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What Have We Learned about National Development Banks? Evidence from Brazil*

O que aprendemos sobre os Bancos Nacionais de Desenvolvimento? Evidências do Brasil

RICARDO BARBOZA[+]
SAMUEL PESSOA[++]
FÁBIO ROITMAN [x]
EDUARDO PONTUAL RIBEIRO [xx]

RESUMO: Existem 553 bancos de desenvolvimento no mundo: 18% dessas instituições surgiram desde a crise financeira de 2008. Existe uma vasta literatura teórica sobre tais instituições, mas as evidências sobre sua eficácia são dispersas. Este artigo fornece uma revisão sistemática dos estudos de efeito causal de um dos maiores e mais representativos bancos de desenvolvimento do mundo, o Banco Nacional de Desenvolvimento Econômico e Social (BNDES). Analisamos 48 trabalhos acadêmicos que estimam o impacto dos empréstimos e programas de crédito do BNDES em várias dimensões de políticas. Em geral, as evidências indicam que os bancos de desenvolvimento podem ser um instrumento eficaz para aumentar o investimento, as exportações, o emprego e o PIB, principalmente quando os tomadores de empréstimo são micro, pequenas e médias empresas. A experiência brasileira também sugere que os bancos de desenvolvimento podem ser uma importante ferramenta de combate às mudanças climáticas, reduzindo o desmatamento. Por outro lado, evidências indicam que a maior dificuldade dessas instituições é gerar impactos positivos na produtividade, variável

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[+] Pesquisador Associado da FGV IBRE e Gerente de Pesquisa Econômica do BNDES, Rio de Janeiro/RJ, Brasil. E-mail: ricardo.barboza@bndes.gov.br. Orcid: 0000-0001-8952-8132.

[++] Pesquisador Associado da FGV IBRE, Rio de Janeiro/RJ, Brasil. E-mail: samuel.pessoa@fgv.br. Orcid: 0000-0001-7775-4415.

[x] Gerente de Monitoramento e Avaliação do BNDES, Rio de Janeiro/RJ, Brasil. E-mail: fabio.roitman@bndes.gov.br. Orcid: 0000-0002-4372-643X.

[xx] Professor do Instituto de Economia da UFRJ, Rio de Janeiro/RJ, Brasil. E-mail: eribeiro@ie.ufrj.br. Orcid: 0000-0003-4032-9962. Submitted: 20/July/2022; Approved: 4/October/2022.

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essencial para o crescimento econômico. Finalmente, as evidências são inconclusivas sobre a influência política nos empréstimos do banco de desenvolvimento.
PALAVRAS-CHAVE: Bancos de desenvolvimento; bancos estatais; revisão sistemática; BNDES.

ABSTRACT: There are 553 development banks in the world: 18% of these institutions have emerged since the 2008 financial crisis. There is a large theoretical literature on such institutions, but the evidence on their effectiveness is scattered. This paper provides a systematic review of causal effect studies of one of the largest and most representative development banks in the world, the Brazilian Development Bank (BNDES). We review 48 academic papers that estimate BNDES loans and credit programs impact in several policy dimensions. In general, the evidence indicates that development banks can be an effective instrument to increase investment, exports, employment and GDP, particularly when borrowers are micro, small and medium-sized companies. The Brazilian experience also suggests that development banks can be an important tool to fight against climate change, reducing deforestation. On the other hand, evidence indicates that the greatest difficulty for these institutions is to generate positive impacts on productivity, an essential variable for economic growth. Finally, the evidence is inconclusive on political influence on development bank's loans.
KEYWORDS: Development banks; state-owned banks; systematic review; BNDES.
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> "The great insight into development over the last 35 years is that institutions matter, and among them the most important are development banks."
> Joseph Stiglitz (August 2019)

1. INTRODUCTION

There are 553 development banks in the world: 18% of these institutions have emerged since the 2008 financial crisis (Xu et al., 2021).[1] For example, the Bangladesh Development Bank was created in 2009; France's Bpifrance in 2012; the British Business Bank and the Strategic Banking Corporation of Ireland in 2014; the Development Bank of Nigeria in 2017; the U.S. International Development Finance Corporation in 2019; and the Scottish National Investment Bank in 2020. In this context, some economists argue that the era of development banks has arrived. (Griffith-Jones et al., 2020).

Despite the immense production of development banks around the world, we know very little about the effects of this type of institution. Although there is a large theoretical literature on development banks (Amsdem, 1989; Bruck, 1998; Armendáriz de Aghion, 1999; Torres and Zeidan, 2016; Griffith-Jones and

[1] See https://www.nse.pku.edu.cn/dfidatabase/.

Ocampo, 2018; Fernandez-Arias, Hausmann and Panizza, 2020), there is no extensive survey of causal empirical evidence about the activities of these institutions.

In theory, there are several reasons to support development banks. They are considered an important tool to solve market imperfections that would leave projects that generate positive externalities without financing (Greenwald and Stiglitz, 1986; Musacchio, Lazzarini, Makhoul and Simmons, 2017). These institutions also lend resources to companies that would not carry out projects in the absence of long-term funding (Rodrik, 2004). Finally, development banks can operate in a countercyclical manner, enabling economies to return to full employment in moments of crisis (Gutierrez et al., 2011).

However, there are also arguments about the potential damaging effects of development banks. These financial institutions are often accused of reducing the financial development of countries (La Porta, Silanes and Shleifer, 2002), replacing the credit that would be provided by the private sector (Lazzarini, Musacchio, Bandeira-de-Mello and Marcon, 2015), favoring certain politically connected economic groups (Faccio, 2006), causing resource misallocation (Antunes, Cavalcanti and Villamil, 2015;Buera, Moll and Shin, 2013) and even conducting "*zombie lending*", i.e., lending resources to firms that would die in the absence of their support (Caballero, Hoshi and Kashyap, 2008).

