BNDES FINANCING AND LABOR PRODUCTIVITY IN BRAZIL: AN ANALYSIS BY COMPANY SIZE

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ABSTRACT

The question of productivity gains among micro and small enterprises in response to economic incentives remains underexplored in the academic literature. What exists is a multitude of unresolved questions. This applied study seeks to shed light on a topic that has long been overlooked in discussions about the efficiency of public spending in general —and the role of the Banco Nacional de Desenvolvimento Econômico e Social (BNDES) in particular— in fostering corporate productivity. Accordingly, this research set out to examine the effects of BNDES financing on the productivity of Brazilian firms, segmented by size and sector. The analysis employed both traditional econometric models (ordinary least squares and fixed effects) and system GMM models to address endogeneity issues. The results support the argument that micro and small enterprises —despite having more rudimentary production and management structures— experience greater productivity gains when granted access to BNDES funding.

Keywords: labor productivity, BNDES, company size.
JEL Classification: C33, L2, O4.

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EL FINANCIAMIENTO DEL BNDES Y LA PRODUCTIVIDAD LABORAL EN BRASIL:
UN ANÁLISIS POR TAMAÑO DE EMPRESA

RESUMEN

La cuestión del aumento de la productividad en las micro y pequeñas empresas en respuesta a incentivos económicos sigue siendo poco explorada en la literatura académica. Existe una multitud de preguntas sin resolver. Este estudio aplicado busca arrojar luz sobre un tema que durante mucho tiempo se ha pasado por alto en los debates sobre la eficiencia del gasto público en general, y el papel del Banco Nacional de Desenvolvimento Econômico e Social (BNDES), en particular, en el fomento de la productividad empresarial. Por consiguiente, esta investigación propone examinar los efectos de la financiación del BNDES en la productividad de las empresas brasileñas, segmentadas por tamaño y sector. El análisis empleó modelos econométricos tradicionales (mínimos cuadrados ordinarios y efectos fijos) y modelos de sistema GMM para abordar cuestiones de endogeneidad. Los resultados respaldan el argumento de que las micro y pequeñas empresas, a pesar de contar con estructuras de producción y gestión más rudimentarias, experimentan mayores aumentos de productividad cuando acceden al financiamiento del BNDES.

Palabras clave: productividad laboral, BNDES, tamaño de la empresa.
Clasificación JEL: C33, L2, O4.

1. INTRODUCTION

Productivity differentials between firms and sectors are a reality in every country. However, in some cases, these disparities not only reach significant magnitudes but also persist over time, showing no signs of long-term convergence. This phenomenon is referred to as "productive heterogeneity" or "structural heterogeneity." It is not a new concern in economic thought, having been addressed by ECLAC (Economic Commission for Latin America and the Caribbean) theories since the 1950s (Prebisch, 1949; Furtado, 1961). Brazil, in particular, has long been considered a paradigmatic example of this phenomenon.

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Unlike the classic ECLAC interpretation of structural heterogeneity —which focused on productivity gaps (specifically labor productivity, measured as value added per unit of labor) between different sectors or economic activities— recent evidence suggests that these disparities are even more pronounced within sectors, among firms themselves. In other words, the phenomenon distinguishes firms far more than it does sectors.

In so-called "developing" economies like Brazil, there is a striking contrast between internationally competitive global players and a vast number of firms with very low productivity. Furthermore, the data indicate that this productivity gap is strongly associated with firm size. High-productivity segments are predominantly composed of medium and large enterprises, while the low-productivity segment consists mainly of micro and small enterprises, both formal and informal (Dix-Carneiro, Goldberg, and Ulyssea, 2025; Nogueira and Zucoloto, 2019; Ulyssea, 2018).

Overcoming intra-sectoral heterogeneity requires industrial policies that are directly and specifically tailored to this context. Traditional industrial policy (IP) theory typically overlooks intra-sectoral dynamics and does not account for company size. In general, IP is defined as a set of deliberate actions by the state aimed at shifting the composition of economic activity in favor of the manufacturing sector (Chang, 2003) or towards its most dynamic branches (Lane, 2022). Nevertheless, IP also encompasses innovation, technology, international trade, and domestic production capacity policies (Oqubay *et al.*, 2020), highlighting the centrality of productivity concerns within industrial policy discourse.

Despite this, the productivity challenges inherent to micro and small enterprises (MSEs) in peripheral economies often receive insufficient attention in the literature. The prevailing national debate tends to focus on a broader context dominated by medium and, above all, large firms —which enjoy a more prominent position.

Crucially, what tends to be overlooked by traditional IP approaches is that national productivity reflects not only inter-sectoral but also intra-sectoral performance —that is, the productivity of all firms, across all sizes and sectors, that constitute the economic structure. In peripheral countries, small businesses are the main employers. In Brazil, these firms —encompassing both formal and informal employment— account

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for approximately three-quarters of the total workforce (Nogueira and Zucoloto, 2019)[1].

Given their relatively low levels of capital per worker, micro and small enterprises often operate with lower labor productivity than larger firms. However, this lower capital intensity implies that new investments —such as the acquisition of machinery, equipment, or improvements in production processes— may generate relatively large improvements in labor productivity.

Accordingly, Miguez and Moraes (2014) advocate for a productivity strategy that emphasizes intra-sectoral improvements —suggesting that it is possible to boost productivity within the various economic activities that comprise the economy. One of their arguments is that the most productive sectors, such as those oriented toward exports, are already operating near their productivity ceiling, defined by international competitiveness.

With this in mind, the central research question of this study is as follows: *Is there a difference in marginal productivity gains between* MSEs *and large firms when they receive funding from Banco Nacional de Desenvolvimento Econômico e Social (*BNDES*)?* This study aims to empirically test this hypothesis. The premise is that MSEs, being less competitive and characterized by rudimentary production and management structures, may exhibit greater scalability and gains from new productive investments. The central argument developed in this study relates to differences in capital intensity across firms of different sizes. Micro and small enterprises typically operate with lower levels of capital per worker, which results in lower labor productivity when compared with medium and large firms. However, precisely because capital is relatively scarce in these firms, the introduction of new investment —financed, for example, through development bank credit— may generate proportionally larger productivity gains. In this sense, although labor productivity is initially lower in micro and small enterprises, additional capital investment may produce stronger improvements in labor productivity due to their lower capital intensity (Foley, Michl, and Tavani, 2019).

[1] For more information on the difference in productivity between firms and countries, see the works of Bloom and Van Reenen (2010) and Syverson (2004; 2011).

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The issue of productivity gains among micro and small enterprises in response to economic incentives remains underexplored in the literature, leaving a significant gap. This article seeks to shed light on a topic that has long remained on the periphery of discussions surrounding public resource efficiency in general —and the role of BNDES in particular— in enhancing firm-level productivity.

Based on the aforementioned arguments, the aim of this study is to assess the effects of BNDES funding on the productivity of Brazilian firms, segmented by size and sector.

