined in Table 1.[31] All estimated coefficients significantly different from zero have the expected positive sign and the model exhibits reasonable fit, as shown by the percentage of concordance and the Hosmer and Lemeshow Statistic. In particular, performing well pre-treatment (in terms of employment and profit) increases a firm's probability of being supported. Firm size is also important in terms of both the number of employees and revenue. The capital stock matters too when entered together with the number of employees. It is instead insignificant when entered together with revenue. A possible explanation is its weaker correlation with the former than the latter.

Table 3. Probit model results

Probit model	Employees	Revenues
Dependent variable: BNDES dummy	(i)	(ii)
Capital Stock	0.08	0.06
	(0.04)**	(0.04)
Number of Employees	0.17	
	(0.06)***	
Revenue		0.15
		(0.05)***
Solvency	-0.96	-0.86
	(0.85)	(0.84)
Profit	-0.58	-0.71
	(0.54)	(0.55)
Profit Growth	0.07	0.08
	(0.04)*	(0.04)*
Employees Growth	0.28	0.38
	(0.16)*	(0.16)**
Revenue Growth	-0.10	-0.17
	(0.14)	(0.14)
Market Share	190.87	182.76
	(87.14)**	(87.58)*
Multinational Status	-0.10	-0.17
	(0.14)	(0.14)
Rich Region	0.14	0.12
	(0.13)	(0.13)
Sector Dummies	Yes	Yes
Observations	5,550	5,550
Percent Concordant	76%	76.2%
Hosmer and Lemeshow Statistic (p-value)	0.86	0.74

Source: Elaborated by the authors.

We can now pair granted and nongranted firms with similar ex-ante probability of being funded (PSM). We start looking for matches at the seventh decimal digit

[31] For parsimony, we present only results related to treatment Group 1. Results for the other treatment groups are available upon request.

of probability. For unmatched firms we gradually relax the requirement until the second decimal digit. Granted firms that at that point cannot find a nongranted match are dropped.[32] Starting with all nongranted firms, we find six different "control" groups depending on each "treated" group. A summary of how many firms are matched is shown in Table 4. More than 70% of treated firms find their nontreated "twin".[33]

Table 4. Number of matched firms

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Treated matched	118	169	65	108	99	144
Treated not matched	23	58	10	35	13	46
Percentage matched	84%	74%	87%	76%	88%	76%

Source: Elaborated by the authors.

Table 5 illustrates the extent to which matched pairs are similar in terms of the observable characteristics selected through the Probit model. It reports averages for these characteristics as well as t-statistics and p-values for the test of mean difference between matched pairs.[34] While in the Probit regression all continuous variables are in logs, the averages and the tests of means in Table 5 are in levels, which makes the comparison more telling than in logs as this reduces the variability of variables for matching while allowing it to be larger when testing for balancing.

Table 5. Comparing firms after matching

	Nontreated		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	1,102	-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	0.1%	0.1%	0.2%	0.9%	-1.61	11.0%
Multinational Status	8%	11%	16%	9%	-1.14	25.6%

(To be continued)

[32] More information on PSM results are presented in Appendix III.

[33] Instead of our PSM, we could have used other types of PSM (such as one-to-many or Kernel). These alternatives would have increased the number of matched nongranted firms. However, they would have reduced the quality of matches. Given that through our PSM more than 70% of treated firms find their nontreated 'twin', we have preferred to favour match quality. Moreover, Kernel matching is used by Lage de Sousa (2013), who investigates the effects of our BNDES schemes during (but not after) implementation. His findings are consistent with ours.

[34] For parsimony, in the main text we present only results related to treatment Group 1. Results for the other treatment groups are available in Appendix III.

(Continued)

	Nontreated		Treated		Testing matched firms	
	Not matched	Matched	Matched	Not matched	t Value	P-value
Rich	87%	87%	89%	83%	-0.40	68.9%
Labor 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	96.6%
Investment	2.3	5.6	11.9	33.5	-1.41	16.0%
Cash Flow/Capital	16.8%	10.6%	10.4%	11.4%	0.14	88.8%
Investment/Capital	4.0%	4.3%	6.8%	6%	-3.23	0.2%
Number of Firms	6,226	118	118	23	-	-

Source: Elaborated by the authors.

In general, treated and nontreated firms are much more alike in Table 5 than in Table 2. At the 5% level of significance nearly all averages do not exhibit any statistically difference. Most notably, this happens not only for the eligibility-related variables selected through the Probit model, but also for key additional variables (labor productivity, TFP, and cash flow to capital) not included in that model because of their irrelevance for eligibility. As our aim is to measure the impact of BNDES loans on the productivity of beneficiaries, for our purposes it is important that matched firms exhibit similar productivity levels before treatment even though productivity is not used to match them. The same holds for the ratio of cash flow to capital. In this respect, one may argue that, although the investment level remains higher for granted than nongranted firms and overall they still look more credit constrained, their ability to generate funds for investment has become more alike after PSM.

3.2.3 Unobservable characteristics

Although beneficiaries and nonbeneficiaries are fairly similar in terms of observable characteristics after PSM, differences in terms of unobservable characteristics might still exist so that the problem of selection bias persists. We deal with time-invariant unobservable characteristics by estimating the impact by difference-in-differences (more details in Section 5). Then we are left with time-variant unobservable characteristics that might distort our results. Management quality or the capability to generate projects, for instance, are unobservable characteristics that might change over time, especially due to different circumstances faced by firms, such as increased competition or macroeconomic shocks. In order to tackle this issue, we use some observable facts that might affect those unobservable time-variant characteristics. This allows us to design additional control groups to be used for robustness checks.

There are three observable facts that can be used for this purpose: investment, survival and ability to access BNDES funds. First, as granted firms are among those

interested in making investments, we consider the group of all nongranted firms that during the investigated period have both invested and survived. This provides us with a group of firms (Group B) that have managed to invest and remain active during the whole period we investigate, therefore having, for instance, similar management quality and capability to generate projects to those of granted firms. There are 6,344 such firms. Still, for unobservable reasons, these nongranted firms might still not be eligible for BNDES financial support. To deal with this issue, we consider another refined group composed by the firms that did receive BNDES loans but *not* during the investigated period. The logic behind this is that one may argue that these firms were likely to be eligible for BNDES support during our investigated period but did not apply. Specifically, given that the information we use to test whether BNDES financial support had any impact begins in 1996 and ends in 2006, we place in the refined group (Group C) all firms granted in 2007 for the first time. There are 128 of them. It is important to stress that firms in Group C are contained also in groups A and B, and firms in Group B also belong to Group A. In other words, our controls groups A, B and C are labelled in increasing order of refinement.[35]

Now that we have identified the "treatment" and "control" groups, we are ready to check: whether granted firms are indeed relatively credit constrained before receiving BNDES support; and then how their productivity growth compares with that of other otherwise similar nongranted noncredit constrained firms after receiving BNDES support.

4. Are granted firms more credit constrained before "treatment"?

We investigate credit constraints by looking at the correlation between firms' investment and cash flows.[36] The underlying idea (we already used to comment on tables 2 and 5) is that, when firms are credit constrained, investment has to rely on own liquidity thus leading to a positive correlation between investment and cash flow (FAZZARI; HUBBARD; PETERSEN, 1988). This measure has been criticized by Kaplan and Zingales (1997) among others and alternative approaches have been proposed in the literature, such as that by Almeida, Campello and Weisbach (2004).[37] This approach, however, requires information on how much cash each firm has, which unfortunately is not available in our dataset. On the

[35] Descriptive statistics for groups B and C compared with other control and treated groups are available in Table A.2 in Appendix II.

[36] See Aldrighi and Bisinha (2010), Ambrozio *et al.* (2017), and Terra (2003) for other papers investigating credit restriction using Brazilian firm-level data.

[37] See Ambrozio *et al.* (2017) for additional details.

other hand, recent papers following Fazzari, Hubbard and Petersen (1988) – such as Carpenter and Guariglia (2008), Guariglia (2008) and Guariglia, Liu and Song (2011) – show that their idea is still valid for the purpose of investigating credit constraints, especially when information needed to implement other approaches is not available.

Specifically, we test for the presence of credit constraints that are particularly relevant for granted firms by running the following regression:

$$Inv_{it}/K_{it-1} = \beta(CashFlow_{it}/K_{it-1}) + \alpha(CashFlow_{it}/K_{it-1})*BNDES_{i} + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

where *i* identifies the firm and *t* denotes the year, Inv_{it} is the level of investment, K_{it-1} is the capital stock, $CashFlow_{it}$ is the amount of cash flow generated, $BNDES_{i}$ is a dummy for "treated" firms, X_{it} is a set of controls and ε_{it} is the error term. As the capital stock is lagged in time, this specification requires two-period information and, as our treated group includes firms granted in 1998, we are restricted to use information from 1996 and 1997. We are thus able to estimate this specification only with OLS in the cross section. In order to eliminate firm specific characteristics as much as possible, we introduce different sets of dummies, including OECD technological classification, size, region and multinational status, as well as current and lagged sales over capital. For investment opportunities, we follow the literature by including sectoral value added variation and investment. The parameter of interest is α. A significant positive estimate would mean that, before receiving BNDES support in 1998, granted firms in treated groups faced indeed stricter credit constraints than nongranted firms in control groups.

Table 6 reports the estimation results based on equation (1) for treated Group 1. Columns correspond to the different counterfactuals. Since the coefficient of cash flow interacted with the BNDES dummy is positive and significant in all entries, the table shows that granted firms are indeed more credit constrained than all control groups before being awarded BNDES financial support. These findings are confirmed also in the case of firms granted BNDES Automatic, but not for those granted only once.[38] This means that firms that requested BNDES financial support only once were not more credit constrained whereas those that requested it more than once were. Such divergence suggests that repeated treatment can indeed be considered as a marker of a firm being more credit constrained while single treatment cannot. This will enable us to provide a more nuanced picture of how BNDES loans affect relative firm performance depending on the number of treatments.

[38] Results for other groups are available in Appendix IV.

Table 6. Credit restriction for Group 1

Dependent variable: Invest/K	Group A (1)	Group B (2)	Group C (3)	Paired Firms (4)
Cash Flow/K	0.000816***	0.000436	-0.00704	0.0508
	(0.00041)	(0.00110)	(0.0159)	(0.0394)
BNDES * Cash Flow/K	0.131***	0.128***	0.128***	0.120**
	(0.0302)	(0.03)	(0.0419)	(0.0532)
Sales/K	-0.00029***	-0.000413***	-0.00124	-0.0247***
	(3.45e-05)	(0.000158)	(0.00355)	(0.00721)
Sales/K lagged in time	0.000352***	0.000290***	0.000518***	0.0168***
	(1.96e-05)	(2.44e-05)	(0.000188)	(0.00406)
OECD Tech. Dummy	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes
Multinational Dummy	Yes	Yes	Yes	Yes
Size Dummy	Yes	Yes	Yes	Yes
Observations	18.104	6.485	271	216
R-squared	0.111	0.132	0.215	0.181

Source: Elaborated by the authors.