The competing views in the literature should be guided by the empirical evidence available on development banks. There has been considerable effort to try to obtain causal evidence about these institutions, as can be seen in international development journals.[2] However, these studies tend to focus on multilateral development banks, reflecting their own internal evaluation efforts. Many multilateral development banks have evaluation units, such as the DIME (Development Impact Evaluation) in the World Bank or the Office of Evaluation and Oversight (OVE) in the IADB. Broccolini, Lotti, Maffioli, Presbitero and Stucchi (2020) is a recent example of empirical evidence on multilateral development banks impacts using non-experimental methods. Evaluations about national development banks are harder to find. Musacchio et al. (2017) analyze the evidence of the causal impact of six national development banks, but based on a small sample of references.

We propose a broader evaluation of results from the Brazilian Development Bank (BNDES) activities, exploring the interest from academia on the issue. We review 48 academic papers that tried to identify causal relations associated with BNDES loans, grants and equity funding. We follow the systematic review methods of Waddington et al. (2012). This effort is important for (i) *policy makers* interested in evidence-based public policies and whose lack of resources and specialized training prevents them from following the results of academic papers (Hjort, Moreira, Rao and Santini, 2019); (ii) academics interested in supplementing theo-

[2] Such as the *Journal of Development Economics*, the *Journal of Development Studies*, the *World Bank Economic Review*, the *World Development*, the *The European Journal of Development Research* and *The Development Policy Review*, among others.

retical knowledge on development banks through empirical evidence; (iii) the social control of public resources that are used to maintain the activities of development banks.

The BNDES is the main development bank in Brazil and one of the largest in the world.[3]

A review of BNDES lending policies, funding and perspectives up to 2017 may be seen in Frischtak et al (2017). The BNDES provides mostly long-term loans focused on productive investment. Its operation was characterized (until 2017) by a lower interest rate (TJLP) than market interest rates and (between 2008 and 2014) by a considerable governmental funding.[4] BNDES loans had a strong expansion period between 2008 and 2014, followed by a strong contraction period between 2015 and 2021. In 2021, BNDES' loans – in relation to Brazilian GDP – reached their lowest levels since data have become available in 1996.

The BNDES case can be informative for understanding the effects of development banks. Firstly, because this is an institution with broad and representative scope of activities in the universe of development banks, serving all sectors of the economy (infrastructure, industry, agriculture, trade and services), all company sizes (from micro to large) and several typical support segments for these institutions (innovation, green economy, exports and capital markets) – Além and Madeira (2015). Secondly, because the BNDES' operation, as seen, was characterized by government support, which is common in development banks (Luna-Martinez and Vicente, 2012). In third place, because BNDES is responsible for a variety of programs, including first tier and second tier loans, grants and equity funding, mostly all available tools for development banks (Fernández-Arias, Hausmann, Panizza, 2020).

In general, the evidence indicates that BNDES loans increase investment, employment and exports, especially when the credit borrowers are micro, small and medium-sized companies. The Bank also appears to have positive effects on economic activity (a result consistent with the positive effects on investment and exports – components of aggregate demand – and employment). There is also evidence that the operation of the BNDES – mainly through the Amazon Fund[5] – was able to reduce deforestation in the Amazon rainforest. However, most articles suggest that the BNDES has null effects on productivity. Finally, the literature is not conclusive about whether there was political influence in determining the Bank's loans. Although we recognize that each development bank has its particularities,

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[3] See https://www.nse.pku.edu.cn/dfidatabase/.

[4] In 2018, the TLP, whose value is linked to a long-term market interest rate (5-year NTN-b), was created as the new reference financial cost of the BNDES, replacing TJLP. In addition, the return of government funding from the BNDES back to the government began in 2016, not to mention that a large portion had already been prepaid to the National Treasury.

[5] The Amazon Fund is a REDD+ mechanism created to raise donations for non-reimbursable investments in efforts to prevent, monitor and combat deforestation, as well as to promote the preservation and sustainable use in the Brazilian Amazon.

these results from the Brazilian case may be the best information available to guide the other countries experiences.

This article is divided into four sections, including this introduction. Section 2 presents the criteria for selecting the papers. Section 3 details the evidence available about the BNDES. Finally, Section 4 presents some final considerations.

2. REVIEW PROCEDURES

We consider studies that seek to identify causal relations involving the BNDES. It includes those that assess the impacts of the BNDES' operation, as well as those that investigate what determines such operations and impacts.

Some systematic surveys on causal effects consider only studies that employ random experiments or quasi-experimental methods (Escueta et al., 2017; Evans, Philips and Ruffini, 2019). Since these methods use on less restrictive hypotheses to identify causal relations, the evidence obtained based on them can be considered closer to evaluation gold standards. However, among the published studies dealing with the BNDES, none use a random experiment; only Sztutman and Aldrighi (2019) employ a regression discontinuity design and only Cavalcanti and Vaz (2017) estimate by the method of difference in differences based on a quasi-natural experiment. Therefore, we decided not to adopt a restrictive criterion in relation to the method. We considered studies that use data and employ estimation methods that seek, in some way, to identify causality. By this criterion, studies that use fully calibrated models are not included, nor are those that estimate regressions without seeking to deal with selection bias. This choice is common in systematic reviews (Piza et al., 2016).

As the criterion related to the empirical methods used is not very restrictive, adopting a criterion related to publication source was considered important. In that regard, only studies that underwent a peer selection process are considered in this survey. It includes articles published in journals, studies presented at economic congress, award-winning studies, doctoral theses and master's dissertations. We do not consider book chapters, working papers and institutional publications. The choice to not include institutional publications, even if some undergo peer review processes, was made because it is not clear if the review is internal or external. June 2019 was established as the cut-off date so that only studies published or presented to date would be considered.