To qualify for BNDES financing, applicants must meet several criteria, including tax, fiscal, and social obligations compliance; satisfactory credit history; payment capacity; sufficient collateral; and not being under a debt restructuring regime. It is therefore assumed that larger firms have easier access to BNDES credit. This introduces potential endogeneity concerns, as more productive (and typically larger) firms may be more likely to access BNDES funding. To address this issue, the study employs a System Generalized Method of Moments (GMM) model for the correlation analysis.

This study contributes to the literature in three main ways. First, it provides an empirical assessment of the relationship between development bank financing and labor productivity in Brazilian manufacturing firms. Second, it focuses explicitly on intra-sector productivity heterogeneity by analyzing the effects of credit according to firm size. Third, it employs dynamic panel estimation techniques (System GMM) in order to address potential endogeneity between productivity and access to credit.

This paper is structured in six sections, including this introduction. Section 2 presents a brief review of the literature on micro and small businesses and labor productivity. Section 3 explores existing studies on industrial policy. Section 4 details the methodology (System GMM). The final two sections present the results and conclusions.

2. MICRO AND SMALL ENTERPRISES AND LABOR PRODUCTIVITY IN THE INTRA-SECTORAL CONTEXT

The structuralist tradition has long emphasized that differences in productivity across sectors play a central role in explaining income gaps between countries. According to this perspective, development depends

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fundamentally on structural transformation —that is, the reallocation of labor and resources toward sectors characterized by higher technological intensity and increasing returns to scale[2].

Unlike the traditional ECLAC approach, the heterogeneity dilemma incorporates the challenges of intra-sectoral heterogeneity and extends far beyond the perspective of sectoral (or structural) change in the economy. Moreover, this dichotomy between low-productivity small firms and high-productivity large firms encompasses complex debates and structural relationships that go beyond merely "replacing" low-productivity firms with high-productivity ones through a process of "selection." Syverson (2004; 2011) offers a comprehensive overview of the literature concerning the factors that influence enterprise productivity. Beyond structural transformation, recent studies have also drawn attention to productivity heterogeneity within sectors, particularly among firms of different sizes and technological capabilities (Dix-Carneiro, Goldberg, and Ulyssea, 2025; Ulyssea, 2018).

Nogueira and Zucoloto (2019) highlight two possible pathways for increasing aggregate productivity in the Brazilian economy. The first involves structural change through the expansion of higher-productivity sectors. The second emphasizes productivity gains within sectors, achieved through improvements in the productive and organizational capabilities of firms operating at lower productivity levels. This latter perspective underscores the potential role of policies aimed at upgrading the performance of micro and small enterprises[3]. The first would require a significant increase in the output of the most productive firms, which would absorb workers from lower-productivity firms. For it to happen, these companies would need to expand their sales significantly, which in turn would depend on increased demand for their products either domestically or internationally.

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[2] Recent contributions within the structuralist and new developmentalist literature have reinforced this view by highlighting the importance of technological capabilities, employment structure, and the quality of jobs in shaping productivity dynamics and income convergence (Bresser-Pereira, Oreiro, and Marconi, 2021; Gala *et al.*, 2017; Oreiro *et al.*, 2022).

[3] Along the same lines, but for the case of other countries, we can cite the work of Ngo *et al.* (2020), Ngo and Tran (2020) and Kreuser and Newman (2018).

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However, for domestic sales to grow, aggregate demand must increase, which depends on higher purchasing power among the population. The very low productivity of most jobs in the country, however, prevents this from happening, creating a vicious cycle that cannot be broken from the supply side. Regarding the foreign market, these companies are generally already operating at the limit of their capacity to compete globally, with little room for expanding their market share, at least in the medium term.

The sectoral trajectory, which involves an effective increase in firm-level productivity, also rests on two possible mechanisms. Productivity growth in less dynamic firms can occur either through the denominator effect (a reduction in the number of employees without a proportional decrease in value added) or the numerator effect (an increase in value added without a corresponding increase in employment). The first scenario, once again, would lead to mass unemployment.

This leaves only the final hypothesis: improving the technical content of jobs in low-productivity firms —namely, micro and small enterprises. In other words, for this path to materialize, investment must be encouraged to enhance the production and organizational processes of Brazilian MSEs. This would enable them to adopt more modern and efficient capital goods, as well as business services to improve their organizational processes.

3. INDUSTRIAL POLICY AND THE ECONOMIC CONTEXT OF BRAZIL

Although there is growing agreement on the purposes of IP —aimed at accelerating the growth of sectors with greater potential to spread growth and/or generate externalities, especially those associated with technological innovation— there is still a broad consensus on the challenges inherent in their implementation. While neoclassical economists recognize that, ideally, IP can have merit, they point out that the choice of sectors is problematic, and that negative effects such as increased rent-seeking and intervention failures can outweigh their benefits. In contrast, developmentalists argue that, despite the challenges, successful IPs have the potential to fundamentally change a country's position in the international division of labor, taking it to higher levels of productivity and prosperity.

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Performance in foreign trade is particularly highlighted —as an indicator and also as an important mechanism in an industrial policy. It is considered that there is importance not only in the *quantum* exported, but mainly in the structure of exports (Rodrik, 2004; Rodrik, 2010; Chang, 2006; Ocampo, Rada, and Taylor, 2009; Thirlwall, 1979; Cimoli, 2005). For this school of thought, structural transformation is related to the shift in exports towards sectors with higher technological content and/or higher income elasticity.

Heterodox literature highlights the importance of fostering structural change in the economy, especially in manufacturing production, emphasizing gains in scale and scope, sectoral spillovers and the relationship with technological innovation as key elements (Kaldor, 1957; Pavitt, 1984). Kaldor's emphasis on external demand (exports) as a crucial demand factor for increasing domestic productivity and the balance of payments constraint highlighted in Thirlwall (1979) represent solid sources of support for seeking structural change.

Despite the broad adoption of IP by many developing countries throughout the 20th century, success stories are relatively rare, most notably the "Asian miracle" (Cherif and Hasanov, 2019; Lane, 2022). However, recent macroeconomic trends have renewed political interest in IP, highlighting the importance of evaluating results to measure the success or failure of national strategies.

During the years of the Workers' Party government (2003-2016), Brazil implemented at least three important initiatives aimed at the industrial sector. The first was the Industrial, Technological and Foreign Trade Policy (*Política Industrial, Tecnológica e de Comércio Exterior*, PITCE) in 2004, followed by the Productive Development Policy (*Política de Desenvolvimento Produtivo*, PDP) in 2008, and the *Plano Brasil Maior* (PBM) in 2011. More recently, in 2024, the "New Industry Brazil" (*Nova Indústria Brasil*, NIB) was launched

PITCE aimed to improve economic efficiency, stimulate cutting-edge technologies, and strengthen export competitiveness. Its objective included improving the productive structure, stimulating business innovation, and expanding exports to strengthen Brazil's international presence. Furthermore, this policy was an integral part of a broader national development strategy and was not an isolated action. The priority areas considered by the federal government when implementing PITCE in-

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cluded innovation and technological development, external integration, industrial modernization, increasing production capacity, and strategic choices. These strategic choices covered sectors such as semiconductors, software, capital goods, and pharmaceuticals (BRASIL, 2003).