Notes: Standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

5. How do granted firms compare with nongranted firms after "treatment"?

After checking that before accessing BNDES funds, repeatedly granted firms faced more severe credit constraints than nongranted ones, we can now investigate whether BNDES support affected their subsequent relative performance. We do this through a difference-in-differences (DID) approach to eliminate time-invariant unobservable characteristics that are different between "treated" and "nontreated" firms. In particular, we adopt the specification in Bronzini and De Blasio (2006):

$$y_{it} = \boldsymbol{\beta}\, BNDES_i + \sum_t \boldsymbol{\alpha}_t D_t + \sum_t \boldsymbol{\delta}_t (BNDES_i \,.\, POST_t) + X_{it}\,\gamma + \boldsymbol{\varepsilon}_{it} \qquad (2)$$

where y_{it} is a productivity measure, $BNDES_i$ is a dummy variable indicating granted firms, D_t is a dummy year, $POST_t$ is a set of dummies for each year after the firm received the loan, and X_{it} is the vector of control variables. The parameter of interest is δ_t: its estimated value measures the differential impact of BNDES support on firm productivity in a given year. Note that the estimation of (2) allows us to assess not only whether BNDES support affects firm productivity in general, but also when its impact eventually materializes.

Table 7 presents the estimation results using treatment groups 1 and 2. Control groups are Group A and paired firms through PSM ("paired"). Columns of each counterfactual group are divided into two types of productivity measures: labor productivity and total factor productivity (TFP).[39]

[39] Outcomes for treated groups 5 and 6 are very similar to those for groups 1 and 2 when estimating for control groups A and Paired. Results are available in Appendix V, together with expanded versions of the tables shown in this section including all covariates.

Table 7. Results of difference-in-differences (more than once)

Treated group	Group 1				Group 2			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Effect in 1998	0.130**	0.00176	0.103	0.00371	0.0562	0.00904	0.0531	-0.000451
	(0.0577)	(0.00870)	(0.102)	(0.00319)	(0.0625)	(0.00845)	(0.0951)	(0.00176)
Effect in 1999	0.150***	-0.00273	0.0940	0.00188	0.0922	0.00208	0.0838	-0.00264
	(0.0549)	(0.00916)	(0.0983)	(0.00291)	(0.0573)	(0.00993)	(0.129)	(0.00181)
Effect in 2000	0.181***	-0.0853	0.194	0.00112	0.124*	-0.0829	0.0589	-0.00167
	(0.0562)	(0.0714)	(0.118)	(0.00286)	(0.0665)	(0.0700)	(0.122)	(0.00115)
Effect in 2001	0.163***	-0.0115	0.195*	0.00101	0.137***	-0.00943	-0.00842	-0.00216*
	(0.0589)	(0.0109)	(0.119)	(0.00278)	(0.0513)	(0.0108)	(0.0757)	(0.00115)
Effect in 2002	0.169***	-0.0165*	0.0724	0.00245	0.126**	-0.0136	0.0906	-0.00113
	(0.0567)	(0.00976)	(0.0736)	(0.00285)	(0.0495)	(0.00982)	(0.0848)	(0.00126)
Effect in 2003	0.126**	-0.0117	0.104	0.000838	0.0703	-0.00960	0.0553	-0.00198*
	(0.0529)	(0.0103)	(0.0743)	(0.00276)	(0.0500)	(0.0114)	(0.0865)	(0.00113)
Effect in 2004	0.0993*	-0.0269**	0.0918	-0.000126	0.0424	-0.0259**	0.0638	-0.00217*
	(0.0583)	(0.0125)	(0.0760)	(0.00309)	(0.0537)	(0.0131)	(0.0910)	(0.00120)
Effect in 2005	0.0573	-0.0300*	0.0717	-6.61e-05	0.0176	-0.0289*	0.0282	-0.00317**
	(0.0587)	(0.0164)	(0.0763)	(0.00307)	(0.0515)	(0.0168)	(0.0856)	(0.00151)
Effect in 2006	0.0122	-0.0528***	0.0789	0.000593	-0.0216	-0.0516***	-0.0242	-0.00248**
	(0.0581)	(0.0174)	(0.0744)	(0.00276)	(0.0516)	(0.0179)	(0.0800)	(0.00125)
Multiple Treatments	0.00255	0.0129***	0.0120	0.000218	0.0182**	0.0137***	0.0315***	0.000259**
	(0.00802)	(0.00403)	(0.0102)	(0.000148)	(0.00882)	(0.00431)	(0.00969)	(0.000121)
Domestic Capital	0.0194***		-0.0217		0.0190***		-0.0156	
	(0.00450)		(0.0301)		(0.00450)		(0.0326)	
Imported Capital	0.0181**		0.0529**		0.0189**		0.0357	
	(0.00904)		(0.0225)		(0.00906)		(0.0360)	
Observations	203,418	175,963	2,336	2,317	203,943	176,488	2,703	2,689
R-squared	0.693	0.481	0.779	0.495	0.694	0.481	0.754	0.547

Source: Elaborated by the authors.

Notes: Robust standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

As the TFP measure accounts for differences in capital stock among firms, the corresponding regressions do not feature investment in either domestic capital or imported capital as a covariate.[40] Instead these are included in the case of labor productivity. Interestingly, investment in imported capital and labor productivity are positively correlated while no clear cut correlation appears in the case of

[40] We also tried including them but results remained qualitatively similar.

domestic capital. This may suggest that imported capital goods are technologically more advanced.

As for our parameter of interest, in the case of labor productivity results are mixed depending on control groups. In our least refined control group (Group A), we find a positive impact of BNDES support on labor productivity until 2004 for treatment Group 1 and until 2002 for treatment Group 2. Nonetheless, no effect is evidenced afterwards, suggesting that loans improve the relative performance of granted firms for seven or five years, depending on the treatment group. However, this does not happen when we consider the most refined control groups (paired). Compared to these groups, "treated" firms do not perform any different.

Results are not mixed in the case of TFP, in which no effect of BNDES support is detected in the first years after "treated" firms are granted whatever comparison group is considered. From 2003, BNDES financial support consistently impacts negatively on granted firms when compared with nongranted firms in the least refined control (Group A) no matter whether treated firms survived or not. This holds also for granted firms in the Paired control group when the treated group includes nonsurvivors (Group 2) but ceases to hold when the treated group consists of survivors only (Group 1). As the most refined comparison between treated Group 1 and control group Paired reveals no differential effect of treatment in terms of both labor productivity and TFP, we conclude that in our sample there is no strong evidence that BNDES support differentially affects firm productivity growth.

As in Table 7 the number of treatments is positively correlated with firms' productivity, it is relevant to investigate BNDES effects on firms granted only once.[41] Table 8 shows outcomes for treatment groups 3 and 4, which are those supported by BNDES only in 1998 and no more until the end of our investigated period (2006). The effects of loans on firms' productivity become less evident for these groups. The positive effect on labor productivity vanishes completely and independently of which control group is considered, from the most naïve (Group A) to the most refined (Paired). This shows that granted firms tend to perform similarly to other firms not only while projects are being implemented but also after their full implementation. In terms of TFP, a negative impact occurs at the end of our investigated period (last two years: 2005 and 2006), yet only when granted firms are compared with the most naïve control group (Group A). The effect disappears completely in the case of paired firms.

[41] We also estimated the model using two strategies for multiple treatments. First, we introduced two dummies: one for firms financed twice to four times; another for firms financed five times or more. Second, we introduced a dummy for each multiple treatment: one for double treatment, another for triple treatment, and so on. All estimations remained similar to those we report and are available upon request.

Table 8. Results of difference-in-differences (just once)

Treated group	Group 3				Group 4			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Effect in 1998	0.0261	0.0194**	0.00939	-0.0165	0.0493	0.0119	0.113	-0.000821
	(0.0822)	(0.00868)	(0.104)	(0.0174)	(0.0902)	(0.0109)	(0.135)	(0.00237)
Effect in 1999	0.0508	0.00920	-0.0456	-0.00399	0.0763	0.00202	0.0163	-0.00253
	(0.0722)	(0.00931)	(0.103)	(0.00354)	(0.0821)	(0.0121)	(0.158)	(0.00253)
Effect in 2000	0.0432	-0.0759	-0.0694	-0.000177	0.0730	-0.0825	-0.0322	-0.00112
	(0.0972)	(0.0724)	(0.109)	(0.00291)	(0.1000)	(0.0706)	(0.163)	(0.00135)
Effect in 2001	0.0752	-0.00510	-0.0422	-0.00177	0.108	-0.0111	-0.0578	-0.00149
	(0.0559)	(0.0101)	(0.112)	(0.00293)	(0.0721)	(0.0123)	(0.105)	(0.00137)
Effect in 2002	0.0710	-0.0106	0.0728	-5.14e-05	0.109	-0.0159	0.0471	0.000458
	(0.0510)	(0.00908)	(0.103)	(0.00304)	(0.0681)	(0.0116)	(0.117)	(0.00166)
Effect in 2003	0.0608	-0.000425	0.121	-0.000950	0.102	-0.00522	0.142	-0.000398
	(0.0516)	(0.0121)	(0.103)	(0.00273)	(0.0668)	(0.0144)	(0.118)	(0.00135)
Effect in 2004	0.0246	-0.0204	0.168	5.31e-05	0.0702	-0.0244	0.0938	-0.000715
	(0.0589)	(0.0127)	(0.117)	(0.00289)	(0.0713)	(0.0157)	(0.125)	(0.00148)
Effect in 2005	0.0122	-0.0272*	0.117	0.001000	0.0626	-0.0305*	0.0483	-0.00234
	(0.0498)	(0.0153)	(0.112)	(0.00301)	(0.0652)	(0.0180)	(0.107)	(0.00201)
Effect in 2006	-0.0647	-0.0535***	0.0128	-0.00271	-0.0138	-0.0567***	0.0195	-0.000935
	(0.0567)	(0.0165)	(0.117)	(0.00291)	(0.0709)	(0.0187)	(0.115)	(0.00151)
Domestic Capital	0.0196***		-0.0182		0.0196***		0.0855*	
	(0.00450)		(0.0300)		(0.00450)		(0.0491)	
Imported Capital	0.0186**		0.000187		0.0187**		0.0627	
	(0.00907)		(0.0319)		(0.00907)		(0.0451)	
Observations	203,128	175,677	1,203	1,189	203,150	175,696	1,674	1,661
R-squared	0.693	0.11	0.870	0.191	0.693	0.481	0.761	0.391

Source: Elaborated by the authors.