In summary, this survey includes studies that meet the following criteria: (i) use data and employ an estimation method to seek to identify a causal relation involving the BNDES; and (ii) published in journals, presented at academic meetings, awarded or approved doctoral theses and master's dissertations. The publication deadline was June 2019.

We mapped 70 papers that met these criteria (Barboza et al (2020)). They were

classified by topic, based on the issues investigated. In this paper, we present evidence of the BNDES' effects on the following economic variables: investment, employment, exports, GDP, productivity, as well as deforestation and the relation between political connections and BNDES loans. There are 48 papers that investigate these topics.

The analysis of the result of each study takes into account the sign and the statistical significance of the estimates obtained, without considering the magnitude.[6] Thus, the result of each study is classified as positive (statistically significant and positive), negative (statistically significant and negative), null (statistically not different from zero) or mixed. The result is classified as mixed if it varies according to the specification, sample or method used – for example, positive and statistically significant coefficient in one specification and statistically nonsignificant in another specification. There are some cases in which the distinction between positive and mixed results can be subtle. For example, in a study in which the effects are estimated by cohort treatment, positive and significant estimates are obtained for most years, and null estimates are obtained for some years. In situations such as this, the interpretation of the author(s) is favored. If the author(s) highlight(s) in the text that the result varies according to the cohort, then the evidence is classified as mixed. However, if the author(s) highlight(s) the positive and significant estimates found for most of the years, then the result is considered to be positive.

3. WHAT WE KNOW: A SUMMARY OF THE EVIDENCE

Effects of BNDES on investment

The Brazilian Development Bank mission, according to the institution's website, is "*To enable financial solutions that add investments for the sustainable development of the Brazilian nation*". This mission makes sense for a development bank, as stimulating investment is a potential mechanism for boosting economic growth. So, has the BNDES been able to add investments to the Brazilian economy?

Table 1 shows the academic papers that tried to answer this question. There are 18 studies in total, 10 of which indicate a positive effect of the BNDES on investment, while five indicate a null effect, and three show mixed evidence.

[6] It is difficult to analyze the magnitude of the estimates because the dependent variables vary across the studies. For example, among the studies that investigate the impacts of BNDES on investment, there are those that measure investment: (i) by level; (ii) by logarithm; (iii) by rate; (iv) deducted from the value of BNDES' financing.

Table 1: Summary of works on the effects of BNDES on Investment

Reference	BNDES instrument	Data base	Result
Vivacqua (2007)	BNDES	Economática	Positive
Ribeiro and De Negri (2009)	Public credit for innovation	PIA and PINTEC	Positive
Inoue, Lazzarini and Musacchio (2013)	BNDES Stock Market	Economática	Mixed
Machado et al. (2014)	PSI Finame	PIA	Positive
Lazzarini et al. (2015)	Financing or Shareholding	Economática	Null
Bonomo, Brito and Martins (2015)	BNDES Direct	Economática	Null
Machado and Roitman (2015)	PSI Finame	PIA	Positive
Lavieri (2015)	BNDES	PIA. PAS and PAC	Mixed
Brigante (2016)	BNDES Innovation	Pintec	Null
Monteiro (2017)	BNDES Direct	Economática	Positive
Eclache da Silva (2017)	BNDES	Economática	Positive
Alves, Silva and Morais (2017)	BNDES	Webscraping	Mixed
Machado, Martini and Gama (2017)	BNDES Innovation	Pintec	Positive
Cavalcanti and Vaz (2017)	Those used by small companies	PIA	Positive
Castro (2018)	Public credit	BCB and IBGE	Null
Santos Silva (2018)	BNDES	Economática	Null
Oliveira, F. (2019)	BNDES	Serasa and Economática	Positive
Barboza and Vasconcelos (2019)	BNDES and BNDES Finame	Monitor do PIB	Positive

Most of the evidence suggests that the institution has been able to add investments to the supported firms and to the economy. However, what mechanisms would make the BNDES' products effective in increasing the investment of firms or of the country? There are several possible channels, and the literature does not have a clear answer: (i) in case the financed companies are credit constrained, the BNDES may have acted to alleviate the restriction, allowing a higher level of investment; (ii) in case they are companies with long-term projects, with no market willing to finance at such maturity, the BNDES may have completed the market and made the projects possible; (iii) in case of projects with positive externalities, the Bank's operations may have prevented the underinvestment that is characteristic in this type of situation; (iv) BNDES may have increased investment because it had a lower interest rate than the market, allowing a greater amount invested; (v)

BNDES may have increased banking competition, reducing *spreads* and the cost of capital and enabling more investments in the country.

Discussing the mechanisms is important, as there is a pattern among the academic papers, which concerns the databases considered by each study and the results obtained (see third column of Table 1). Most studies that found the BNDES had a null effect on investment used Economática as a data source (in this case, data from publicly traded Brazilian companies). However, most studies that found a positive effect used the Annual Industrial Survey (PIA), the Technological Innovation Survey (Pintec) or Serasa, which are databases that more faithfully represent the universe of Brazilian companies, with a high concentration of micro, small and medium-sized and private equity firms.

Publicly traded companies should not be credit constrained, as they have access to capital markets. It is natural, therefore, that development banks have a smaller effect (or null effect) in these cases. Smaller and/or private equity companies, however, have greater difficulty in accessing resources in the credit market. This may explain the BNDES' effectiveness in lending to these firms. Given that subsidized interest rates were present in almost all loans (to public companies and to MSMEs), but a positive effect was found only in evaluations that considered mostly MSMEs, it is possible that the main (but not the only) mechanism of effectiveness of the BNDES is the easing of credit restrictions – common in MSMEs, but not in publicly traded companies.