In 2008, the PDP was launched with a broader approach than the PITCE, aiming to revitalize the Brazilian economy with a focus on industry (DIEESE, 2008).

The strategy involved tax benefits of R$ 21.4 billion (≈ US$ 11.76 Billion[4]) until 2011, as well as significant financing of R$ 210.4 billion (≈ US$ 115.60 Billion) from the BNDES for expansion, modernization, and innovation projects in industry and the service sector. The PDP also prioritized 25 sectors, expanding from PITCE's 4, and was complemented by Finep's R&D programs (IEDI, 2008). Its objectives included promoting sustainable economic growth, encouraging productive investment, stimulating business innovation, and strengthening MSEs.

Between 2011 and 2014, the PBM was implemented with the slogan "innovate to compete; compete to grow", with an emphasis on technological innovation and strengthening national production. Strategic guidelines were established, including technological development, the strengthening of national skills, and the expansion of domestic and foreign markets for Brazilian companies, while also aiming to promote a socially inclusive and environmentally sustainable environment. However, the PBM received criticism for its horizontal approach, which was more comprehensive and improvised in its formulation, and for favoring less innovative companies, without a clear strategic selection of sectors (Machado, 2019).

The most recent industrial policy is the "New Industry Brazil" (NIB) launched in 2024. The program employs conventional government policy tools, such as subsidies, loans at lower interest rates, and increased government investment. It also uses tax incentives and specific resources to boost certain economic sectors. Based on the concept of missions for development, created by Mazzucato (2021), the NIB put into the plan a set of missions or strategic sectors to which resources should be allocat-

[4] Based on the average exchange rate of 1.82 RS/US$ for the years 2008-2012, according to data from IPEADATA.

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ed. From 2023 to 2026, the expectation is that R$ 300 billion (≈ US$ 60 Billion[5]) will be earmarked for the following sectors: *i)* sustainable and digital agro-industrial chains for food, nutritional, and energy security; *ii)* resilient health industrial economic complex to reduce vulnerabilities and expand access to health; *iii)* sustainable infrastructure, sanitation, housing and mobility for productive integration and well-being in cities; *iv)* digital transformation of industry to increase productivity; *v)* bioeconomy, decarbonization and energy transition and security to guarantee resources for future generations; *vi)* technologies of interest to national sovereignty and defence (BRASIL, 2024).

Stumm, Nunes, and Perissinotto (2019) examine the period 2004-2011 and point out that the central objective was to promote a dynamic interaction between investment and consumption, with the aim of integrating the population into the consumer market and revitalizing the productive sector through technology, infrastructure and easier access to credit. However, the authors point out that the results of industrial policies have fallen short of initial expectations, showing a discrepancy between costs and benefits. Initially, the policies were broad and not focused on specific sectors, but later there was a transition to prioritizing strategic and high-tech sectors — vertical policies. However, the authors identify inconsistencies in the industrial policy of the respective period, such as the lack of clarity in the priority sectors and the tendency to favor sectors that are already internationally competitive to the detriment of those with long-term innovation potential — the so-called national champions for the domestic media. Three main factors are indicated by the authors as responsible for the failure of these policies: the lack of political support to implement the proposals, the difference between what was planned and what was executed, and the lack of an effective organizational structure.

Machado (2019) analyzes the implementation of industrial policies from the perspective of the economic complexity approach (Hausmann and Hidalgo, 2011) and argues that, by considering the disbursements approved by the BNDES as an indicator of sectoral incentives, there would be a reduction in Brazil's economic complexity, without a clear

[5] Based on the exchange rate of 5.0 RS/US$ for the year 2023, according to data from IPEADATA.

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characterization of industrial policies in search of diversification of the productive structure. The author suggests that there was continuity between the first two industrial policies of the Lula government (PITCE and PDP), with a focus on promoting research and innovation activities. However, the financial crisis affected the implementation and priorities of the PDP, directing attention to anti-cyclical policies to deal with the adverse effects, although these were not aligned with the objectives of industrial policy. In addition, political influence led to the inclusion of a wide range of sectors, resulting in the dispersion of the priority focus.

Ottaviano and Lage de Sousa (2014) show that, in emerging economies, credit constraints represent one of the main obstacles to increases in industrial productivity. The article analyzes BNDES loans and shows that these constraints are real, especially for firms that repeatedly resort to the bank. The authors' results indicate that BNDES support helped such firms reach performance levels similar to those of firms without credit constraints.

There are other studies that have investigated the relationship between BNDES financing and productivity, such as Coelho and Negri (2011), who estimated the impacts of BNDES credit on firm productivity using a quantile treatment effect approach; Calice, Ribeiro, and Byskov (2018), who linked access to BNDES financing to reductions in misallocation and productivity gains at the firm level; Morais, De Negri, and Mattos (2022), providing aggregate and sectoral evidence for employment and productivity; Corseuil et al. (2023), on the BNDES Card and productivity mechanisms via scale and firm survival; and Orsolin and Nogueira (2025), in a more structural approach, relating BNDES financing to export productivity in Brazil's micro-regions.

The present study seeks to highlight the importance of industrial policy, through BNDES resources, as a driver of development and productivity growth. However, its purpose is to delve into the intrasectoral heterogeneity of the Brazilian economy, a topic that has received little empirical attention. In other words, the paper engages with the already consolidated debate on the importance of industrial policy and BNDES financing, while raising additional questions regarding the efficiency, effectiveness, and purpose of the promotion and allocation of these resources.

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4. METHODOLOGY

This section explains the methodology used in this study, including the source and database, the panel data model, the model specification and the variables used.

4.1. Source and database

To estimate the relationship between BNDES financing and labor productivity across sectors of the Brazilian economy, considering the size of firms within each sector, it was necessary to use a broad range of databases.

Labor productivity data were constructed using a special tabulation from the Structural Enterprise Surveys provided by IBGE (Instituto Brasileiro de Geografia e Estatistica). This tabulation provided data for the period from 2009 to 2020, grouped by economic activities within the manufacturing sector[6], including the number of firms, occupied personnel, and added value. These data were further stratified by company size according to the parameters established annually by the General Law of Micro and Small Enterprises (Complementary Law No. 123/2006). For instance, in 2020, the following criteria were applied (Brazil, 2006):

- Annual revenue up to R$ 81,000.
- Microenterprise – Annual revenues greater than R$ 81,000 and up to R$ 360,000.
- Small enterprise – Annual revenues greater than R$ 360,000 and up to R$ 4.80 million.
- Medium enterprise – Annual revenues greater than R$ 4.80 million and up to R$ 78.0 million.
- Large enterprise – Annual revenues greater than R$ 78.0 million.

It is important to note that despite considerable internal heterogeneity, each of these firm groups tends to exhibit characteristic business behav-

[6] The activities were classified by Activity Group (3 digits) of the National Classification of Economic Activities (Cnae 2.0). The study considered 96 activities (from Cnae 10.1 to 32.9). Some of the industrial activities, for reasons of confidentiality, were not included in the special tabulation.