Notes: Robust standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

The existence of unobserved time-variant characteristics, which are not considered in the previous estimations, might be interfering in the overall results. As a robustness check, we estimate the effect of these schemes using the two control groups described in Section 4: nongranted firms that have both invested and survived (Group B) and, among those, all firms granted in 2007 for the first time (Group C). As these control groups include only surviving firms, we consider only granted firms that have also survived during the investigated period: treatment groups 1, 3 and 5. Table 9 shows the results. Columns present a similar structure as in previous tables and, while different control groups are used, the message remains basically the same. A positive impact on labor productivity occurs in all three treated groups when we use the less refined control Group B but disappears when we look at the more refined control Group C. Once more, there is little evidence that BNDES support differentially affects firm productivity growth also after controlling for the existence of unobserved time-variant characteristics.

Table 9. Results of difference-in-differences (robustness check – unobservable time-variant characteristics)

Treated group	Group 1				Group 3				Group 5			
Control group	Group B		Group C		Group B		Group C		Group B		Group C	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Effect in 1998	0.0943*	0.0162	0.180	0.0211	0.129	0.0173	0.230	0.0197	0.105	0.0217	0.189	0.0239
	(0.0565)	(0.0451)	(0.156)	(0.0649)	(0.0865)	(0.0648)	(0.168)	(0.0791)	(0.0647)	(0.0497)	(0.158)	(0.0684)
Effect in 1999	0.109**	-0.0210	0.0303	-0.0227	0.133*	-0.0159	0.0578	-0.0279	0.121**	-0.0196	0.0444	-0.0215
	(0.0533)	(0.0431)	(0.123)	(0.0609)	(0.0802)	(0.0608)	(0.137)	(0.0735)	(0.0594)	(0.0456)	(0.126)	(0.0626)
Effect in 2000	0.130**	-0.0185	0.0742	-0.0383	0.106	-0.0333	0.0461	-0.0676	0.146**	-0.0266	0.0845	-0.0457
	(0.0550)	(0.0442)	(0.158)	(0.0613)	(0.0854)	(0.0621)	(0.172)	(0.0746)	(0.0595)	(0.0472)	(0.160)	(0.0631)
Effect in 2001	0.128**	-0.0276	0.281	0.00854	0.0971	-0.0568	0.258	-0.0335	0.127**	-0.0375	0.281	0.000887
	(0.0574)	(0.0415)	(0.199)	(0.0587)	(0.0891)	(0.0603)	(0.210)	(0.0730)	(0.0614)	(0.0461)	(0.201)	(0.0617)
Effect in 2002	0.153***	0.0224	0.182	0.0121	0.135	0.0168	0.175	-0.00557	0.141**	0.00287	0.167	-0.0108
	(0.0550)	(0.0442)	(0.130)	(0.0624)	(0.0845)	(0.0650)	(0.146)	(0.0774)	(0.0612)	(0.0492)	(0.132)	(0.0656)
Effect in 2003	0.123**	-0.0284	-0.0456	-0.0402	0.141*	-0.0391	-0.0240	-0.0647	0.102*	-0.0347	-0.0727	-0.0507
	(0.0511)	(0.0450)	(0.106)	(0.0606)	(0.0779)	(0.0630)	(0.122)	(0.0741)	(0.0590)	(0.0500)	(0.110)	(0.0641)
Effect in 2004	0.113**	-0.0184	-0.0556	-0.0598	0.132*	-0.0256	-0.0231	-0.0854	0.0968	-0.00373	-0.0746	-0.0529
	(0.0561)	(0.0429)	(0.108)	(0.0620)	(0.0801)	(0.0611)	(0.122)	(0.0752)	(0.0655)	(0.0475)	(0.112)	(0.0653)
Effect in 2005	0.0875	-0.0462	-0.0822	-0.0574	0.117	-0.0547	-0.0376	-0.0796	0.0763	-0.0321	-0.101	-0.0494
	(0.0563)	(0.0417)	(0.108)	(0.0612)	(0.0796)	(0.0595)	(0.121)	(0.0735)	(0.0658)	(0.0467)	(0.113)	(0.0642)
Effect in 2006	0.0600	-0.0636	-0.104	-0.115*	0.0608	-0.0815	-0.0978	-0.144*	0.0707	-0.0534	-0.102	-0.111*
	(0.0563)	(0.0439)	(0.107)	(0.0642)	(0.0868)	(0.0629)	(0.125)	(0.0783)	(0.0649)	(0.0486)	(0.111)	(0.0671)
Multiple treatments	0.00657	-0.0138*	0.0136	-0.00822					0.0144	-0.00783	0.0176	-0.0124
	(0.00782)	(0.00712)	(0.00915)	(0.00752)					(0.0104)	(0.00890)	(0.0112)	(0.00881)
Domestic capital	-0.0147***		-0.144***		-0.0138**		-0.119**		-0.0148***		-0.154***	
	(0.00568)		(0.0394)		(0.00570)		(0.0478)		(0.00569)		(0.0416)	
Imported capital	0.0143		0.0770**		0.0142		0.0949**		0.0144		0.0811**	
	(0.00900)		(0.0319)		(0.00902)		(0.0415)		(0.00900)		(0.0359)	
Observations	78,137	76,878	2.698	2,674	77,479	76,220	2,040	2,016	77,847	76,592	2.408	2,388
R-squared	0.707	0.445	0.694	0.446	0.705	0.445	0.653	0.457	0.705	0.445	0.664	0.439

Source: Elaborated by the authors.

Notes: Robust standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

These findings are not an isolated case in the literature. For example, Criscuolo *et al.* (2016) investigate the effect of industrial policy in the UK. Their results show no significant impact on firms' productivity, even though there are effects on employment and investment. Arráiz, Meléndez and Stucchi (2014) evaluate the effects of government-backed partial credit guarantees on firms' performance in Colombia. Although they find some impact on output and employment, no effect is found on productivity. Similar outcomes are also reported by other papers listed in Coelho and Lage de Sousa (2010), including Ottaviano and Lage de Sousa (2008) and Lage de Sousa (2013). These last two papers investigate the same BNDES schemes as we do here but use different empirical strategies and a different granted year (1997), which suggests that our results may hold regardless of the year investigated. Given that Lage de Sousa (2013) uses Kernel matching strategy, our results also seem robust across different matching strategies.

6. Concluding remarks

We have addressed the question whether BNDES Finem and BNDES Automatic loans help relax credit constraints hampering the productivity of Brazilian manufacturers from the perspective of what would have happened to the granted firms had they not been supported by BNDES but their credit constraints had been nonetheless otherwise removed. In so doing, we have taken a difference-in-differences approach carefully evaluating alternative treatment and control groups. We have first checked whether firms granted BNDES loans were indeed credit constrained before treatment and found supportive evidence for firms that were granted more than once. We have then looked at productivity growth and found that, by giving granted firms the resources to implement their projects, BNDES support has allowed them to perform like otherwise similar noncredit-constrained nongranted firms. On the other hand, firms that have requested financial support *only once* do not seem to be credit constrained before being granted, and perform similarly to those nongranted after receiving government support.

Overall, our findings suggest that credit constraints facing Brazilian manufacturing firms are real, at least for firms that apply to BNDES repeatedly and BNDES funding has allowed beneficiaries to match the performance of similar unconstrained firms in terms of productivity but not to outperform them.

These findings have important policy implications. Government support of the type provided by BNDES can allow credit constrained firms to perform as otherwise similar unconstrained ones. It might also increase firm average productivity by making constrained firms more productive than they would otherwise be. There is, however, no evidence that this type of government support can make firms choose better projects than they would choose on their own in the absence of credit constraints.

In the trade literature with heterogeneous firms, only the most productive firms are able to export (see, e.g., MELITZ, 2003 and MELITZ; OTTAVIANO, 2008). Therefore, productivity improvements are required to enter the international market. Credit constraints make it difficult for firms to raise their performance and consequently to export. Our paper contributes to the literature by showing that removing firms' credit constraint enables firms to perform similarly to unconstrained firms. As a consequence, firms become capable of exporting. In our study, 10% of the beneficiaries started to export after being granted, and their export growth was 50% higher than Brazilian total export growth. Understanding the links between credit restriction, productivity improvements and export performance remains a promising direction for future research in international trade.

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Appendix I: List of variables

Table A1 . Description of variables

Variables	Variable description	Source
Multinationals	Number of Multinationals	BACEN
% Multinationals	Share of Multinationals	BACEN
Labor Productivity	Value Added/Number of Employees	PIA
Value Added	Value Added	PIA
Number of Employees	Number of Employees	PIA
Average Wage	Total Wages/Number of Employees	PIA
Investment	Total Investment	PIA
Capital Stock	Capital Stock calculated by Perpetual Inventory (using Energy Consumption)	PIA
Total Revenue	Total Revenue (including Financial Revenue, for example)	PIA
Selling Revenue	Net Selling Revenues (only Goods)	PIA
Market Share	Market Share by Net Selling Revenues	PIA
Total Production Value	Value of Total Production (before taxes)	PIA
Energy Consumption	Expenditure in Electricity and Fuel Expenditure	PIA
Profitability	Net Profits/Total Revenue	PIA
Net Profit	Net Profits	PIA
Cash Flow	Net Profits plus Depreciation & Amortizations	PIA
Financial Status	Financial Expenditure/Total Costs	PIA
Solvency	Financial Expenditure/Net Selling Revenue	PIA
Financial Expenditures	Financial Expenditure	PIA
Total Cost	Total Cost	PIA
Efficiency	Production Cost/Total Production Value	PIA
Tax 1	Production Taxes/Selling Gross Revenue	PIA
Tax 2	All Taxes (Production + Land)/Selling Gross Revenue	PIA
Employees Growth	Annual Growth of Total Number of Employees	PIA
Revenue Growth	Annual Growth of Net Selling Revenue	PIA
Productivity Growth	Annual Growth of Productivity	PIA
Profit Growth	Annual Growth of Profits	PIA
Number Firms Profitable	Number of Firms which have earn Profits	PIA
Share of Profitable	Share of Profitable Firms	PIA
Rich Region	Number of Firms in Rich Regions	PIA
% Rich Region	Share of Firms in Rich Regions	PIA
Small Size	Number of Firms which Number of Employees is less than 100	PIA
Medium Size	Number of Firms which Number of Employees is greater than 100 and less than 500	PIA
Large Size	Number of Firms which Number of Employees is greater than 500	PIA
Share of Small	Share of Small Firms (< 100)	PIA
Share of Medium	Share of Medium Firms (> 100 e < 500)	PIA
Share of Large	Share of Large Firms (> 500)	PIA
OECD Classification	High, Medium-High, Medium-Low and Low Technology	PIA & OECD
Export Coefficient	Total Exports/Total Production Value	PIA & SECEX
Import Coefficient	Total Imports/Total Production Value	PIA & SECEX
Input Imports Coef	Intermediates Goods Imports/Manufacturing Operation Cost	PIA & SECEX
Capital Imports Coef	Capital Goods Imports/Investments	PIA & SECEX
Age	Number of Years of Firm's existence	RAIS
Workers' Schooling	Number of Years Spent on Education	RAIS
Skill Worker %	Share of Workers with at least Undergraduate Level Completed	RAIS
Capital Imports	Capital Goods Imports	SECEX
Input Imports	Intermediates Goods Imports	SECEX
Total Exports	Total Volume of Exports FOB	SECEX
Export Status	Percentage of Firms which have exported during 1996 and 2006	SECEX
Total Imports	Total Volume of Imports FOB	SECEX