Finally, an important thing for public policy purposes is to quantify the BNDES's additionality, that is, how much each $1 BRL disbursed by the Bank generated in new investments (which would not have occurred in the absence of the development bank action). Unfortunately, few studies have conducted this evaluation. Barboza and Vasconcelos (2019) found that each $1 BRL of BNDES loans increased the investment on average by $0.46 BRL between 2002 and 2016. In the case of BNDES Finame loans, a credit line for the acquisition of machinery and equipment, each $1BRL increased the investment on average by $0.73 BRL. Machado et al. (2014) obtained an additional investment from BNDES PSI of $1.18 BRL in 2009 and $0.58 BRL in 2010. These values suggest that the Bank has positive effects on investment (especially in times of crisis), but there is some degree of source substitution and/or *crowding-out* effect at the Bank's operation. In other words, development banks can be useful instruments for public policy, but they must prevent resources from flowing to borrowers who do not need this support.

Effects from BNDES on employment

Job creation is a frequent concern of development banks. In Brazilian case, as determined by the Federal Constitution, the BNDES receives resources from the Workers' Support Fund (in Portuguese, Fundo de Amparo ao Trabalhador, FAT) to be able to make loans to companies of various sizes, raising the employment level of the economy. It is natural, therefore, that the evaluation of the impact of the BNDES on employment is highlighted in the literature. There are two lines of in-

vestigation. One analyzes the effect on employment in the financed firms. Another line of investigation studies the effect on employment without being restricted to financed firms, covering the municipality in which the investment is made or the firms producing the capital goods whose acquisition is financed.

Most evaluations focus on the effect on employment in the financed companies. The BNDES instruments analyzed in these evaluations are generally used to finance investment. Hence, two conditions must be met for these instruments to have a positive effect on employment: i) the financing must increase investment, and ii) the added investment must lead to increased employment. For example, financing obtained for the construction of a new plant has a positive effect on employment in the financed company if investment increases and if the increase in installed capacity leads the company to hire new employees.

The studies that assess the impact on financed companies are listed in Chart A of Table 2. Four of the five studies analyze a wide range of financed companies of various sizes. The exception is Gonçalves (2013), which evaluates nonautomatic financing – for which the value exceeds a minimum threshold, and which are submitted to analysis by the BNDES. In this case, the number of financed companies is relatively small,[7] and the amount is, in general, larger. Regarding the methodology, it should be noted that Coelho and De Negri (2010) seek to estimate how the treatment effect varies over the distribution, which is known as the quantile treatment effect.

The results obtained by four of these five studies point to a positive effect on employment in the financed companies. Gonçalves (2013) differs from the others by not finding a statistically significant impact. This may be related to the profile of the firms supported through the instruments analyzed. These are larger companies, on which the evaluations of the impact of the BNDES on investment, in general, do not find positive results, as discussed in the previous subsection.

Table 2: Summary of works on the effects from BNDES on employment

Reference	Evaluated instrument	Result
CHART A: Effects on financed firms		
Ribeiro and De Negri (2009)	Public credit for innovation	Positive
Coelho and De Negri (2010)	BNDES	Positive
Gonçalves (2013)	BNDES nonautomatic financing	Null
Maffioli et al. (2017)	BNDES and Finep	Positive
Tabajara (2019)	BNDES indirect financing	Positive
CHART B: Effects not restricted to financed firms		
Assunção et al. (2016)	Construction of hydroelectric plants	Positive
Pinto, Grimaldi and Martini (2018)	BNDES local content policy	Positive

[7] The number of financed companies is less than or equal to 101 – this is the number of financial transactions analyzed.

There are also studies that seek to deal with effects on employment that may not be restricted to the financed companies. The financing of an investment project may have an effect on employment in construction during the project's implementation phase. The financing may also impact employment in economic activities that produce the inputs or capital goods used in the financed ventures. The studies that do not focus only on financed companies are listed in Chart B of Table 2.

Assunção et al. (2016) estimate, through the synthetic control method, the effect of the construction of hydroelectric plants – most of which are financed by the BNDES – on formal employment in the municipality where the construction is executed. The conclusion is that the average effect is positive in the first five years after the start of construction, although the intensity of this effect shows an increasing trajectory until the second year and a decreasing trajectory after that.

Pinto, Grimaldi and Martini (2018) analyzed the effect on employment in companies that manufacture capital goods that can be acquired with BNDES financing. The Bank's financing for the acquisition of capital goods is subject to local content criteria: those that meet the criteria undergo an accreditation process and may be financed. The estimates indicate that for a company that manufactures capital goods, having accredited products positively impacts employment.

In summary, studies dealing with the effect of the BNDES on employment found, in most cases, positive results. Among those that analyze employment in financed companies, there is favorable evidence when considering instruments that are not restricted to large companies. There are also evaluations that found a positive effect on employment in the municipalities where the investments were made and on companies that manufacture capital goods that can be acquired with BNDES financing.

Table 3: Summary of works on the effects from BNDES on Exports

Reference	BNDES instrument	Evaluated variable	Result
Silva (2012)	BNDES Exim	Nº of consecutive years in which the company exports	Positive
Galetti and Hiratuka (2013)	BNDES Exim	Exported value	Positive
Alvarez, Prince and Kannebley (2014)	BNDES Exim	Nº of consecutive years in which the company exports Nº of countries to which the company exports Exported value per employee	Positive Positive Positive
Schmidt (2012)	BNDES Exim	Exported value	Mixed
		Nº of products exported	Mixed
		Nº of countries to which the company exports	Mixed
		% of exports to countries outside Mercosur	Positive
		% of exports of medium- and high- technology products	Null
		Nº of exported medium and high technology products	Mixed
		Average value of exports per product	Mixed
		Average value of exports per country	Mixed
Maffioli et al. (2017)	BNDES and Finep	Exported value Indicator that the company exports	Positive Null

Effects of the BNDES on exports

As is common in development banks, the BNDES has credit lines that aim to support exports. Therefore, we should expect the Bank's operation to positively impact the exports of financed firms. This impact could occur either *directly*, that is, without being through another variable, or *indirectly*, since other support instruments of Bank may impact exports. Examples: (i) financing for investment in a new production plant may allow the expansion of the exported volume; (ii) financing for an investment that increases productivity may enable entry into the international market.