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iors. Therefore, it is somewhat feasible to generalize specific management practices, capital intensity, and technological content of productive processes for each firm size. Consequently, it is expected that investment credits produce distinct outcomes across firm size categories.

Labor productivity —the study's main variable of interest— was computed for each firm size within each activity by dividing the respective added values by the number of occupied personnel, with values adjusted to constant 2020 prices using the Broad Consumer Price Index (*Índice Nacional de Preços ao Consumidor Amplo*, IPCA).

Data on BNDES financing were collected from the institution's online platform, encompassing credit values granted to firms and interest rates applied. Financing amounts were also adjusted for inflation to constant 2020 prices using the IPCA. These data were similarly grouped by economic activity and stratified by firm size following criteria defined by the bank:

- Individual Microentrepreneur – Annual gross operational revenues up to R$ 81,000.
- Microenterprise – Annual gross operational revenues up to R$ 360,000.
- Small enterprise – Annual gross operational revenues greater than R$ 360,000 and up to R$ 4.80 million.
- Medium enterprise – Annual gross operational revenues greater than R$ 4.80 million and up to R$ 300 million.
- Large enterprise – Annual gross operational revenues greater than R$ 300 million.

For determining interest rates, average interest values were calculated for each treatment unit. The credit amount granted represented the independent variable in this study, while the average interest rate served as one of the control variables.

It should be highlighted that although BNDES classifies firms by size using criteria closely resembling those of the General Law for MSEs, there is a discrepancy regarding the minimum revenue threshold for classifying large enterprises. While this threshold is R$ 78 million under the General Law, it is R$ 300 million according to BNDES criteria. Despite this disparity, the universe of large enterprises is relatively small. For example, in 2020, according to IBGE's special tabulation, the

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manufacturing sector included 4,355 large firms out of a total of 268,353 firms, with medium-sized enterprises numbering 20,107. Therefore, this classification difference is unlikely to significantly affect the number of enterprises considered medium-sized. Additionally, from a management or business behavior perspective, firms with revenues between R$ 78 million and R$ 300 million exhibit similarities to those exceeding R$ 300 million. Thus, it is believed that this classification discrepancy has minimal impact on the estimators calculated in this study.

Export data were obtained from the Comex Stat platform, classified by economic activity (CNAE, *Classificação Nacional de Atividades Econômicas*) but not by firm size due to unavailability. The variable used was the total exported value for each CNAE activity, deflated to 2020 prices using the U.S. Consumer Price Index. This variable served as a control in all estimated models.

Data from the Annual Social Information Report (RAIS) were extracted, including technical occupation percentages relative to total employment (PoTec[7]), average employee age, and average remuneration measured in minimum wages for each economic activity. These variables also functioned as controls within the models.

4.2. Panel data model

GMM estimation, developed by Holtz-Eakin, Newey, and Rosen (1988), and later by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998) is widely used in empirical studies when the variables are not strictly exogenous. According to Cameron and Trivedi (2005 p. 743), it is easier to obtain instruments for panel data than for cross-sectional data, as long as the regressors from previous periods can be used as instruments for the endogenous regressors of the current period, which increases the efficiency of the estimates in cases of partially exogenous variables. Roodman (2009) recommends the use of dynamic panel estimators when: *i)* the variables are correlated with

[7] Occupations considered as PoTec are those that, according to the Brazilian Classification of Occupations (CBO 02), receive the codes 203 (Researchers); 202, 214 and 222 (Engineers); 1,237 and 1,426 (R&D Directors and Managers); and 201, 211, 212, 213 and 221 ("Scientific" Professionals).

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their previous values and with present errors; *ii)* the dependent variable has a time trend based on previous periods; *iii)* there are many individuals in the panel, and there is heteroscedasticity and autocorrelation within individuals, but not between them. The specification tests in this study showed several of these characteristics, justifying the use of dynamic panels to correct bias in the estimates.

Roodman (2009) introduced the *xtabond2* command, which facilitates two-stage estimation with Windmeijer's (2005) correction for robust standard errors. It is important to highlight some essential points when estimating the GMM system, especially concerning second-order autocorrelation and the instruments used in the model. Second-order autocorrelation is assessed by the Arellano-Bond AR (2) test. The null hypothesis of this test indicates the absence of second-order autocorrelation. Thus, the p-value of the test is expected to be > 0.05 —which would lead to a non-rejection of the null hypothesis that there is no second-order autocorrelation. The Hansen test is used to assess the validity of the instruments. The null hypothesis of the Hansen test indicates that the instruments are exogenous. Likewise, a p-value > 0.05 is expected, leading to a non-rejection of the null hypothesis that the instruments are exogenous. Furthermore, Roodman (2009) recommends that the number of instruments should not exceed the number of individuals in the panel.

4.3. Model specification and variables

The first-order dynamic model, expressed in the following equation, describes the specification of the estimates in this paper:

$$\ln lpMicro_{it} = \Phi \ln lp_Micro_{it-1} + \beta_1 \ln Bndes_Micro_{it} + \beta_2 \ln Interest_Micro_{it} + \gamma \ln X'_{it} + \mu_t + \alpha_i + e_{it}$$

$$\ln lp_Small_{it} = \Phi \ln lp_Small_{it-1} + \beta_1 \ln Bndes_Small_{it} + \beta_2 \ln Interest_Small_{it} + \gamma \ln X'_{it} + \mu_t + \alpha_i + e_{it}$$

$$\ln lp_Medium_{it} = \Phi \ln lp_Medium_{it-1} + \beta_1 \ln Bndes_Medium_{it} + \beta_2 \ln Interest_Medium_{it} + \gamma \ln X'_{it} + \mu_t + \alpha_i + e_{it}$$

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$$\ln lp_Large_{it} = \Phi \ln lp_Large_{it-1} + \beta_1 \ln Bndes_Large_{it} + \beta_2 \ln Interest_Large_{it} + \gamma \ln X'_{it} + \mu_t + \alpha_i + e_{it}$$

$$\ln lp_Total_{it} = \Phi \ln lp_Total_{it-1} + \beta_1 \ln Bndes_Total_{it} + \beta_2 \ln Interest_Total_{it} + \gamma \ln X'_{it} + \mu_t + \alpha_i + e_{it}$$

Where *t* represents time (2009-2020) and *i* represents the CNAE of the manufacturing industry. The dependent variable changes between the equations, being the labor productivity (*lp*) of microenterprises, small, medium and large companies. Finally, we have the labor productivity for the entire manufacturing industry without considering the size of the companies.

As explanatory variables, we have a set of control variables and those of main interest, which are the resources from BNDES and the average interest charged to the companies that received these resources. The resources from BNDES and the average interest rate charged are divided by company size: micro, small, medium, and large. The control variables (X') are the same for the different estimated models: exports, staff employed in technical activities (Potec), average remuneration in minimum wages and the average age of workers. α_{it} and μ_{it} represents the individual and time-fixed effects, and e_{it} represents the error term of the model.

5. RESULTS

Tables 1-5 show the results of this study. The main purpose of the models was to verify the relationship between BNDES resources and labor productivity in the sectors of the Brazilian economy. To find out more about this relationship, the tests were carried out considering the different company sizes (micro-enterprises, small, medium and large companies and the total). Time dummies and a set of control variables were used in the estimations[8].