Appendix II: Descriptive statistics

Table A2. Average of some variables for financed firms in 1998 and nonfinanced firms one year before treatment (in 1997)

Firms' type	Nontreated firms			Treated firms			
Variables	All firms over 30 employees	Survived and invested from 1996 to 2006	First treated in 2007	All first time in 1998	Automatic BNDES first time in 1998	All only in 1998	Unit
Number of Firms	21,380	6,344	128	141	112	75	
Age	20.1	22.6	22.1	26.6	25.0	24.4	Years
Labor Productivity	26.6	26.8	27.0	35.5	29.7	31.8	R$ thousand/ worker
Labor Productivity Growth	30.3%	26.0%	14.3%	31.7%	27.6%	34.6%	%
TFP Levinhson-Petrin	100	101	93	115	107	106	TFP All Firms = 100
TFP Growth	-3.2%	-1.1%	-2.9%	0.5%	-1.6%	0.0%	%
Investment/Capital	3.7%	4.0%	4.2%	6.6%	6.9%	5.5%	%
Cash Flow/Capital	12.3%	16.7%	19.0%	10.5%	10.4%	11.2%	%
Export Status	32.2%	40.0%	38.3%	58.9%	54.5%	49.3%	%
Value Added	6.84	7.40	12.07	28.90	9.99	24.95	R$ millions
Number of Employees	175	196	255	620	332	468	Number
Average Wage	22.0	23.3	21.4	31.5	26.9	24.8	R$ thousand/ worker
Workers' Schooling	6.7	6.7	6.5	7.1	7.0	6.9	Years
Skilled Worker %	5.8%	6.8%	5.7%	9.2%	8.1%	9.2%	%
Investment	1.17	0.86	1.24	5.45	1.58	4.79	R$ millions
Capital Stock 1	31.58	19.61	34.86	84.45	29.02	53.87	R$ millions
Capital Stock 2	32.35	18.15	32.19	113.44	33.22	81.44	R$ millions
Total Revenue	17.01	16.56	25.21	80.71	22.66	82.02	R$ millions
Selling Revenue	15.71	15.41	21.65	72.91	21.22	73.50	R$ millions
Market Share	0.09%	0.11%	0.12%	0.33%	0.11%	0.31%	%
Total Production Value	14.96	14.90	21.60	68.49	20.86	64.88	R$ millions
Capital Imports	0.32	0.30	0.30	3.49	0.28	5.64	R$ billions
Input Imports	1.18	1.20	1.54	3.97	0.63	4.20	R$ billions
Energy Consumption	1.00	0.99	1.23	5.99	0.93	2.54	R$ millions
Profitability	5.85%	6.69%	7.92%	5.68%	5.89%	6.38%	%
Net Profit	1.00	1.11	2.00	4.58	1.34	5.23	R$ millions
Financial Status	3.9%	3.6%	3.2%	4.7%	4.5%	5.0%	%
Solvency 1	3.9%	3.0%	2.2%	2.8%	2.8%	3.1%	%
Solvency 2	3.6%	2.8%	1.9%	2.5%	2.6%	2.8%	%
Financial Expenditures	0.62	0.46	0.47	2.05	0.59	2.28	R$ millions
Total Cost	18.2	16.6	24.4	79.3	22.1	80.2	R$ millions
Efficiency	52%	50%	53%	52%	52%	51%	%
Tax 1	17%	16%	16%	15%	15%	15%	%
Tax 2	17%	16%	17%	15%	15%	15%	%

(To be continued)

(Continued)

Firms' type	Nontreated firms			Treated firms			
Variables	All firms over 30 employees	Survived and invested from 1996 to 2006	First treated in 2007	All first time in 1998	Automatic BNDES first time in 1998	All only in 1998	Unit
Total Exports	1.87	1.75	4.47	9.27	1.13	6.45	R$ millions
Total Imports	1.75	1.78	2.14	8.67	1.20	11.68	R$ millions
Export Coefficient	4.9%	6.1%	7.7%	6.5%	5.6%	5.1%	%
Import Coefficient	4.2%	4.6%	5.3%	5.6%	4.6%	4.5%	%
Input Imports Coefficient	4%	5%	7%	6%	5%	5%	%
Capital Imports Coefficient	5%	6%	8%	9%	9%	5%	%
Employees Growth	0.1%	4.3%	1.8%	8.8%	10.3%	6.2%	%
Revenue Growth	22.1%	20.6%	16.9%	17.5%	13.7%	13.8%	%
Profit Growth	45.8%	50.1%	15.3%	44.4%	50.3%	65.1%	%
Number Firms Profitable	4,344	1,740	36	40	34	24	Number
Share of Profitable	20.3%	27.4%	28.1%	28.4%	30.4%	32.0%	%
Multinationals	1,089	509	7	21	13	8	Number
% Multinationals	5.09%	8.02%	5.47%	14.89%	11.61%	10.67%	%
Rich Region	18,165	5,505	119	124	97	61	Number
% Rich Region	85%	87%	93%	88%	87%	81%	%
Small Size	14,416	3,584	69	43	42	31	Number
Medium Size	5,686	2,304	45	57	48	27	Number
Large Size	1,278	456	14	41	22	17	Number
Share of Small	67%	56%	54%	30%	38%	41%	%
Share of Medium	27%	36%	35%	40%	43%	36%	%
Share of Large	6%	7%	11%	29%	20%	23%	%
OECD Classification							
High & Medium-High Tech	4,732	1,648	23	45	36	26	Number
Medium-Low Tech	5,360	1,789	36	30	18	13	Number
Low Tech	11,288	2,907	69	66	58	36	Number
Share High & Medium-High Tech	22%	26%	18%	32%	32%	35%	%
Share Medium-Low Tech	25%	28%	28%	21%	16%	17%	%
Share Low Tech	53%	46%	54%	47%	52%	48%	%

Appendix III: Propensity score matching

Table A3a. Comparing Group 5 after matching with nongranted

	Nontreated		Treated		Testing matched firms	
	Not matched	Matched	Matched	Not matched	t Value	P-value
Capital Stock	18	26	30	20	-0.49	62.8%
Number of Employees	192	312	337	297	-0.36	72.1%
Solvency	3.0%	2.4%	2.6%	4.3%	-0.39	69.8%
Profit	6.7%	6.1%	6.5%	1.0%	-0.40	68.6%
Profit Growth	49%	87%	51%	-23%	1.22	22.5%
Employment Growth	4%	4%	9%	19%	-1.21	22.9%
Revenue Growth	21%	18%	16%	0%	0.51	61.0%
Market Share	0.10%	0.10%	0.10%	0.00%	-1.43	15.3%
Multinational Status	8%	6%	13%	0%	-1.69	9.2%
Rich	87%	85%	88%	77%	-0.62	53.7%
Labor Productivity	26.7	25.2	31.7	14.1	-1.72	8.7%
TFP Productivity	99.6	100	102.7	93.5	-1.55	12.3%
Investment	0.8	1.4	1.6	1.6	-0.25	80.5%
Cash Flow/Capital	16.8%	10.8%	10.1%	12.4%	0.41	68.2%
Investment/Capital	4.0%	4.4%	7.0%	6.4%	-2.94	0.3%
Number of Firms	6,235	99	99	13	-	-

Table A3b. Comparing Group 3 after matching with nongranted

	Nontreated		Treated		Testing matched firms	
	Not matched	Matched	Matched	Not matched	t Value	P-value
Capital Stock	20	27	35	177	-0.42	67.4%
Number of Employees	195	298	302	1,553	-0.05	95.8%
Solvency	3.0%	2.5%	3.1%	2.8%	1.42	15.9%
Profit	6.7%	6.8%	7.0%	2.4%	-0.10	92.2%
Profit Growth	50%	54%	63%	117%	-0.27	79.1%
Employment Growth	4%	3%	5%	18%	-0.33	74.4%
Revenue Growth	21%	19%	15%	9%	0.81	41.9%
Market Share	0.1%	0.1%	0.1%	1.6%	-0.65	51.4%
Multinational Status	8%	6%	9%	20%	-0.65	51.4%
Rich	87%	85%	83%	70%	0.24	81.3%
Labor Productivity	26.9	25.7	31.5	33.7	-1.12	26.7%
TFP Productivity	99.6	100.2	102.2	99.1	-1.36	17.5%
Investment	0.9	0.6	2.5	18.0	-1.78	7.8%
Cash Flow/Capital	16.7%	10.5%	10.3%	17%	0.08	93.6%
Investment/Capital	4.0%	5.9%	4.1%	14.4%	1.59	11.2%
Number of Firms	6,279	65	65	10	-	-

Table A3c. Comparing Group 2 after matching with nongranted

	Nontreated		Treated		Testing matched firms	
	Not matched	Matched	Matched	Not matched	t Value	P-value
Capital Stock	12	48	74	43	-0.98	33.0%
Number of Employees	131	384	561	464	-1.61	10.8%
Solvency	3.9%	2.5%	2.6%	3.2%	-0.27	78.6%
Profit	6.0%	5.4%	6.2%	4.4%	-0.91	36.3%
Profit Growth	55%	4%	1%	32%	1.45	15.1%
Employment Growth	-1%	12%	9%	10%	0.55	58.0%
Revenue Growth	20%	102%	18%	14%	1.13	26.1%
Market Share	0.1%	0.2%	0.3%	0.4%	-1.19	23.6%
Multinational Status	5%	10%	14%	10%	-1.01	31.4%
Rich	84%	89%	90%	79%	-0.18	85.9%
Labor Productivity	67.2	136.7	101.6	97.9	1.09	27.6%
TFP Productivity	100.2	83.4	80.5	88.7	0.87	38.6%
Investment	1.7	17.2	14.4	10.4	0.21	83.2%
Number of Firms	18,240	169	169	58	-	-

Note: Results on cash flow/investment and investment/capital show similar patterns and are available upon request.

Table A3d. Comparing Group 4 after matching with nongranted

	Nontreated		Treated		Testing matched firms	
	Not matched	Matched	Matched	Not matched	t Value	P-value
Capital Stock	12	18	51	31	-2.07	4.1%
Number of Employees	133	263	438	380	-1.48	14.1%
Solvency	3.9%	2.6%	2.9%	3.4%	-0.57	56.9%
Profit	6.0%	5.0%	6.8%	4.4%	-1.63	10.4%
Profit Growth	55%	5%	1%	-1%	1.32	19.3%
Employment Growth	-1%	7%	7%	17%	0.04	96.8%
Revenue Growth	21%	32%	16%	16%	1.53	12.8%
Market Share	0.1%	0.1%	0.2%	0.4%	-1.40	16.5%
Multinational Status	5%	10%	14%	10%	0.23	81.9%
Rich	84%	90%	87%	77%	0.64	52.6%
Labor Productivity	67.7	91.5	83.5	86.3	0.51	60.8%
TFP Productivity	100.1	86.9	83.6	99.1	0.85	39.4%
Investment	1.9	2.6	12.8	6.7	-1.85	6.7%
Number of Firms	18,301	108	108	35	-	-

Note: Results on cash flow/investment and investment/capital show similar patterns and are available upon request.