Among the five studies that investigate the effect of the BNDES on exports, presented in Table 3, four evaluate the impact of BNDES Exim, a product of export support lines. Silva (2012), Schmidt (2012), Galetti and Hiratuka (2013) and Alvarez, Prince and Kannebley Junior (2014) used data by company and considered supported those that took BNDES Exim financing. There are also other similarities between the impact assessments of BNDES Exim: (i) all restrict the sample to industrial exporting companies and employ matching; (ii) three include the period from 2000 to 2007. Although the BNDES Exim impact assessments analyze the impact on export performance, they measure export performance in different ways. As shown in Table 3, positive and significant impacts of BNDES Exim were found on most export performance measures. Even if, in the case of Schmidt (2012), the results are not maintained in all cohorts of supported companies – which is why the evidence for some variables is considered mixed – there is, in general, convergence in the conclusion that BNDES Exim has a positive effect on export performance.

Maffioli et al. (2017) also investigated the impact on export performance, but the analysis covered all financing transactions of the BNDES and Finep – and not just those carried out within the scope of export support lines. There is evidence that access to BNDES or Finep credit has a positive impact on exported value but has no effect on the probability of exporting. The authors interpret this result as indicating that public credit impacts the volume exported by companies that were already exporters but does not seem to contribute to the entry into the international market of those that did not export.

In summary, the four studies that evaluated BNDES Exim obtained evidence of a positive impact on export performance. When the analysis is extended to all BNDES and Finep financing, there is a positive effect on the exported value but not on the probability of exporting.

Effects of the BNDES on the GDP

Development banks are often used to act in a counter-cyclical way, that is, with the aim of stimulating economic activity. In the Brazilian case, what is the effect of BNDES on the GDP? This question is highly correlated with what was discussed in the previous three subsections. After all, if the bank is able to add investments, employment and exports to the economy, we should expect that the GDP

would be positively affected by the institution. In the literature, there are nine articles dedicated to this task, most of them focusing on the regional GDP (especially at the municipal level) and only two focusing on the aggregate level of the Brazilian economy. A summary of the nine articles is shown in Table 4.

Table 4: Summary of works on the effects of BNDES on GDP

Reference	BNDES instrument	Analyzed Variable	Result
Barbosa-Filho (2011)	BNDES	Northeast GDP	Null
Burns (2012)	BNDES	Municipal GDP	Positive
Wegelin (2014)	BNDES	Municipal GDP	Positive
Assunção et al. (2016)	BNDES Finem	Municipal GDP	Positive
Martini et al. (2018)	BNDES Finem	Municipal GDP	Positive
Maitino (2018)	BNDES	Brazil output gap	Positive
Machado (2018)	BNDES Infra	Regions GDP	Mixed
Barboza and Vasconcelos (2019)	BNDES	Brazil GDP	Positive
Zanchi (2019)	BNDES Direct and Indirect	Municipal GDP	Mixed

Barbosa-Filho (2011) investigates the relation between BNDES financing and the northeast region's GDP. To that end, it uses annual data on BNDES disbursements and estimates some vector autoregression models (VAR) in search of impulse response functions. The results obtained for the effects of the BNDES on the northeast GDP are, according to the author, statistically nonsignificant. Machado (2018) also estimates the effects of the BNDES on the regional GDP, but through a panel model with fixed effects and focuses on infrastructure loans for all regions of the country. Unlike Barbosa-Filho (2011), it was found that BNDES disbursements have a large positive effect on the northeast region. The same positive effect would occur in the north, but not in the south, southeast and midwest, which receive most of the institution's disbursements.

Zanchi (2019) also uses a panel model to investigate the effect of the BNDES on GDP *per capita*, but at the municipality level, considering a sample of 5,504 Brazilian municipalities. In addition, the model separates the effects of BNDES direct and indirect credits and considers the possibility of *spillover effects* among municipalities. The estimates obtained indicate that BNDES indirect credit is an effective instrument to increase municipal GDP *per capita*, with each additional $1,000 BRL credit *per capita* increasing the GDP *per capita* of the following year by 0.35%. BNDES direct credit, however, did not prove to be an effective instrument in the analyzed period, with effects on GDP *per capita* statistically indistinguishable from zero.

Wegelin (2014) investigated the effect of the BNDES on the GDP of municipalities but, for this, used propensity score matching. The results indicate that the GDP and GDP *per capita* of the municipalities varied positively because of the treatment. In quantitative terms, the GDP and GDP *per capita* grew, on average,

0.4% more per year in the units that experienced an increase in disbursement growth, and the benefit generated for each $1 BRL of BNDES disbursement was, on average, an $0.29 BRL increase in the GDP. Burns (2012) also assesses the effects of BNDES disbursements on municipal GDP *per capita*, but through a *generalized* propensity score. The results suggest a positive and significant relation among the analyzed variables. The magnitude indicates that, assuming that one municipality had disbursements *per capita* 10% higher than the other and that both have the same propensity to obtain credit, the former would have a GDP *per capita* approximately 1% higher.

The BNDES' operations are often linked to the infrastructure sector, which is an usual goal of development banks. Martini et al. (2018) and Assunção et al. (2016) assessed the effects of infrastructure construction on local economies. Martini et al. (2018) focused on the construction of wind farms, and Assunção et al. (2016) focused on the construction of hydroelectric plants. Given the relatively small universe of these types of operations, both studies used the synthetic control methodology to obtain an adequate counterfactual. The results of the two evaluations suggest that the construction of energy infrastructure (wind or hydroelectric) has temporary effects on GDP *per capita*, increasing local activity during the first years of the work but dissipating over time, following an inverted U shape.