Variables that may be endogenous are lagged in time and transformed into differences to be used as a "substitute" (instrument) for their origi-

[8] For more details on the variables used, see the methodology section.

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nal values. This procedure is used to avoid the problem of endogeneity, which occurs when an explanatory variable is influenced by what is being explained. In this case, BNDES funds may not be the direct cause of the increase in labor productivity, but rather a consequence of it. This is because the BNDES has specific criteria for granting credit, and it is expected that more productive companies will be able to meet these criteria more easily. If this possible endogeneity relationship is not considered, the analysis could generate uncertainty about the direction of causality: whether BNDES resources increase productivity or the more productive companies manage to attract more BNDES resources.

The results obtained from traditional estimates, such as the Ordinary Least Squares (OLS) and Fixed Effects (FE) models, indicate that the funds made available by the BNDES have a positive and significant impact on the productivity of companies of all sizes. This finding suggests that, in a more simplified analysis, BNDES funding seems to benefit both micro-enterprises and large corporations.

However, to guarantee the results' robustness and avoid criticism related to the endogeneity of the data, a more advanced model was adopted, the two-step system GMM. This model is specially designed to deal with the possibility that productivity may influence the receipt of funds from the BNDES, a concern that is crucial when analyzing the relationships between the variables in question.

When applying the System GMM model, the results showed that only micro and small companies had significant coefficients. This evidence suggests that, when controlling adequately for endogeneity, the positive impact of BNDES funding on productivity is restricted to these specific market segments. In contrast, for large companies, the data suggests that receiving BNDES funds has little to no impact on productivity. This implies that although these companies may be productive, this productivity is not necessarily attributable to BNDES financing, suggesting that large corporations may have other sources of efficiency that are not related to access to BNDES credit.

Thus, the use of the System GMM model is a distinguishing feature of this study, as it allows for a more precise and rigorous analysis of the effects of financing on productivity, especially when considering the complexity of the interactions between the variables. This methodological approach should be emphasized when presenting the results to the

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public, as it provides a solid basis for the conclusions drawn. In short, the rigorous analysis reveals that the impact of the BNDES on productivity is significant only for micro and small companies, while for large companies, the effect is marginal, which has relevant implications for understanding the effectiveness of BNDES financing and its consequences for different sizes of companies.

Table 1. Model results for the dependent variable: labor productivity for micro-enterprises

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*
L. lnLP_micro			0.672***	0.434**	0.179	0.179	0.176
			(0.136)	(0.204)	(0.146)	(0.147)	(0.146)
lnBndes_micro	0.251***	0.195***	0.0413	0.0650	0.466*	0.465*	0.468*
	(0.0285)	(0.0279)	(0.0458)	(0.114)	(0.240)	(0.241)	(0.241)
L. lnBndes_micro			0.120***	–0.0174	–0.0254	–0.0255	–0.0254
			(0.0444)	(0.0413)	(0.0336)	(0.0336)	(0.0336)
lnExp	–0.167***	–0.146**		–0.0699	–0.167**	–0.167**	–0.167**
	(0.0422)	(0.0666)		(0.0614)	(0.0734)	(0.0734)	(0.0719)
2010				–0.453	0.722	0.721	–2.220*
				(0.736)	(0.607)	(0.610)	(1.195)
2011				–0.166	1.237*	1.234*	–1.706
				(0.786)	(0.697)	(0.699)	(1.105)
2012				–0.00780			–2.957*
				(0.970)			(1.743)
2013				–0.179	–0.158	–0.153	–3.109*
				(0.765)	(0.211)	(0.212)	(1.863)
2014				–0.371	0.924	0.922	–2.025*
				(0.802)	(0.619)	(0.622)	(1.163)
2015				0.0189	2.538*	2.530*	–0.404
				(0.581)	(1.450)	(1.457)	(0.372)
2016				–0.633	2.252	2.245	–0.683*
				(0.518)	(1.577)	(1.582)	(0.384)

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Table 1. Model results for the dependent variable: labor productivity for micro-enterprises (concluded)

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*	*lnlp_micro*
2017				−0.172	2.810	2.798	−0.131
				(0.505)	(1.798)	(1.805)	(0.234)
2018					2.942*	2.931*	
					(1.736)	(1.743)	
2019				−2.863***	−0.181	−0.192	−3.123***
				(0.307)	(1.536)	(1.542)	(0.335)
2020				−1.993***	0.400	0.389	−2.545***
				(0.698)	(1.658)	(1.672)	(0.538)
Potec	−12.01***	−18.57***			−8.193	−8.154	−8.812
	(2.647)	(4.005)			(9.328)	(9.232)	(9.180)
lnInterest_micro	−0.279	−0.423**			−2.249*	−2.239*	−2.258*
	(0.203)	(0.189)			(1.323)	(1.329)	(1.331)
lnRemuneration_mw	0.0798	0.101				−0.0437	0.0136
	(0.166)	(0.271)				(0.214)	(0.207)
lnAge_of_workers	−1.246	−1.251					−1.249
	(0.808)	(1.318)					(1.036)
Constant	14.02***	14.62***	0.640	6.392**	7.759***	7.760***	15.11***
	(3.002)	(4.875)	(1.106)	(2.766)	(2.508)	(2.543)	(4.609)
Observation	1,152	1,152	1,056	1,056	1,056	1,056	1,056
R2	0.213						
Number of individuals		96	96	96	96	96	96
AR (2)		0.118	0.151	0.151	0.350	0.350	0.354
Hansen Test		0.000	0.446	0.446	0.254	0.251	0.253
Lag of instruments		2	2	2	2	2	2

Note 1: standard errors in brackets. *** p < 0.01, ** p < 0.05, * p < 0.1.

Note 2: the correction for standard errors proposed by Windmeijer (2005) was used.

Source: own elaboration.

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Table 2. Model results for the dependent variable: labor productivity for small companies

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnpt_pequena*	*lnpt_pequena*	*lnpt_pequena*	*lnpt_pequena*	*lnpt_pequena*	*lnpt_pequena*	*lnpt_pequena*
L. lnLP_Small			0.374***	–0.536***	–0.482***	–0.481***	–0.481***
			(0.131)	(0.161)	(0.149)	(0.147)	(0.149)
lnBndes_Small	0.177***	0.145***	0.219***	0.202**	0.305	0.301	0.301
	(0.0186)	(0.0176)	(0.0688)	(0.0831)	(0.379)	(0.382)	(0.377)
L. lnBndes_Small			0.0141	–0.0219	–0.00130	–0.00150	–0.000643
			(0.0539)	(0.0301)	(0.0431)	(0.0432)	(0.0445)
lnExp	–0.154***	–0.0519		–0.137**	–0.152*	–0.164**	–0.163*
	(0.0268)	(0.0537)		(0.0690)	(0.0813)	(0.0824)	(0.0835)
2010				–0.328**	–0.946	–0.927	–0.926
				(0.162)	(1.698)	(1.705)	(1.674)
2011				–0.231*	–0.685	–0.667	–0.671
				(0.134)	(1.392)	(1.400)	(1.354)
2012				–0.364*	–1.424	–1.396	–1.397
				(0.201)	(2.462)	(2.472)	(2.416)
2013				–0.189	–1.439	–1.412	–1.414
				(0.186)	(2.619)	(2.630)	(2.573)
2014				0.0157	–0.701	–0.683	–0.687
				(0.123)	(1.639)	(1.648)	(1.594)
2015					–0.105	–0.102	–0.107
					(0.320)	(0.325)	(0.302)
2016				0.257	0.00110	0.000178	–0.000312
				(0.192)	(0.267)	(0.266)	(0.263)
2017				–0.162			
				(0.123)			
2018				0.101	–0.00974	–0.00454	–0.00373
				(0.135)	(0.351)	(0.350)	(0.346)