Table A3e. Comparing Group 6 after matching with nongranted

	Nontreated		Treated		Testing matched firms	
	Not matched	Matched	Matched	Not matched	t Value	P-value
Capital Stock	12	22	30	16	-1.21	22.6%
Number of Employees	131	286	333	251	-0.84	40.1%
Solvency	3.9%	2.4%	2.5%	3.6%	-0.19	85.0%
Profit	6.0%	5.2%	6.4%	4.8%	-1.36	17.4%
Profit Growth	55%	5%	1%	45%	1.56	12.4%
Employment Growth	-1%	11%	9%	15%	0.21	83.4%
Revenue Growth	20%	112%	16%	13%	1.11	27.0%
Market Share	0.1%	0.1%	0.1%	0.1%	-0.67	50.3%
Multinational Status	5%	8%	10%	9%	-0.60	54.6%
Rich	84%	91%	90%	80%	0.40	69.2%
Labor Productivity	67.5	88.1	88.0	70.6	0.01	98.9%
TFP Productivity	100.1	86.4	86.2	97.7	0.06	95.0%
Investment	1.8	3.8	4.1	3.9	-0.24	81.0%
Number of Firms	18,237	144	144	46	-	-

Note: Results on cash flow/investment and investment/capital show similar patterns and are available upon request.

Appendix IV: Credit constraints for alternative treated groups

Table A4a. Credit restriction for Group 3

Dependent variable: Invest/K	Group A (1)	Group B (2)	Group C (3)	Paired firms (4)
Cash Flow/K	0.000827***	0.000519	0.0141	0.0871
	(0.00041)	(0.00109)	(0.0159)	(0.0656)
BNDES * Cash Flow/K	0.0599	0.0549	0.0544	0.0836
	(0.0373)	(0.0370)	(0.0452)	(0.0686)
Sales/K	-0.00029***	-0.000423***	-0.00131**	-0.0417***
	(3.45e-05)	(0.000158)	(0.00558)	(0.00978)
Sales/K lagged in time	0.000352***	0.000290***	0.000952***	0.0344***
	(1.95e-05)	(2.43e-05)	(0.000258)	(0.00673)
OECD Tech. Dummy	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes
Multinational Dummy	Yes	Yes	Yes	Yes
Size Dummy	Yes	Yes	Yes	Yes
Observations	18,038	6,419	203	128
R-squared	0.110	0.129	0.246	0.324

Notes: Standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

Table A4b. Credit restriction for Group 5

Dependent variable: Invest/K	Group A (1)	Group B (2)	Group C (3)	Paired firms (4)
Cash Flow/K	0.000814***	0.000430	-0.00642	0.0664
	(0.000411)	(0.00110)	(0.0167)	(0.0426)
BNDES * Cash Flow/K	0.135***	0.126***	0.114**	0.0728
	(0.0349)	(0.0346)	(0.0485)	(0.0646)
Sales/K	-0.00029***	-0.000414***	-0.00106	-0.0524***
	(3.46e-05)	(0.000159)	(0.00404)	(0.0113)
Sales/K lagged in time	0.000352***	0.000290***	0.000501***	0.0299***
	(1.96e-05)	(2.44e-05)	(0.000208)	(0.00587)
OECD Tech. Dummy	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes
Multinational Dummy	Yes	Yes	Yes	Yes
Size Dummy	Yes	Yes	Yes	Yes
Observations	18,075	6,456	240	180
R-squared	0.111	0.131	0.207	0.222

Notes: Standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

Appendix V: Post-treatment performance for alternative treated groups

Table A5a. Results of difference-in-differences (more than once)

Treated group	Group 1				Group 2			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Effect in 1998	0.130**	0.00176	0.103	0.00371	0.0562	0.00904	0.0531	-0.000451
	(0.0577)	(0.00870)	(0.102)	(0.00319)	(0.0625)	(0.00845)	(0.0951)	(0.00176)
Effect in 1999	0.150***	-0.00273	0.0940	0.00188	0.0922	0.00208	0.0838	-0.00264
	(0.0549)	(0.00916)	(0.0983)	(0.00291)	(0.0573)	(0.00993)	(0.129)	(0.00181)
Effect in 2000	0.181***	-0.0853	0.194	0.00112	0.124*	-0.0829	0.0589	-0.00167
	(0.0562)	(0.0714)	(0.118)	(0.00286)	(0.0665)	(0.0700)	(0.122)	(0.00115)
Effect in 2001	0.163***	-0.0115	0.195*	0.00101	0.137***	-0.00943	-0.00842	-0.00216*
	(0.0589)	(0.0109)	(0.119)	(0.00278)	(0.0513)	(0.0108)	(0.0757)	(0.00115)
Effect in 2002	0.169***	-0.0165*	0.0724	0.00245	0.126**	-0.0136	0.0906	-0.00113
	(0.0567)	(0.00976)	(0.0736)	(0.00285)	(0.0495)	(0.00982)	(0.0848)	(0.00126)
Effect in 2003	0.126**	-0.0117	0.104	0.000838	0.0703	-0.00960	0.0553	-0.00198*
	(0.0529)	(0.0103)	(0.0743)	(0.00276)	(0.0500)	(0.0114)	(0.0865)	(0.00113)
Effect in 2004	0.0993*	-0.0269**	0.0918	-0.000126	0.0424	-0.0259**	0.0638	-0.00217*
	(0.0583)	(0.0125)	(0.0760)	(0.00309)	(0.0537)	(0.0131)	(0.0910)	(0.00120)
Effect in 2005	0.0573	-0.0300*	0.0717	-6.61e-05	0.0176	-0.0289*	0.0282	-0.00317**
	(0.0587)	(0.0164)	(0.0763)	(0.00307)	(0.0515)	(0.0168)	(0.0856)	(0.00151)
Effect in 2006	0.0122	-0.0528***	0.0789	0.000593	-0.0216	-0.0516***	-0.0242	-0.00248**
	(0.0581)	(0.0174)	(0.0744)	(0.00276)	(0.0516)	(0.0179)	(0.0800)	(0.00125)
Multiple Treatments	0.00255	0.0129***	0.0120	0.000218	0.0182**	0.0137***	0.0315***	0.000259**
	(0.00802)	(0.00403)	(0.0102)	(0.000148)	(0.00882)	(0.00431)	(0.00969)	(0.000121)
Domestic Capital	0.0194***	-	-0.0217	-	0.0190***	-	-0.0156	-
	(0.00450)		(0.0301)		(0.00450)		(0.0326)	

(To be continued)

(Continued)

Treated group	Group 1				Group 2			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Imported Capital	0.0181**	-	0.0529**	-	0.0189**	-	0.0357	-
	(0.00904)		(0.0225)		(0.00906)		(0.0360)	
Imported Input	0.436***	0.0777***	0.710***	0.0224***	0.439***	0.0774***	0.598**	0.00476**
	(0.0966)	(0.0224)	(0.199)	(0.00703)	(0.0970)	(0.0223)	(0.279)	(0.00191)
Export Coefficient	0.203***	0.00188	0.118*	0.00408***	0.204***	0.00186	0.0904	0.00215**
	(0.0384)	(0.0133)	(0.0662)	(0.00122)	(0.0386)	(0.0133)	(0.0691)	(0.00104)
Import Coefficient	-1.211***	-0.115***	-1.156***	-0.0341***	-1.218***	-0.115***	-1.426***	-0.00890***
	(0.163)	(0.0338)	(0.331)	(0.00793)	(0.164)	(0.0335)	(0.520)	(0.00204)
Net Sales Revenue	0.496***	-0.0468***	0.584***	-0.00301***	0.496***	-0.0468***	0.630***	-0.00249***
	(0.00490)	(0.00879)	(0.0275)	(0.000410)	(0.00489)	(0.00878)	(0.0289)	(0.000279)
Number of Employees	-0.423***	-	-0.582***	-	-0.423***	-	-0.560***	-
	(0.00666)		(0.0395)		(0.00665)		(0.0372)	
Cost/Revenue	-2.010***	-0.163***	-1.670***	-0.0158***	-2.009***	-0.163***	-1.554***	-0.0158***
	(0.0750)	(0.0433)	(0.378)	(0.00365)	(0.0748)	(0.0432)	(0.237)	(0.00496)
Firms' Age	-0.0175***	-0.0817***	0.0997*	-0.000177	-0.0174***	-0.0815***	-0.106**	-0.00194***
	(0.00380)	(0.0283)	(0.0516)	(0.000829)	(0.00380)	(0.0282)	(0.0422)	(0.000484)
Years of Schooling	-0.0162*	-0.0195	0.266**	0.00244	-0.0165*	-0.0195	-0.0499	0.000118
	(0.00971)	(0.0141)	(0.115)	(0.00245)	(0.00970)	(0.0141)	(0.0594)	(0.00112)
Skilled Labor	0.309***	0.0198	-0.0225	-0.0104***	0.312***	0.0202	0.517***	0.00170
	(0.0350)	(0.0436)	(0.195)	(0.00341)	(0.0349)	(0.0437)	(0.147)	(0.00181)
Average Salary	0.567***	0.0534***	0.435***	0.000782	0.566***	0.0534***	0.400***	0.000586
	(0.00682)	(0.0118)	(0.0351)	(0.000930)	(0.00681)	(0.0118)	(0.0390)	(0.000599)
Investment	0.0103***	-0.00394***	0.00989**	-0.000204***	0.0104***	-0.00393***	0.0172***	-0.000149***
	(0.000421)	(0.000930)	(0.00389)	(6.66e-05)	(0.000421)	(0.000927)	(0.00329)	(4.33e-05)

(To be continued)

(Continued)