In quantitative terms, Martini et al. (2018) observed median effects on municipal GDP *per capita* – between 7.1% and 9.4% –, with a *peak* between two to three years after construction started, using a sample of 34 wind power plants. The effects were more intense for relatively poorer municipalities that received larger parks. Assunção et al. (2016) also found effects on the activity level more focused on the short term, with the construction of 82 hydroelectric plants increasing the growth of the affected municipalities in the first years after construction started. The peak of the median effect occurs in the year following the construction of the work and with a positive magnitude of 6.5% difference in relation to counterfactual growth. This difference starts to decline in the second year and becomes 8% negative in the fourth year after construction. In the fifth year, GDP growth rates *per capita* for treated and control municipalities are almost identical.

Regarding the aggregate effects of BNDES disbursements, the available evidence is positive, as seen at the municipal level. Maitino (2018), for example, estimates several IS curve specifications for the Brazilian economy, including regressors that represent BNDES loans. The estimates suggest positive and statistically significant effects of the BNDES loans on the output gap in various specifications tested. The positive effect of the BNDES on Brazilian GDP was also found by Barboza and Vasconcelos (2019). Although the objective of the paper is to determine the effects of the BNDES on investment, the LBVAR model allows for obtaining impulse response functions for several variables in the model.

In summary, most of the available evidence suggests that increases in Brazilian development bank loans have stimulating effects on local and aggregate economic activity. This result is consistent with the evidence obtained for investment, employment and exports. In addition, this result legitimizes development banks to be considered a possible instrument for countercyclical action (see Gutierrez et al., 2011).

Effects of the BNDES on productivity

Productivity is an important, if not the most important, variable for long-term growth. Not always, however, the actions of development banks are designed with this explicit objective. For example, BNDES instruments did not have, in their conception, an explicit focus on the challenge of increasing productivity. In any case, there is a literature that investigates the effects of the BNDES on productivity.

The BNDES' effect on the productivity of financed companies tends to occur through investment, since a large portion of the bank's credit in recent years was allocated to finance investments. For there to be a positive effect on productivity, it is necessary not only that BNDES financing increases investments but also that the added investments lead to increase productivity. This depends on the characteristics of the investment projects carried out and of the capital goods acquired. For example, if the investment consists of the installation of a new productive plant identical to the plant that the firm already operates, there may even be, under specific conditions, an increase in labor productivity, but there will hardly be an increase in total factor productivity (TFP). However, the installation of a new plant with superior technology, which reduces costs and/or improves the product, is capable of leading to an increase in labor productivity and TFP.

Evaluations that study the topic focus on the effects on the productivity of the financed firms. There are five studies in total, as shown in Table 5. Four of these are similar in terms of the data used: (i) they use data from the Annual Industrial Survey (PIA), conducted by the IBGE; and (ii) they analyze financing provided until 2005 and monitor the performance of companies for several years after financing. The use of PIA data is justified because the information present in this survey allows the calculation of capital stock, without which it is not possible to estimate TFP. Tracking companies' performance for several years after financing is important because the effect on productivity may not be immediate.

Table 5: Summary of works on the effects of the BNDES on productivity

Reference	BNDES instrument	Evaluated variable	Result
Ribeiro and De Negri (2009)	Public credit for innovation	TFP Labor productivity	Null Null
Coelho and De Negri (2010)	BNDES	TFP Labor productivity	Mixed Positive
Araújo (2014)	Finame, BNDES Automático and Finem Finame	Labor productivity	Null Null
Cavalcanti and Vaz (2017)	Those used by small companies	TFP Labor productivity	Positive Positive
Sousa and Ottaviano (2018)	BNDES Finem and BNDES Automático	TFP Labor productivity	Null Null

Cavalcanti and Vaz (2017) stand out because of the methodology used. The authors use a change in the company size classification adopted by BNDES and compare companies benefiting from the change with those not affected. The estimation by difference in differences is, therefore, based on an exogenous variation, an approach considered more appropriate for identifying causality than the panel methods and/or propensity score estimation, widely used in BNDES impact assessments.

As shown in Table 5, Araújo (2014) investigates labor productivity and finds no evidence of an impact on this variable. The other four studies analyze both labor productivity and TFP, and the results obtained by each for the two productivity measures, in general, point to the same direction. Ribeiro and De Negri (2009) conclude that the effects on labor productivity and on TFP are not significantly different from zero. Sousa and Ottaviano (2018) also do not obtain evidence of impact on either of the two productivity measures. However, Cavalcanti and Vaz (2017) estimate positive effects both on labor productivity and on TFP. Coelho and De Negri (2010) estimates suggest a positive impact on labor productivity and constitute mixed evidence in relation to TFP.

Therefore, most studies that investigate the effect of the BNDES on productivity do not find evidence of impact. Cavalcanti and Vaz (2017) deviate from this pattern and obtain positive results for both productivity measures. Possible explanations for this are differences in the type of support analyzed and in the methodology. Cavalcanti and Vaz (2017) investigate support for small companies, while the other studies analyze supports that cover different company sizes. In addition, as previously mentioned, they use an exogenous variation to identify the causal effect, which does not occur in the other studies.

Based on these results, it is possible to affirm that, if most evaluations that analyze company growth measures – investment and employment –, suggest positive effects of the BNDES on these variables, the same does not apply to evaluations that investigate the bank's impact on productivity. This contrast is explicit in Ribeiro and De Negri (2009) and in Coelho and De Negri (2010), who obtained evidence of a positive impact on the growth of supported companies but not on TFP.

These findings are not an isolated case in the development literature (Sousa and Ottaviano (2018)). 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.

Effects of the BNDES on deforestation

Assessing the impact of BNDES' operation on deforestation in the Amazon rainforest is justified by three reasons. First, because tackling climate change is a challenge without precedent for development banks. Second, because BNDES is the manager of the Amazon Fund, which supports, with non-refundable resources, ac-

tions to prevent, monitor and combat deforestation in the region. The third reason is related to the financing that BNDES grants to investment projects in the region.