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Table 2. Model results for the dependent variable: labor productivity for small companies (concluded)

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnpt_ pequena*	*lnpt_ pequena*	*lnpt_ pequena*	*lnpt_ pequena*	*lnpt_ pequena*	*lnpt_ pequena*	*lnpt_ pequena*
2019				–2.381***	–2.663***	–2.661***	–2.658***
				(0.155)	(0.615)	(0.607)	(0.613)
2020				–4.044***	–3.937***	–3.936***	–3.935***
				(0.459)	(0.397)	(0.395)	(0.395)
Potec	5.036***	–2.191			4.798	5.145	4.888
	(1.647)	(3.124)			(8.491)	(7.850)	(8.925)
lnInterest_small	–0.194	–0.422***			–1.205	–1.190	–1.183
	(0.139)	(0.117)			(2.260)	(2.261)	(2.261)
lnRemuneration_mw	–0.134	–0.102				–0.392	–0.372
	(0.105)	(0.231)				(0.291)	(0.332)
lnAge_of_workers	–0.288	–0.339					–0.468
	(0.512)	(1.124)					(1.890)
Constant	12.14***	11.18***	3.210**	16.85***	17.25***	17.47***	19.08**
	(1.902)	(4.133)	(1.262)	(1.874)	(1.826)	(1.880)	(7.482)
Observation	1,152	1,152	1,056	1,056	1,056	1,056	1,056
R2	0.171						
Number of individuals		96	96	96	96	96	96
AR (2)			0.041	0.413	0.628	0.632	0.635
Hansen Test			0.000	0.383	0.097	0.097	0.094
Lag of instruments		2	2	2	2	2	2

Note 1: standard errors in brackets. *** p < 0.01, ** p < 0.05, * p < 0.1.

Note 2: the correction for standard errors proposed by Windmeijer (2005) was used.

Source: own elaboration.

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Table 3. Model results for the dependent variable: labor productivity for medium-sized companies

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnlp_media*	*lnlp_media*	*lnlp_media*	*lnlp_media*	*lnlp_media*	*lnlp_media*	*lnlp_media*
L. lnLP_Medium			0.634***	0.441*	0.478***	0.479***	0.476***
			(0.116)	(0.234)	(0.165)	(0.166)	(0.166)
lnBndes_Medium	0.307***	0.159***	0.286***	–0.0406	–0.111	–0.109	–0.110
	(0.0310)	(0.0284)	(0.0984)	(0.0958)	(0.266)	(0.275)	(0.280)
L. lnBndes_Medium			–0.0411	–0.00915	–0.0151	–0.0153	–0.0152
			(0.0490)	(0.0268)	(0.0410)	(0.0405)	(0.0408)
lnExp	0.0942**	0.197**		0.0601	0.0505	0.0485	0.0479
	(0.0416)	(0.0862)		(0.0624)	(0.0660)	(0.0707)	(0.0697)
2010				–0.0762	0.0890	–0.485	0.0977
				(0.301)	(0.401)	(0.798)	(0.408)
2011				–0.0100	0.0164	–0.561	0.0231
				(0.141)	(0.299)	(1.382)	(0.273)
2012					0.584		0.586
					(1.101)		(1.176)
2013				–0.148	0.540	–0.0469	0.534
				(0.121)	(1.203)	(0.152)	(1.278)
2014				–0.116	0.146	–0.432	0.144
				(0.142)	(0.294)	(0.895)	(0.303)
2015				–0.110	–0.475	–1.042	–0.474
				(0.373)	(1.131)	(2.287)	(1.182)
2016				–0.319	–0.357	–0.931	–0.351
				(0.361)	(0.404)	(1.527)	(0.417)
2017				–0.112	–0.183	–0.756	–0.179
				(0.326)	(0.472)	(1.596)	(0.480)
2018				–0.129		–0.575	
				(0.172)		(1.147)	

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Table 3. Model results for the dependent variable: labor productivity for medium-sized companies (concluded)

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnlp_media*	*lnlp_media*	*lnlp_media*	*lnlp_media*	*lnlp_media*	*lnlp_media*	*lnlp_media*
2019				−2.604***	−2.445***	−3.024**	−2.442***
				(0.321)	(0.266)	(1.342)	(0.244)
2020				−1.481**	−1.477*	−2.044	−1.487*
				(0.669)	(0.808)	(1.920)	(0.848)
Potec	9.795***	−2.299			1.698	1.884	2.412
	(2.494)	(4.905)			(2.586)	(2.614)	(2.810)
lnInterest_medium	−0.772***	−0.604***			1.197	1.178	1.188
	(0.268)	(0.213)			(2.289)	(2.365)	(2.410)
lnRemuneration_mw	0.0332	0.162				−0.0803	−0.121
	(0.162)	(0.379)				(0.258)	(0.255)
lnAge_of_workers	0.0884	−0.0317					0.911
	(0.785)	(1.843)					(1.660)
Constant	4.304	4.788	0.0574	5.838*	4.679***	5.274**	1.526
	(2.909)	(6.759)	(1.847)	(3.514)	(1.718)	(2.332)	(5.257)
Observation	1,152	1,152	1,056	1,056	1,056	1,056	1,056
R2	0.158						
Number of individuals		96	96	96	96	96	96
AR (2)			0.381	0.365	0.406	0.406	0.409
Hansen Test			0.000	0.489	0.312	0.305	0.318
Lag of instruments			2	2	2	2	2

Note 1: standard errors in brackets. *** p < 0.01, ** p < 0.05, * p < 0.1.

Note 2: the correction for standard errors proposed by Windmeijer (2005) was used.

Source: own elaboration.