Treated group	Group 1				Group 2			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Solvency	1.272***	0.0103	1.323***	0.00349	1.270***	0.0103	1.734***	0.00977
	(0.0856)	(0.0273)	(0.265)	(0.00347)	(0.0854)	(0.0273)	(0.327)	(0.00827)
Revenue Growth	-0.461***	0.0176***	-0.373**	0.00294***	-0.461***	0.0176***	-0.364***	0.00160*
	(0.0126)	(0.00592)	(0.145)	(0.000706)	(0.0126)	(0.00590)	(0.125)	(0.000832)
Employment Growth	0.463***	0.0186	0.478***	-0.000764	0.463***	0.0186	0.460***	-0.000303
	(0.0117)	(0.0223)	(0.162)	(0.00142)	(0.0117)	(0.0222)	(0.130)	(0.000666)
Productivity Growth	0.492***	0.000691	0.483***	9.54e-05	0.492***	0.000676	0.483***	0.000305**
	(0.00995)	(0.000564)	(0.168)	(0.000134)	(0.00994)	(0.000567)	(0.132)	(0.000134)
Profitable	0.170***	-0.00544	0.00363	-0.000476	0.170***	-0.00544	0.0772***	-0.000454
	(0.00772)	(0.00948)	(0.0251)	(0.000510)	(0.00770)	(0.00945)	(0.0231)	(0.000422)
Multinational Status	0.0506***	0.0120***	-0.0659*	0.00181**	0.0492***	0.0115***	0.00730	0.00130***
	(0.0109)	(0.00375)	(0.0371)	(0.000873)	(0.0109)	(0.00355)	(0.0359)	(0.000416)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OECD Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	203,418	175,963	2,336	2,317	203,943	176,488	2,703	2,689
R-squared	0.693	0.481	0.779	0.495	0.694	0.481	0.754	0.547

Notes: Robust standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

Table A5b. Results of difference-in-differences (just once)

Treated group	Group 3				Group 4			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Effect in 1998	0.0261	0.0194**	0.00939	-0.0165	0.0493	0.0119	0.113	-0.000821
	(0.0822)	(0.00868)	(0.104)	(0.0174)	(0.0902)	(0.0109)	(0.135)	(0.00237)
Effect in 1999	0.0508	0.00920	-0.0456	-0.00399	0.0763	0.00202	0.0163	-0.00253
	(0.0722)	(0.00931)	(0.103)	(0.00354)	(0.0821)	(0.0121)	(0.158)	(0.00253)
Effect in 2000	0.0432	-0.0759	-0.0694	-0.000177	0.0730	-0.0825	-0.0322	-0.00112
	(0.0972)	(0.0724)	(0.109)	(0.00291)	(0.1000)	(0.0706)	(0.163)	(0.00135)
Effect in 2001	0.0752	-0.00510	-0.0422	-0.00177	0.108	-0.0111	-0.0578	-0.00149
	(0.0559)	(0.0101)	(0.112)	(0.00293)	(0.0721)	(0.0123)	(0.105)	(0.00137)
Effect in 2002	0.0710	-0.0106	0.0728	-5.14e-05	0.109	-0.0159	0.0471	0.000458
	(0.0510)	(0.00908)	(0.103)	(0.00304)	(0.0681)	(0.0116)	(0.117)	(0.00166)
Effect in 2003	0.0608	-0.000425	0.121	-0.000950	0.102	-0.00522	0.142	-0.000398
	(0.0516)	(0.0121)	(0.103)	(0.00273)	(0.0668)	(0.0144)	(0.118)	(0.00135)
Effect in 2004	0.0246	-0.0204	0.168	5.31e-05	0.0702	-0.0244	0.0938	-0.000715
	(0.0589)	(0.0127)	(0.117)	(0.00289)	(0.0713)	(0.0157)	(0.125)	(0.00148)
Effect in 2005	0.0122	-0.0272*	0.117	0.001000	0.0626	-0.0305*	0.0483	-0.00234
	(0.0498)	(0.0153)	(0.112)	(0.00301)	(0.0652)	(0.0180)	(0.107)	(0.00201)
Effect in 2006	-0.0647	-0.0535***	0.0128	-0.00271	-0.0138	-0.0567***	0.0195	-0.000935
	(0.0567)	(0.0165)	(0.117)	(0.00291)	(0.0709)	(0.0187)	(0.115)	(0.00151)
Domestic Capital	0.0196***	-	-0.0182	-	0.0196***	-	0.0855*	-
	(0.00450)		(0.0300)		(0.00450)		(0.0491)	
Imported Capital	0.0186**	-	0.000187	-	0.0187**	-	0.0627	-
	(0.00907)		(0.0319)		(0.00907)		(0.0451)	
Imported Input	0.440***	0.0775***	0.673***	0.00105	0.439***	0.0774***	0.686**	0.00234
	(0.0970)	(0.0224)	(0.184)	(0.00408)	(0.0970)	(0.0224)	(0.337)	(0.00177)

(To be continued)

(Continued)

Treated group	Group 3				Group 4			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Export Coefficient	0.206***	0.00220	-0.373***	-0.0126	0.206***	0.00221	0.141	0.00284*
	(0.0387)	(0.0135)	(0.0943)	(0.0179)	(0.0387)	(0.0135)	(0.0953)	(0.00166)
Import Coefficient	-1.218***	-0.115***	-0.671**	-0.0119	-1.218***	-0.115***	-1.924***	-0.00763***
	(0.164)	(0.0335)	(0.278)	(0.0103)	(0.164)	(0.0335)	(0.590)	(0.00222)
Net Sales Revenue	0.495***	-0.0470***	0.625***	-0.00265***	0.495***	-0.0470***	0.591***	-0.00286***
	(0.00491)	(0.00884)	(0.0242)	(0.000551)	(0.00491)	(0.00884)	(0.0352)	(0.000368)
Number of Employees	-0.422***	-	-0.643***	-	-0.422***	-	-0.568***	-
	(0.00668)		(0.0478)		(0.00668)		(0.0482)	
Cost/Revenue	-2.010***	-0.163***	-2.106***	-0.0329***	-2.010***	-0.163***	-1.809***	-0.0193***
	(0.0750)	(0.0433)	(0.221)	(0.0109)	(0.0750)	(0.0433)	(0.299)	(0.00705)
Firms' Age	-0.0175***	-0.0817***	0.0840**	-0.00554	-0.0175***	-0.0817***	-0.104**	-0.00216***
	(0.00380)	(0.0282)	(0.0334)	(0.00366)	(0.00380)	(0.0282)	(0.0529)	(0.000672)
Years of Schooling	-0.0171*	-0.0197	-0.122	0.00516	-0.0172*	-0.0197	-0.105	-0.000634
	(0.00971)	(0.0142)	(0.0796)	(0.00869)	(0.00971)	(0.0142)	(0.0745)	(0.00163)
Skilled Labor	0.316***	0.0203	0.678***	-0.00718	0.317***	0.0205	0.676***	0.00361
	(0.0351)	(0.0441)	(0.185)	(0.0102)	(0.0351)	(0.0441)	(0.174)	(0.00252)
Average Salary	0.567***	0.0535***	0.287***	0.000431	0.567***	0.0535***	0.426***	0.000753
	(0.00683)	(0.0118)	(0.0401)	(0.00105)	(0.00683)	(0.0118)	(0.0534)	(0.000933)
Investment	0.0104***	-0.00394***	0.0150***	5.20e-05	0.0104***	-0.00394***	0.0174***	-0.000111*
	(0.000422)	(0.000927)	(0.00289)	(0.000255)	(0.000422)	(0.000927)	(0.00445)	(5.96e-05)
Solvency	1.272***	0.0107	1.212***	0.0231**	1.272***	0.0107	2.279***	0.0239*
	(0.0855)	(0.0273)	(0.170)	(0.0114)	(0.0855)	(0.0273)	(0.399)	(0.0144)
Revenue Growth	-0.461***	0.0176***	-0.343***	-0.000823	-0.461***	0.0176***	-0.361**	0.00149
	(0.0126)	(0.00591)	(0.0729)	(0.00291)	(0.0126)	(0.00591)	(0.146)	(0.00123)

(To be continued)

(Continued)

Treated group	Group 3				Group 4			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Employment Growth	0.463***	0.0187	0.273***	0.000367	0.463***	0.0187	0.415**	-0.000180
	(0.0118)	(0.0223)	(0.0905)	(0.00144)	(0.0118)	(0.0223)	(0.167)	(0.000933)
Productivity Growth	0.492***	0.000671	0.411***	0.000273	0.492***	0.000670	0.476***	0.000301*
	(0.00994)	(0.000568)	(0.0678)	(0.000645)	(0.00994)	(0.000568)	(0.151)	(0.000173)
Profitable	0.171***	-0.00538	0.0451*	-0.00158	0.171***	-0.00537	0.101***	-0.000238
	(0.00773)	(0.00948)	(0.0241)	(0.00164)	(0.00773)	(0.00948)	(0.0318)	(0.000615)
Multinational Status	0.0504***	0.0116***	0.0334	0.00490	0.0502***	0.0116***	0.0490	0.00266***
	(0.0110)	(0.00368)	(0.0540)	(0.00343)	(0.0110)	(0.00367)	(0.0609)	(0.000839)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OECD Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	203,128	175,677	1,203	1,189	203,150	175,696	1,674	1,661
R-squared	0.693	0.11	0.870	0.191	0.693	0.481	0.761	0.391

Notes: Robust standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

Table A5c. Results of difference-in-differences (BNDES Automatic)

Treated group	Group 5				Group 6			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Effect in 1998	0.137**	0.00210	0.0555	0.00610	0.0966*	0.0127	0.0527	-0.000609
	(0.0665)	(0.00930)	(0.0960)	(0.00524)	(0.0579)	(0.00941)	(0.108)	(0.00199)
Effect in 1999	0.160***	-0.00361	0.0425	0.00423	0.0935	0.00447	0.0831	-0.00343*
	(0.0618)	(0.00954)	(0.0917)	(0.00466)	(0.0658)	(0.0113)	(0.148)	(0.00204)
Effect in 2000	0.195***	-0.0851	-0.0159	0.00265	0.125	-0.0800	0.0633	-0.00204
	(0.0610)	(0.0711)	(0.102)	(0.00445)	(0.0763)	(0.0684)	(0.141)	(0.00124)
Effect in 2001	0.161**	-0.0140	-0.00923	0.00222	0.137**	-0.00905	-0.0236	-0.00252**
	(0.0631)	(0.0111)	(0.102)	(0.00444)	(0.0556)	(0.0113)	(0.0843)	(0.00126)
Effect in 2002	0.158**	-0.0176*	0.000578	0.00471	0.108**	-0.0118	0.0599	-0.00133
	(0.0634)	(0.0103)	(0.0974)	(0.00475)	(0.0548)	(0.0109)	(0.0952)	(0.00141)
Effect in 2003	0.105*	-0.0138	0.0414	0.00301	0.0491	-0.00850	0.0241	-0.00230*
	(0.0610)	(0.0107)	(0.0959)	(0.00432)	(0.0571)	(0.0125)	(0.0974)	(0.00125)
Effect in 2004	0.0834	-0.0297**	0.00902	0.00198	0.0282	-0.0261*	0.00137	-0.00259*
	(0.0680)	(0.0126)	(0.0961)	(0.00484)	(0.0622)	(0.0135)	(0.0972)	(0.00135)
Effect in 2005	0.0429	-0.0326*	0.0174	0.000529	0.0122	-0.0289	-0.0245	-0.00359**
	(0.0687)	(0.0167)	(0.0943)	(0.00498)	(0.0594)	(0.0176)	(0.0887)	(0.00168)
Effect in 2006	0.0196	-0.0537***	-0.0211	0.00241	-0.0120	-0.0499***	-0.0513	-0.00301**
	(0.0667)	(0.0176)	(0.108)	(0.00427)	(0.0587)	(0.0186)	(0.0881)	(0.00139)
Multiple Treatments	0.0160	0.00620**	0.0378***	0.00000867	0.0294***	0.00889***	0.0378***	8.67e-05
	(0.0106)	(0.00298)	(0.0111)	(0.000140)	(0.0110)	(0.00345)	(0.0111)	(0.000140)
Domestic Capital	0.0193***	-	0.0364	-	0.0189***	-	0.000122	-
	(0.00451)		(0.0266)		(0.00450)		(0.0368)	
Imported Capital	0.0183**	-	0.0478	-	0.0188**	-	0.0664	-
	(0.00904)		(0.0342)		(0.00906)		(0.0426)	