Two studies analyze the impact of the Amazon Fund on deforestation. In Bouchardet, Porsse and Junior (2016), several projects of the Amazon Fund are considered: the authors compare municipalities in which there is a project with municipalities in which there is none. Simonet et al. (2019), on the other hand, assess the impact of a specific project,[8] comparing rural establishments of communities that participate and do not participate in the project. The estimates obtained in the two studies indicate that the Amazon Fund contributes to the reduction of deforestation.

Assunção, Costa and Szerman (2017) assess the impact of the construction of hydroelectric power plants (HPPs) in the Amazon on deforestation in the vicinity of these projects. Using the synthetic control method, the authors obtain estimates of the impact generated by each HPP. The evidence obtained is mixed: some HPPs cause an increase in deforestation in the surroundings, but others contribute to its reduction.

Table 6: Summary of works on the effects of the BNDES on deforestation

Reference	Evaluated instrument	Variable	Result
Bouchardet, Porsse and Junior (2016)	Amazon Fund	Deforestation	Reduces deforestation
Assunção, Costa and Szerman (2017)	HPP construction	Deforestation	Mixed
Simonet et al. (2019)	Amazon Fund	Deforestation	Reduces deforestation

In summary, the literature evaluating the impact of BNDES on deforestation in the Amazon is small – there are only three studies, as shown in Table 6. Two of them indicate that the Amazon Fund has been effective in reducing deforestation. And one study shows evidence that the construction of HPPs has heterogeneous effects on deforestation – it can contribute to its increase or decrease.

Political connections and the BNDES's operation

In the previous subsections, studies that investigate the effects of the BNDES on some variables of interest were presented. There is also a set of studies in which the BNDES, instead of being the explanatory variable, is the dependent variable. The interest, in this case, is to analyze how some variables affect the BNDES's operation. Among several elements that can affect the performance of the BNDES, one was the focus of several studies: political connections. This interest in the top-

[8] Projeto Assentamentos Sustentáveis na Amazônia (Sustainable Settlements in the Amazon Project).

ic can be attributed, at least in part, to the literature that argues that public banks can be used to serve the personal interests of politicians (Shleifer and Vishny, 1994; La Porta et al., 2002).

The ten studies that empirically investigate whether political connections affect the BNDES' operation can be divided into two groups: (i) seven examine whether the companies' political connections affect the BNDES's allocation of financing and shareholding, and (ii) three investigate whether the political alignments of mayors and governors with the President of the Republic affect the BNDES's allocation of financing.

The seven studies that analyze the companies' political connections are listed in Chart A of Table 7. Five of them analyze types of support that undergo analysis by the BNDES and measure political connections based on electoral donations made by companies. Even so, there are specificities in the way electoral donations are taken into account: some studies consider donations to candidates that won elections; others take into account the totality of donations – those allocated to candidates, parties and campaign committees – without distinguishing between donations to winners and losers.

Table 7: Summary of works on political connections and BNDES

Reference	Political connection	Instrument	Result
CHART A: Political connection of companies			
Sztutman and Aldrighi (2012)	Donation to winning candidates that ran for federal deputy	Financing	Positive
Sztutman and Aldrighi (2019)	Donation to winning candidates that ran for federal deputy	Financing	Null
Lazzarini et al. (2015)	Donation to winning candidates that ran for president, governor and senator	Financing	Null
	Donation to winning candidates that ran for federal deputy	Financing	Positive
	Donation to winning candidates that ran for president, governor and senator	Shareholding	Null
	Donation to winning candidates that ran for federal deputy	Shareholding	Null
Astorino (2015)	Presence in the Board of Directors of a person who helda senior management position at BNDES	Nonautomatic indirect and direct financing	Null
Lopes (2016)	Donation to winning candidates that ran for federal deputy	Nonautomatic indirect and direct financing	Positive
	Donation to winning candidates that ran for president and senator	Nonautomatic indirect and direct financing	Negative
	Donation to candidates, parties and campaign committees	Nonautomatic indirect and direct financing	Negative
	Donation to candidates, parties and campaign committees of the government base	Nonautomatic indirect and direct financing	Positive

Kuronuma et al. (2018)	Donation to candidates, parties and campaign committees	Financing	Positive
Tabajara (2019)	Donation to candidates, parties and campaign committees at the federal level	Indirect financing by federal public banks	Positive
CHART B: Political alignment of mayors and governors			
Coniaric (2014)	Mayor's party belongs to the president's support base	Financing to municipalities	Null
Carvalho (2014)	Governor's party belongs to the president's support base	Financing to private companies	Positive
Pinto (2018)	Mayor's party is the same as the president's party and is different from the governor's party	Financing to municipalities	Positive

The results of these studies vary according to the political connection measure adopted, the type of BNDES support considered, and the method employed, as shown in Chart A of Table 7. Sztutman and Aldrighi (2012), Lazzarini et al. (2015) and Lopes (2016) find evidence that making donations to candidates for federal deputy offices who end up elected increases the volume of financing that the BNDES grants to the company in the years following the election. However, this result is not maintained when Lazzarini et al. (2015) and Lopes (2016) consider donations to candidates elected for other offices, nor when Lazzarini et al. (2015) analyze the effect on BNDES shareholdings. Sztutman and Aldrighi (2019) also examine donations to candidates elected for federal deputy offices, but they use a regression discontinuity design, which is more appropriate for isolating causality. Comparing companies that donated to a candidate for a federal deputy office who was elected by a few votes with companies that donated to a candidate for a federal deputy office who was not elected by a few votes, Sztutman and Aldrighi (2019) found no statistically significant difference in the average volume of BNDES financing. Lopes (2016) and Kuronuma et al. (2018) estimate the effect of total donations, which include not only those made to candidates, and obtain divergent results: Lopes (2016) estimates a negative relation between donations and BNDES financing, while Kuronuma et al. (2018) find a positive relation between the two variables. The result of Lopes (2016) changes when the effect of donations to candidates, parties and campaign committees of the government base is estimated: in this case, the author finds that more donations are associated with more BNDES financing.