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Table 4. Model results for the dependent variable: labor productivity for large companies

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*
L. lnLP_Large			0.319**	0.293	0.220	0.215	0.216
			(0.154)	(0.285)	(0.177)	(0.176)	(0.175)
lnBndes_Large	0.229***	0.0796**	0.131*	0.0470	0.345	0.340	0.344
	(0.0390)	(0.0337)	(0.0681)	(0.0938)	(0.254)	(0.252)	(0.256)
L. lnBndes_Large			0.0436	–0.00612	–0.0384	–0.0379	–0.0356
			(0.0566)	(0.0438)	(0.0310)	(0.0310)	(0.0315)
lnExp	0.330***	0.481***		0.253	0.167	0.174	0.168
	(0.0597)	(0.115)		(0.165)	(0.186)	(0.187)	(0.187)
2010				–0.126	0.441	0.442	–0.759
				(0.364)	(0.592)	(0.593)	(0.604)
2011				0.0498	1.005	0.978	–0.227
				(0.578)	(1.101)	(1.096)	(0.546)
2012							–1.210
							(1.071)
2013				–0.212	–0.468	–0.446	–1.652
				(0.654)	(0.686)	(0.678)	(1.569)
2014				0.0189	0.839	0.838	–0.365
				(0.488)	(0.808)	(0.805)	(0.571)
2015				0.220	2.071	2.028	0.840
				(0.403)	(1.840)	(1.831)	(1.033)
2016				–0.140	0.856	0.840	–0.348
				(0.570)	(1.054)	(1.049)	(0.493)
2017				0.123	0.933	0.928	–0.272
				(0.554)	(0.945)	(0.938)	(0.464)
2018				–0.0290	1.206	1.174	
				(0.695)	(1.064)	(1.065)	

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Table 4. Model results for the dependent variable: labor productivity for large companies (concluded)

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*	*lnlp_grande*
2019				–1.977***	–0.949	–0.958	–2.130***
				(0.670)	(1.069)	(1.073)	(0.500)
2020				–1.301	–0.268	–0.304	–1.464***
				(0.845)	(1.249)	(1.251)	(0.545)
Potec	9.439***	5.294			0.575	0.152	0.809
	(3.370)	(6.499)			(10.24)	(10.26)	(10.37)
lnInterest_large	–0.222	–0.0390			–2.126	–2.083	–2.098
	(0.373)	(0.302)			(2.195)	(2.183)	(2.214)
lnRemuneration_mw	0.439**	0.564				0.334	0.260
	(0.224)	(0.495)				(0.499)	(0.513)
lnAge_of_workers	–0.667	–1.112					1.605
	(1.086)	(2.406)					(1.992)
Constant	2.305	2.669	4.243***	1.769	2.731	2.677	–1.705
	(4.025)	(8.831)	(1.173)	(3.622)	(3.941)	(3.938)	(7.119)
Observation	1,152	1,152	1,056	1,056	1,056	1,056	1,056
R2	0.165						
Number of individuals		96	96	96	96	96	96
AR (2)			0.793	0.923	0.851	0.841	0.843
Hansen Test			0.009	0.134	0.258	0.264	0.254
Lag of instruments			2	2	2	2	2

Note 1: standard errors in brackets. *** p < 0.01, ** p < 0.05, * p < 0.1.

Note 2: the correction for standard errors proposed by Windmeijer (2005) was used.

Source: own elaboration.

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Table 5. Model results for the dependent variable: total labor productivity

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnlp_total*	*lnlp_total*	*lnlp_total*	*lnlp_total*	*lnlp_total*	*lnlp_total*	*lnlp_total*
L. lnlp_total			0.473***	0.424	0.439**	0.448**	0.441**
			(0.122)	(0.282)	(0.217)	(0.212)	(0.212)
lnBndes_total	0.0459***	0.0504***	0.189***	–0.00899*	–0.00340	–0.00380	–0.00382
	(0.00497)	(0.00482)	(0.0310)	(0.00528)	(0.00600)	(0.00597)	(0.00581)
L. lnBndes_total			0.0203	0.00272	0.000729	0.000334	0.000338
			(0.0417)	(0.00629)	(0.00464)	(0.00454)	(0.00443)
lnExp	0.0748***	0.110***		0.0386*	0.0383*	0.0370*	0.0373*
	(0.0140)	(0.0228)		(0.0199)	(0.0211)	(0.0201)	(0.0206)
2010				0.0809*	0.0425	0.0671**	0.0443
				(0.0414)	(0.0366)	(0.0326)	(0.0350)
2011				–0.00531	–0.0237		–0.0223
				(0.0202)	(0.0288)		(0.0288)
2012				0.00702	–0.00736	0.0162	–0.00611
				(0.0263)	(0.0254)	(0.0250)	(0.0260)
2013				0.0629**	0.0276	0.0511**	0.0293
				(0.0265)	(0.0240)	(0.0214)	(0.0236)
2014					–0.0185	0.00526	–0.0167
					(0.0272)	(0.0193)	(0.0272)
2015				0.0422	0.00477	0.0285	0.00711
				(0.0284)	(0.0317)	(0.0315)	(0.0309)
2016				–0.0507**	–0.0812***	–0.0580***	–0.0801***
				(0.0199)	(0.0256)	(0.0210)	(0.0255)
2017				0.00783	–0.0292	–0.00644	–0.0285
				(0.0307)	(0.0238)	(0.0290)	(0.0234)
2018				0.0263		0.0219	
				(0.0278)		(0.0288)	

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Table 5. Model results for the dependent variable: total labor productivity (concluded)

	(OLS)	(FE)	(GMM)	(GMM)	(GMM)	(GMM)	(GMM)
Variables	*lnlp_total*	*lnlp_total*	*lnlp_total*	*lnlp_total*	*lnlp_total*	*lnlp_total*	*lnlp_total*
2019				−2.472***	−2.493***	−2.473***	−2.494***
				(0.0332)	(0.0293)	(0.0361)	(0.0289)
2020				−1.380**	−1.349**	−1.307**	−1.346***
				(0.687)	(0.518)	(0.506)	(0.507)
Potec	10.21***	7.441***			4.810**	4.803**	4.767**
	(0.845)	(1.345)			(2.215)	(2.176)	(2.149)
lnInterest	−0.134**	−0.104*			−0.0259	−0.0251	−0.0245
	(0.0633)	(0.0625)			(0.0199)	(0.0193)	(0.0195)
lnRemuneration_mw	−0.106*	−0.0807				−0.0388	−0.0293
	(0.0555)	(0.0936)				(0.0612)	(0.0642)
lnAge_of_workers	−0.0427	−0.0923					−0.183
	(0.271)	(0.456)					(0.247)
Constant	9.144***	8.551***	2.714**	6.001**	5.717***	5.619***	6.361**
	(1.004)	(1.682)	(1.058)	(2.981)	(2.160)	(2.119)	(2.423)
Observation	1,152	1,152	1,056	1,056	1,056	1,056	1,056
R2	0.215						
Number of individuals		96	96	96	96	96	96
AR (2)			0.531	0.267	0.068	0.067	0.068
Hansen Test			0.000	0.700	0.442	0.437	0.433
Lag of instruments			3	3	3	3	3

Note 1: standard errors in brackets. *** p < 0.01, ** p < 0.05, * p < 0.1.

Note 2: the correction for standard errors proposed by Windmeijer (2005) was used.

Source: own elaboration.

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An assessment of the effects of BNDES credit programs on Brazilian manufacturing firms that does not account for the distinctive characteristics of different firm-size categories can lead to misleading conclusions. Table 5, which presents results for the full sample of firms without size differentiation, suggests such an interpretation, since it indicates broadly positive effects of BNDES credit on labor productivity in Brazil's manufacturing sector. However, when each size category is examined separately (Tables 1-4), the results reveal that these impacts differ by firm size —being larger for smaller firms and virtually nil for large firms once endogeneity is controlled.