(To be continued)

(Continued)

Treated group	Group 5				Group 6			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Imported Input	0.435***	0.0779***	0.828***	0.00184	0.437***	0.0775***	0.652**	0.00825***
	(0.0964)	(0.0224)	(0.279)	(0.00388)	(0.0967)	(0.0224)	(0.322)	(0.00260)
Export Coefficient	0.205***	0.00199	0.263***	0.00253	0.205***	0.00197	0.131*	0.00200
	(0.0384)	(0.0133)	(0.0725)	(0.00189)	(0.0386)	(0.0133)	(0.0738)	(0.00124)
Import Coefficient	-1.211***	-0.115***	-0.759*	-0.00377	-1.216***	-0.115***	-1.287**	-0.0122***
	(0.163)	(0.0337)	(0.452)	(0.00704)	(0.164)	(0.0334)	(0.649)	(0.00260)
Net Sales Revenue	0.496***	-0.0470***	0.593***	-0.00434***	0.496***	-0.0469***	0.628***	-0.00311***
	(0.00490)	(0.00883)	(0.0203)	(0.000560)	(0.00490)	(0.00882)	(0.0289)	(0.000348)
Number of Employees	-0.422***	-	-0.563***	-	-0.422***	-	-0.526***	-
	(0.00668)		(0.0331)		(0.00667)		(0.0434)	
Cost/Revenue	-2.011***	-0.163***	-1.822***	-0.0204***	-2.009***	-0.163***	-1.563***	-0.0181***
	(0.0751)	(0.0433)	(0.187)	(0.00634)	(0.0749)	(0.0432)	(0.264)	(0.00576)
Firms' Age	-0.0175***	-0.0817***	-0.0217	-0.00348**	-0.0176***	-0.0816***	-0.112**	-0.00185***
	(0.00380)	(0.0283)	(0.0246)	(0.00145)	(0.00380)	(0.0282)	(0.0455)	(0.000504)
Years of Schooling	-0.0164*	-0.0196	0.187***	0.00430	-0.0165*	-0.0196	-0.103	0.000700
	(0.00972)	(0.0142)	(0.0696)	(0.00352)	(0.00972)	(0.0142)	(0.0716)	(0.00121)
Skilled Labor	0.311***	0.0195	0.365**	0.00303	0.314***	0.0197	0.733***	-0.000866
	(0.0351)	(0.0436)	(0.182)	(0.00369)	(0.0351)	(0.0437)	(0.172)	(0.00203)
Average Salary	0.567***	0.0535***	0.373***	0.000367	0.566***	0.0535***	0.390***	0.000833
	(0.00683)	(0.0118)	(0.0285)	(0.00161)	(0.00682)	(0.0118)	(0.0412)	(0.000693)
Investment	0.0103***	-0.00394***	0.00329	-0.000254**	0.0104***	-0.00393***	0.0177***	-0.000129***
	(0.000421)	(0.000930)	(0.00238)	(0.000106)	(0.000421)	(0.000927)	(0.00343)	(4.87e-05)
Solvency	1.271***	0.0105	1.505***	0.00277	1.269***	0.0105	1.655***	0.0126
	(0.0857)	(0.0274)	(0.282)	(0.00501)	(0.0855)	(0.0273)	(0.388)	(0.00985)

(To be continued)

(Continued)

Treated group	Group 5				Group 6			
Control group	Group A		Paired		Group A		Paired	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Revenue Growth	-0.462***	0.0176***	-0.373***	0.00246**	-0.461***	0.0176***	-0.370***	0.00189**
	(0.0126)	(0.00593)	(0.0911)	(0.00101)	(0.0126)	(0.00591)	(0.130)	(0.000956)
Employment Growth	0.463***	0.0187	0.397***	-0.00419	0.463***	0.0187	0.436***	-0.000392
	(0.0118)	(0.0223)	(0.0931)	(0.00307)	(0.0117)	(0.0222)	(0.136)	(0.000775)
Productivity Growth	0.492***	0.000688	0.428***	0.000131	0.492***	0.000689	0.486***	0.000302**
	(0.00995)	(0.000565)	(0.0677)	(0.000494)	(0.00994)	(0.000563)	(0.137)	(0.000142)
Profitable	0.171***	-0.00537	0.00879	0.00147*	0.171***	-0.00536	0.0756***	-0.000296
	(0.00773)	(0.00948)	(0.0241)	(0.000848)	(0.00771)	(0.00944)	(0.0251)	(0.000481)
Multinational Status	0.0516***	0.0120***	-0.124**	0.00412**	0.0510***	0.0117***	0.0213	0.00136***
	(0.0110)	(0.00373)	(0.0526)	(0.00165)	(0.0110)	(0.00360)	(0.0443)	(0.000471)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OECD Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	203,150	175,696	1,273	1,254	203,596	176,145	2,291	2,281
R-squared	0.693	0.111	0.890	0.466	0.693	0.481	0.734	0.560

Notes: Robust standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

Table A5d. Results of difference-in-differences (robustness check - unobservable time-variant characteristics)

Treated group	Group 1				Group 3				Group 5			
Control group	Group B		Group C		Group B		Group C		Group B		Group C	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Effect in 1998	0.0943*	0.0162	0.180	0.0211	0.129	0.0173	0.230	0.0197	0.105	0.0217	0.189	0.0239
	(0.0565)	(0.0451)	(0.156)	(0.0649)	(0.0865)	(0.0648)	(0.168)	(0.0791)	(0.0647)	(0.0497)	(0.158)	(0.0684)
Effect in 1999	0.109**	-0.0210	0.0303	-0.0227	0.133*	-0.0159	0.0578	-0.0279	0.121**	-0.0196	0.0444	-0.0215
	(0.0533)	(0.0431)	(0.123)	(0.0609)	(0.0802)	(0.0608)	(0.137)	(0.0735)	(0.0594)	(0.0456)	(0.126)	(0.0626)
Effect in 2000	0.130**	-0.0185	0.0742	-0.0383	0.106	-0.0333	0.0461	-0.0676	0.146**	-0.0266	0.0845	-0.0457
	(0.0550)	(0.0442)	(0.158)	(0.0613)	(0.0854)	(0.0621)	(0.172)	(0.0746)	(0.0595)	(0.0472)	(0.160)	(0.0631)
Effect in 2001	0.128**	-0.0276	0.281	0.00854	0.0971	-0.0568	0.258	-0.0335	0.127**	-0.0375	0.281	0.000887
	(0.0574)	(0.0415)	(0.199)	(0.0587)	(0.0891)	(0.0603)	(0.210)	(0.0730)	(0.0614)	(0.0461)	(0.201)	(0.0617)
Effect in 2002	0.153***	0.0224	0.182	0.0121	0.135	0.0168	0.175	-0.00557	0.141**	0.00287	0.167	-0.0108
	(0.0550)	(0.0442)	(0.130)	(0.0624)	(0.0845)	(0.0650)	(0.146)	(0.0774)	(0.0612)	(0.0492)	(0.132)	(0.0656)
Effect in 2003	0.123**	-0.0284	-0.0456	-0.0402	0.141*	-0.0391	-0.0240	-0.0647	0.102*	-0.0347	-0.0727	-0.0507
	(0.0511)	(0.0450)	(0.106)	(0.0606)	(0.0779)	(0.0630)	(0.122)	(0.0741)	(0.0590)	(0.0500)	(0.110)	(0.0641)
Effect in 2004	0.113**	-0.0184	-0.0556	-0.0598	0.132*	-0.0256	-0.0231	-0.0854	0.0968	-0.00373	-0.0746	-0.0529
	(0.0561)	(0.0429)	(0.108)	(0.0620)	(0.0801)	(0.0611)	(0.122)	(0.0752)	(0.0655)	(0.0475)	(0.112)	(0.0653)
Effect in 2005	0.0875	-0.0462	-0.0822	-0.0574	0.117	-0.0547	-0.0376	-0.0796	0.0763	-0.0321	-0.101	-0.0494
	(0.0563)	(0.0417)	(0.108)	(0.0612)	(0.0796)	(0.0595)	(0.121)	(0.0735)	(0.0658)	(0.0467)	(0.113)	(0.0642)
Effect in 2006	0.0600	-0.0636	-0.104	-0.115*	0.0608	-0.0815	-0.0978	-0.144*	0.0707	-0.0534	-0.102	-0.111*
	(0.0563)	(0.0439)	(0.107)	(0.0642)	(0.0868)	(0.0629)	(0.125)	(0.0783)	(0.0649)	(0.0486)	(0.111)	(0.0671)
Multiple Treatments	0.00657	-0.0138*	0.0136	-0.00822	-	-	-	-	0.0144	-0.00783	0.0176	-0.0124
	(0.00782)	(0.00712)	(0.00915)	(0.00752)					(0.0104)	(0.00890)	(0.0112)	(0.00881)
Domestic Capital	-0.0147***	-	-0.144***	-	-0.0138**	-	-0.119**	-	-0.0148***	-	-0.154***	-
	(0.00568)		(0.0394)		(0.00570)		(0.0478)		(0.00569)		(0.0416)	
Imported Capital	0.0143	-	0.0770**	-	0.0142	-	0.0949**	-	0.0144	-	0.0811**	-
	(0.00900)		(0.0319)		(0.00902)		(0.0415)		(0.00900)		(0.0359)	

(To be continued)

(Continued)