Although the results obtained vary between studies, something common among them is the fact that they do not deal with transmission mechanisms. Thus, finding evidence that politically connected companies have more access to BNDES financing does not allow us to conclude that political influence occurs, necessarily, through the BNDES. Lazzarini et al. (2015) and Sztutman and Aldrighi (2012) suggest an alternative hypothesis in which political influence occurs through the signing of contracts with the government, and the object of these contracts ends up being financed by the BNDES.

Although also investigating the political connections of companies involving BNDES financing, Tabajara (2019) seeks to answer a different question: do companies that make electoral donations at the federal level receive more indirect financing from the BNDES through federal public banks? The interest, in this case, falls on the BNDES's financial agents, who select the borrowers and assume the credit risk of the financing. The conclusion of Tabajara (2019) is that making a donation in federal elections increases the likelihood that the company will receive indirect financing from the BNDES through federal public banks.

Astorino (2015) differs from the other studies by the political connection measure used: a company is defined as politically connected if any member of its Board of Directors held a senior management position at the BNDES. Astorino (2015) finds no evidence that this type of political connection affects BNDES financing.

Chart B of Table 7 presents the three articles that deal with the political alignment of mayors and governors with the president. Coniaric (2014) and Pinto (2018) analyze BNDES financing to municipal public administrations. Coniaric (2014) finds no evidence that municipalities governed by mayors allied to the president receive more financing from the BNDES. However, the results obtained by Pinto (2018) indicate that the municipality is more likely to receive BNDES financing if the mayor belongs to the president's party, and the governor belongs to another party. Carvalho (2014) investigates whether political alignment between the governor and the president affects BNDES financing to private companies in each state. The estimates obtained indicate that BNDES disbursements are higher for states governed by political allies in years close to the electoral race in which the governor is running for reelection.

In summary, for the two issues investigated – political connection of companies and political alignment of mayors and governors – there is no consensus among the studies. Some studies find evidence that political connections affect the allocation of BNDES financing, but others do not obtain evidence of this. So, it is not clear, at least for the Brazilian case, that development banks serve the personal interests of politicians.

4. CONCLUSION

We analyzed 48 academic papers that tried to identify causal relations involving the Brazilian Development Bank, one of the largest and most representative development banks in the world.[9] The available evidence suggests that the BNDES is an effective instrument to foster investment, exports and economic activity in Brazil, especially when its credit is focused on micro, small and medium-sized companies. We also have learned that the BNDES has had positive effects on employ-

[9] An expanded version of this paper, with 70 articles on the performance of the BNDES, can be seen in Barboza et al. (2020).

ment and that the BNDES's operation is important for reducing deforestation in the Amazon rainforest. However, most articles showed that the BNDES had null effects on productivity, which is a point of attention for public policies focused on economic development. It can also be stated that the literature is not conclusive about whether there was political influence in determining BNDES loans.

How could the evidence from Brazil be used to guide discussions on development banks?

Regarding the controversies surrounding those institutions, it can be said that both development bank enthusiasts and their critics have a share of truth in their statements. On the one hand, the Brazilian evidence suggests that development banks might be a useful tool for adding new investments in the economy, in line with what is expected from an institution that corrects market failures (Greenwald and Stiglitz, 1986; Rodrik, 2004). The evidence of positive impacts on GDP and employment, especially in crisis situations, enables development banks to be used as countercyclical instruments (Gutierrez et al., 2011). On the other hand, there is evidence of some degree of funding substitution when a development bank lends resources to companies with greater access to capital markets (Lazzarini et al., 2015). Finally, it is not clear that political connections have been an unequal channel for companies to access the loans of a development bank (Faccio, 2006).

In addition, the Brazilian evidence suggests that development banks can stimulate exports, which is a common practice in several development banks, as well as impacting environmental issues, an issue that is increasingly in vogue on the international economic policy agenda (Herrick et al. (2019); Griffith-Jones, Attridge and Gouett, 2020).

It is important to highlight that the evidence that a certain type of support has a positive effect on some variable is not sufficient to justify this support. The justification, ideally, would depend on a cost-benefit analysis and a comparison with the cost-benefit of alternative public policies. It would be necessary to calculate, for each type of BNDES support, the benefit, in monetary terms, and cost. The calculation of the monetary benefit would involve (i) estimating the effects on all relevant variables; (ii) converting the benefits into monetary values; and (iii) aggregating these values. This calculation is not executed in any of the 48 studies presented, which illustrates the complexity involved. In addition, only one study – Wegelin (2014) – includes an estimate of the cost of the BNDES support that it analyzes. Although less complex than estimating the monetary benefit, calculating the cost requires information about financial flows and the average cost of issuing public debt.

The absence of cost-benefit analyzes supporting the discussions on the BNDES is representative for the group of development banks. Although some development banks do calculate cost-benefit for specific projects, studies that analyze the cost-

benefit ratio of development banks as a whole are scarce. In spite of this, the number of development banks in the world is increasing since the 2008 financial crisis.[10]

Because of its importance, cost-benefit analysis is a topic that should be addressed in the future by the literature on development banks. Impact evaluations subject to less restrictive hypotheses are also important. It would help in this way if the design of the support instruments already considered an evaluation strategy. As many development banks play an important role in infrastructure financing, enhancing evaluations in this field may be part of the agenda of the literature on these institutions.

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[10] In theory, it can be argued that politicians choose to create development banks for personal reasons. But, as seen in the BNDES experience, the evidence on political connections is not conclusive.

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