Moreover, as shown across all tables, estimates from what we may call traditional models —OLS and FE specifications— suggest that resources provided by the BNDES have a positive and significant impact on productivity for firms of all sizes. This finding implies that, under a simplified analytical framework, BNDES financing appears to benefit every size class, from microenterprises through to large corporations.

When the System GMM model is applied —with and without control variables (Tables 1-5)— only microenterprises and small firms exhibit statistically significant coefficients. This evidence suggests that, once endogeneity is properly addressed, the positive effect of BNDES financing on labor productivity is confined to these specific segments. In contrast, for large firms the data indicate that the effect of BNDES funding on productivity is minimal or even nonexistent. This implies that, although large firms may be productive, their productivity cannot necessarily be attributed to BNDES credit, suggesting they rely on other efficiency drivers.

Thus, employing the System GMM methodology constitutes a key strength of this study, allowing for a more precise and rigorous analysis of financing effects on productivity by capturing the complex interactions among variables. This methodological approach should be highlighted when presenting the results, as it provides a robust foundation for the conclusions. In sum, the rigorous analysis demonstrates that BNDES financing significantly boosts productivity only for micro and small firms, while its effect on large firms is marginal —an insight with important implications for understanding the efficacy of BNDES credit across firm-size classes. Figure 1 provides a schematic representation of the synthesis of the results obtained.

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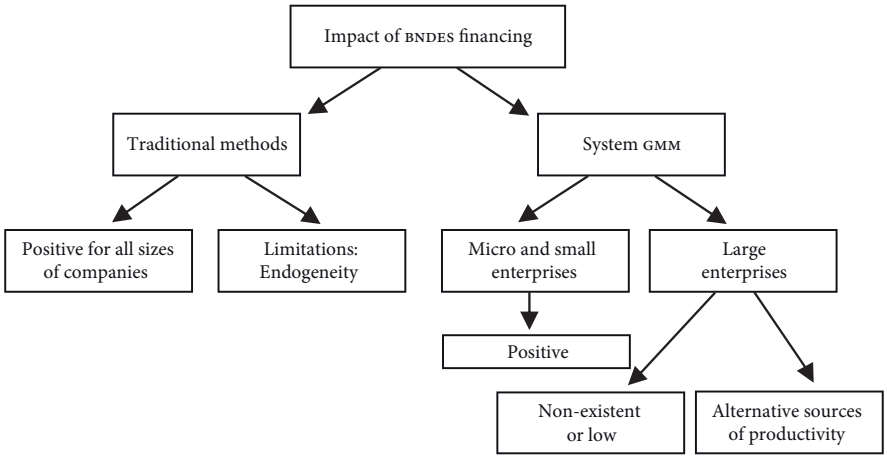
Figure 1. General presentation of results



Source: own elaboration.

5.1. Productivity and the external sector

Examining the other variables, several patterns emerge:

i) The OLS and FE model results indicate that labor productivity in MSEs responds negatively to exports;
ii) Exports have a positive impact on productivity in medium and large enterprises (MLEs).

These findings suggest that supply-side policies those that encourage the expansion of technological and production capacity —are more effective for MSEs, whereas demand-side policies, such as export promotion, are more effective for medium and large firms. In other words, micro and small firms appear constrained by their productive capacity, while medium and large firms face constraints related to external demand. The argument is that MSEs cannot reduce unit costs in response to export incentives. To compete internationally, a firm must be price-competitive, and in general micro and small enterprises lack the scale to lower costs as demand grows. By contrast, large firms can better adjust their supply capacity in response to rising demand.

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Thus, policies aimed at strengthening productive capacity would be most appropriate for smaller firms, whereas trade promotion policies would be better suited to larger ones.

The main constraints faced by MSEs relate to their production capacity. Most operate on a small scale, which raises fixed costs per unit and thereby reduces their competitiveness in global markets. The lack of high-technology equipment and machinery, together with a relatively low stock of experience, limits their ability to implement innovations and improve efficiency. Barriers encountered upon accessing international markets —such as certification, transportation, and regulatory-compliance costs— also weigh disproportionately on these firms, which, even if export demand increases, struggle to expand capacity without incurring substantial expenses. These structural limitations make MSEs dependent on investment-focused policies that strengthen production capacity by lowering fixed costs and promoting mechanization and innovation.

Medium and large enterprises, in turn, possess characteristics that make them more responsive to demand stimuli. They tend to operate at larger scale, reduce fixed costs, and adjust production capacity at low marginal cost; they also enjoy better access to capital and infrastructure for expansion or innovation. Integration of MLEs into global value chains facilitates adaptation to international market requirements, enhancing competitiveness. In other words, supply elasticity is higher, allowing them to benefit from demand stimuli without major cost-structure commitments —partly explaining why productivity in medium and large firms appears to respond more positively to increased exports.

An additional point that should be considered concerns the possible heterogeneity in the use of BNDES credit across firms of different sizes. Large corporations may allocate part of these financial resources to projects that are not directly related to technological upgrading or the acquisition of new capital goods, such as infrastructure investments or financial restructuring. In contrast, micro and small enterprises often rely on development bank credit to finance modernization processes, including the acquisition of machinery, equipment, and improvements in productive organization. This difference in the allocation of credit may partially explain why productivity effects appear to be more pronounced among smaller firms.

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6. FINAL CONSIDERATIONS

This study examined the effects of BNDES financing on labor productivity, with a focus on different company sizes. One of the central challenges in this analysis was addressing the endogeneity inherent in the relationship between BNDES financing and productivity, as larger companies typically are better positioned to meet the eligibility criteria for accessing BNDES credit. To overcome this issue, the study employed System GMM models alongside traditional estimation methods, such as OLS, which do not account for endogeneity.

The results confirm that MSEs, despite their more rudimentary production and management processes, experience greater productivity gains when receiving BNDES resources. In contrast, firms that already operate at higher productivity levels tend to exhibit smaller gains from additional investments, as their production structures are already more capital-intensive and technologically advanced.

These firms, operating closer to saturation levels, benefit less from new injections of capital compared to MSEs, which typically operate with lower capital intensity and greater untapped potential.

Overall, the evidence presented underscores the importance of targeting BNDES financing and industrial policies towards firms that stand to benefit the most from these resources. Such an approach could significantly boost productivity and contribute to reducing productive inequalities in Brazil. Future research should continue to investigate the dynamics of this relationship, exploring how distinct business segments respond to financial incentives and identifying the most effective policy interventions to enhance productivity in a context of structural heterogeneity.

From a policy perspective, these findings suggest that development bank credit may play a particularly important role in supporting productivity gains among micro and small enterprises, which typically face greater financial constraints and operate with lower levels of capital intensity. Consequently, policies aimed at expanding access to long-term financing for these firms may contribute to reducing intra-sector productivity gaps and improving the overall performance of the manufacturing sector. ◄

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