Treated group	Group 1				Group 3				Group 5			
Control group	Group B		Group C		Group B		Group C		Group B		Group C	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Imported Input	0.383***	0.445***	0.931***	0.0131***	0.381***	0.445***	0.962***	0.676***	0.381***	0.445***	0.890***	0.659***
	(0.136)	(0.0598)	(0.220)	(0.00505)	(0.136)	(0.0600)	(0.257)	(0.108)	(0.136)	(0.0598)	(0.238)	(0.104)
Export Coefficient	0.106***	-0.115***	-0.00709	-0.00361**	0.110***	-0.111***	0.107	-0.240***	0.109***	-0.114***	0.0494	-0.323***
	(0.0363)	(0.0130)	(0.0788)	(0.00153)	(0.0367)	(0.0131)	(0.0940)	(0.0622)	(0.0365)	(0.0130)	(0.0894)	(0.0572)
Import Coefficient	-1.238***	-0.582***	-1.568***	-0.0129**	-1.239***	-0.578***	-1.661***	-0.802***	-1.237***	-0.579***	-1.514***	-0.826***
	(0.182)	(0.0704)	(0.510)	(0.00608)	(0.182)	(0.0706)	(0.633)	(0.160)	(0.181)	(0.0705)	(0.580)	(0.155)
Net Sales Revenue	0.554***	0.100***	0.543***	-0.00292***	0.552***	0.100***	0.525***	0.110***	0.554***	0.101***	0.542***	0.117***
	(0.00726)	(0.00238)	(0.0267)	(0.000434)	(0.00731)	(0.00239)	(0.0296)	(0.0125)	(0.00727)	(0.00239)	(0.0279)	(0.0120)
Number of Employees	-0.349***	-	-0.488***	-	-0.336***	-	-0.504***	-	-0.334***	-	-0.471***	-
	(0.0260)		(0.0319)		(0.0289)		(0.0414)		(0.0283)		(0.0399)	
Cost/Revenue	-2.250***	-1.273***	-2.217***	-0.00763**	-2.253***	-1.275***	-2.310***	-1.000***	-2.252***	-1.274***	-2.347***	-0.978***
	(0.0764)	(0.0276)	(0.268)	(0.00327)	(0.0767)	(0.0278)	(0.307)	(0.114)	(0.0766)	(0.0277)	(0.291)	(0.114)
Firms' Age	0.0312***	-0.0535***	-0.0496	-0.000176	0.0311***	-0.0538***	-0.0629	0.0335	0.0310***	-0.0529***	-0.0560	0.0369*
	(0.00786)	(0.00360)	(0.0464)	(0.000496)	(0.00791)	(0.00362)	(0.0588)	(0.0247)	(0.00787)	(0.00360)	(0.0497)	(0.0215)
Years of Schooling	-0.0122	-0.309***	0.0764	0.00618***	-0.0144	-0.310***	0.0600	-0.306***	-0.0127	-0.308***	0.0667	-0.254***
	(0.0144)	(0.00708)	(0.0701)	(0.00152)	(0.0145)	(0.00710)	(0.0852)	(0.0471)	(0.0145)	(0.00709)	(0.0856)	(0.0494)
Skilled Labor	0.127***	0.549***	0.0693	-0.0234***	0.135***	0.552***	0.0299	0.263*	0.130***	0.548***	0.0946	0.317**
	(0.0469)	(0.0282)	(0.180)	(0.00487)	(0.0475)	(0.0286)	(0.269)	(0.156)	(0.0474)	(0.0285)	(0.227)	(0.138)
Average Salary	0.520***	0.211***	0.426***	0.00273***	0.521***	0.211***	0.425***	0.161***	0.519***	0.210***	0.402***	0.156***
	(0.00956)	(0.00420)	(0.0418)	(0.000950)	(0.00963)	(0.00422)	(0.0542)	(0.0242)	(0.00957)	(0.00420)	(0.0443)	(0.0212)
Investment	0.0112***	-0.00203***	0.00338	-0.000255***	0.0113***	-0.00201***	0.00431	-0.000642	0.0112***	-0.00202***	0.00319	-0.00116
	(0.000611)	(0.000295)	(0.00353)	(6.40e-05)	(0.000613)	(0.000296)	(0.00393)	(0.00188)	(0.000612)	(0.000295)	(0.00376)	(0.00176)
Solvency	1.323***	0.607***	1.795***	-0.00388	1.325***	0.609***	1.917***	0.543***	1.323***	0.605***	1.819***	0.379**
	(0.0976)	(0.0379)	(0.298)	(0.00389)	(0.0980)	(0.0380)	(0.354)	(0.192)	(0.0980)	(0.0380)	(0.351)	(0.187)

(To be continued)

(Continued)

Treated group	Group 1				Group 3				Group 5			
Control group	Group B		Group C		Group B		Group C		Group B		Group C	
Dependent variable	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP	Labor	TFP
Revenue Growth	-0.444***	0.0304***	-0.388***	0.00410***	-0.444***	0.0301***	-0.394***	0.0545	-0.445***	0.0306***	-0.412***	0.0791**
	(0.0241)	(0.00615)	(0.119)	(0.00106)	(0.0241)	(0.00617)	(0.130)	(0.0332)	(0.0241)	(0.00616)	(0.126)	(0.0310)
Employment Growth	0.451***	0.00961	0.286**	-0.00218	0.452***	0.00881	0.257	-0.0884*	0.450***	0.00879	0.246*	-0.0737*
	(0.0234)	(0.00693)	(0.131)	(0.00147)	(0.0236)	(0.00699)	(0.169)	(0.0509)	(0.0235)	(0.00697)	(0.145)	(0.0438)
Productivity Growth	0.475***	0.0325***	0.469***	0.000164	0.475***	0.0324***	0.471***	0.0139**	0.475***	0.0325***	0.470***	0.0164**
	(0.0206)	(0.00180)	(0.116)	(0.000102)	(0.0207)	(0.00180)	(0.120)	(0.00695)	(0.0207)	(0.00180)	(0.118)	(0.00711)
Profitable	0.0907***	0.0405***	0.0960***	4.41e-05	0.0918***	0.0411***	0.129***	0.0408**	0.0909***	0.0404***	0.103***	0.0216
	(0.00697)	(0.00339)	(0.0292)	(0.000618)	(0.00702)	(0.00341)	(0.0362)	(0.0184)	(0.00699)	(0.00340)	(0.0318)	(0.0167)
Multinational Status	0.0414***	-0.0648***	-0.0859**	0.000791	0.0428***	-0.0651***	-0.109*	-0.141***	0.0429***	-0.0659***	-0.0614	-0.167***
	(0.0114)	(0.00627)	(0.0378)	(0.000580)	(0.0116)	(0.00638)	(0.0632)	(0.0387)	(0.0114)	(0.00632)	(0.0481)	(0.0310)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OECD Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78,137	76,878	2.698	2,674	77,479	76,220	2,040	2,016	77,847	76,592	2.408	2,388
R-squared	0.707	0.445	0.694	0.446	0.705	0.445	0.653	0.457	0.705	0.445	0.664	0.439

Notes: Robust standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1.

Appendix VI: Measuring TFP

Our TFP measure is calculated following Levinsohn and Petrin (2003) as the firm-level Solow residual based on a Cobb-Douglas production function with labor, capital and intermediates as inputs. Implementation of this approach requires the following variables:

a) Labor – Measured as human capital, calculated as total number of firm employees times employee's average number of years of schooling. Results using the total number of employees are also available upon request.

b) Capital – As there is no measure of firm capital stock in our main database (PIA), we proceeded as follows. First, we used the perpetual inventory method to construct the capital stock at sector level using investments made from 1985 to 1995. Then we imputed the sectoral capital stock to firms according to their market shares in 1995. For example, if the capital stock of sector *j* in 1995 were 100 and firm *i*'s market share were 15%, then the capital stock imputed to firm *i* would be 15. Given this initial capital stock in 1995, from then onwards the yearly time series of each firm's capital stock was generated using its investments and depreciation.

c) Input – The PIA dataset reports firm input expenditure.

d) Output – We use the total value of production as our measure of production. To deal with possible biases arising from the fact that the firm likely makes profit-maximizing decisions based on shocks that are unobservable to the econometrician, implementation of the Levinsohn and Petrin (2003) procedure also requires:

e) Energy – The PIA dataset reports firm energy expenditure.

The estimated Cobb-Douglas coefficients when they are assumed to be the same across sectors and when they are allowed to differ across sectors are reported in Tables A.6a and A.6b. respectively. These results are in line with existing estimates obtained, for instance, by Lopez-Cordova and Moreira (2003) from the same dataset (PIA) in the period 1996-2000, through the alternative Olley and Pakes (1996) approach.

Table A6a. TFP results for full sample

Dependent variable: Total value of production	
Human Capital	0.30
	(0.006)***
Input Consumption	0.43
	(0.005)***

(To be continued)

(Continued)

Dependent variable: Total value of production	
Capital Stock	0.34
	(0.035)***
Wald Test for Constant Returns	4.54
P-value	3.3%

* Significant at 10%, ** at 5% and *** at 1%.

Table A6b. TFP results per sector

Dependent variable: Total value of production			
	Labor	Materials	Capital
Food & Beverages	0.42	0.50	0.10
	(0.0082)***	(0.0145)***	(0.0056)***
Tobacco	0.41	0.30	0.10
	(0.036)***	(0.0632)***	(0.0249)***
Textiles	0.17	0.54	0.15
	(0.0096)***	(0.0204)***	(0.0103)***
Apparel	0.30	0.46	0.10
	(0.0038)***	(0.0099)***	(0.0044)***
Leather	0.28	0.37	0.13
	(0.0047)***	(0.0136)***	(0.0057)***
Wood	0.17	0.62	0.11
	(0.0073)***	(0.0285)***	(0.0062)***
Paper	0.26	0.65	0.16
	(0.0199)***	(0.0265)***	(0.012)***
Printing	0.18	0.96	0.23
	(0.0125)***	(0.0301)***	(0.0115)***
Coke & Refined petroleum	0.47	0.92	0.18
	(0.0398)***	(0.108)***	(0.0232)***
Chemicals	0.33	0.66	0.11
	(0.0128)***	(0.0231)***	(0.0075)***
Plastic & Rubber	0.19	0.79	0.12
	(0.01)***	(0.018)***	(0.0063)***
Nonmetallic	0.17	0.62	0.16
	(0.005)***	(0.0141)***	(0.0089)***
Basic metals	0.34	0.33	0.18
	(0.0214)***	(0.0293)***	(0.0157)***
Metal products	0.24	0.78	0.19
	(0.0077)***	(0.0249)***	(0.0087)***
Machinery & Equipment	0.23	0.70	0.20
	(0.0105)***	(0.0198)***	(0.0081)***
Office equipment	0.27	0.75	0.18
	(0.0723)***	(0.1929)**	(0.0377)***
Electrical equipment	0.28	0.43	0.26
	(0.0241)***	(0.0333)***	(0.0156)***
Electronics	0.27	0.62	0.16
	(0.0205)***	(0.038)***	(0.0214)***

(To be continued)

(Continued)

Dependent variable: Total value of production			
	Labor	Materials	Capital
Health equipments	0.28	0.46	0.24
	(0.021)***	(0.0695)***	(0.0239)***
Moto vehicles	0.15	0.59	0.19
	(0.0118)***	(0.0243)***	(0.0127)***
Other transport equipment	0.23	0.24	0.38
	(0.0217)***	(0.0764)**	(0.0347)***
Furniture and other equipment	0.27	0.64	0.19
	(0.0113)***	(0.0211)***	(0.0088)***

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