An Input-Output Assessment of the Brazilian Development Bank (BNDES) Financial Support on Employment

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1. Introduction

The BNDES (Banco Nacional de Desenvolvimento Econômico e Social - the Brazilian development bank) plays a key role in stimulating the expansion of industry and infrastructure in Brazil. Over the course of the Bank's history, its operations have evolved in accordance with the Brazilian socio-economic challenges, and now they include support for exports, technological innovation, sustainable socio-environmental development and the modernization of public administration. The Bank offers several financial support mechanisms to Brazilian companies of all sizes as well as public administration entities, enabling investments in all economic sectors. BNDES is one of the largest development banks in the world (its assets summed approximately US$ 148 billion in 2023) and carries on a wide mandate.

Input-output models have been used by BNDES since the 1990´s to estimate the number of jobs associated with the implementation of supported investment projects. It is an evaluation tool that allows measuring not only the direct jobs associated with the projects such as in construction and in machinery manufacturing but also in their supply chains. BNDES have been building, since 2011, a monitoring and evaluation system focused on the effectiveness of its support, i.e. economic, social, and environmental effects. These efforts have been recently recognized by the Montreal Group, an international forum of development financial institutions that support small and medium-sized companies.[1] The Montreal Group study indicates that BNDES has a consolidated and advanced monitoring and evaluation system as it monitors its programs, evaluates the results, conducts counterfactual analyses, do macroeconomic modelling and uses impact scoring methodology for the projects.

The input-output models used by BNDES had been mainly improved to absorb new data from Brazil's National Accounts System compiled by Instituto Brasileiro de Geografia e Estatística (IBGE - the Brazilian official statistical office), but starting from the efforts initiated in Santos and Miguez (2022), a cycle of deeper methodological enhancements began. Furthermore, a more recent input-output matrix for the Brazilian economy was used compared to that made available by IBGE. In the present paper, the model was improved using IO matrices estimated for each year and by the calculation of specific input vectors for different types of BNDES support. Annual IO matrices allow more accurate modelling of economic structure for each year and specific input vectors allow considering more of BNDES's disbursements and a better sector allocation. In other words, the estimates are closer to the real impacts of the projects' implementation.

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[1] See Cottin and Galliot (2023).

In this paper the focus lies on employment outcomes because it holds central importance for BNDES due to its primary funding source being the Fundo de Amparo ao Trabalhador (FAT – Worker Support Fund). FAT is a Constitutional fund aimed at financing worker protection programs in Brazil, such as unemployment insurance, salary bonuses, and vocational training programs. FAT also aims to promote economic and social development investing in job creation and income generation programs. Regarding this last topic, the Brazilian Constitution includes that a portion of FAT revenues must go to BNDES as loans. Beyond the financial return of these loans, BNDES is expected to pay special attention to promote job creation using these resources[2].

It is worth noting that we believe other development banks and agencies can adapt the methodology described in this paper to make its own final demand vector and use the IO framework to evaluate the economic impacts of their financing. In this perspective this paper seeks attention not only as a way to BNDES evaluate its loans, but also for other development banks where monitoring and evaluation tools are also used.

This study is organized in four sections, in addition to the introduction. Section 2 presents a brief characterization of BNDES and some data on its performance. Section 3 presents the input-output model developed for this study and how BNDES data are processed to generate final demand vectors. Section 4 analyzes the new results of the model on employment, value added, and wages bill. At the end there are some final comments.

2. The Brazilian Development Bank (BNDES)

The Brazilian Development Bank (BNDES) is the main source of long-term funding for the Brazilian economy, and it is among the biggest development banks in the world. It provides financial support for almost every economic activity in Brazil (agriculture, manufacturing, services and infrastructure) so that companies can start or expand their productive capacity, innovate and export. It also reaches both small and medium sized enterprises (SMEs) and big companies. To accomplish such a diverse mission, BNDES has a wide range of financial instruments, including standard credit lines, project finance, securities (shares, debentures, funds, etc.), financial guarantee, and non-reimbursable resources (grants). Table 1 presents a brief description of the objectives of BNDES's main financial instruments. This information is important because it alters the way they are dealt with in the IO model.

Table 1: BNDES Main Financial Instruments Description

Financial Instrument	Description
BNDES Finem	Financing for large investment projects, whether public or private, aimed at generating and increasing productive capacity and innovation. (ex: manufacturing factories, power plants, highways, railroads, water supply, etc.)
BNDES Finame	Financing for the production or acquisition of domestically produced machinery, equipment, information technology and automation goods, and other industrialized goods. (ex: trucks, buses, tractors, machine-tools, computers, etc.)
BNDES Exim	Financing for the export of domestically produced goods (especially machinery and equipment) and services (including infrastructure projects and construction).

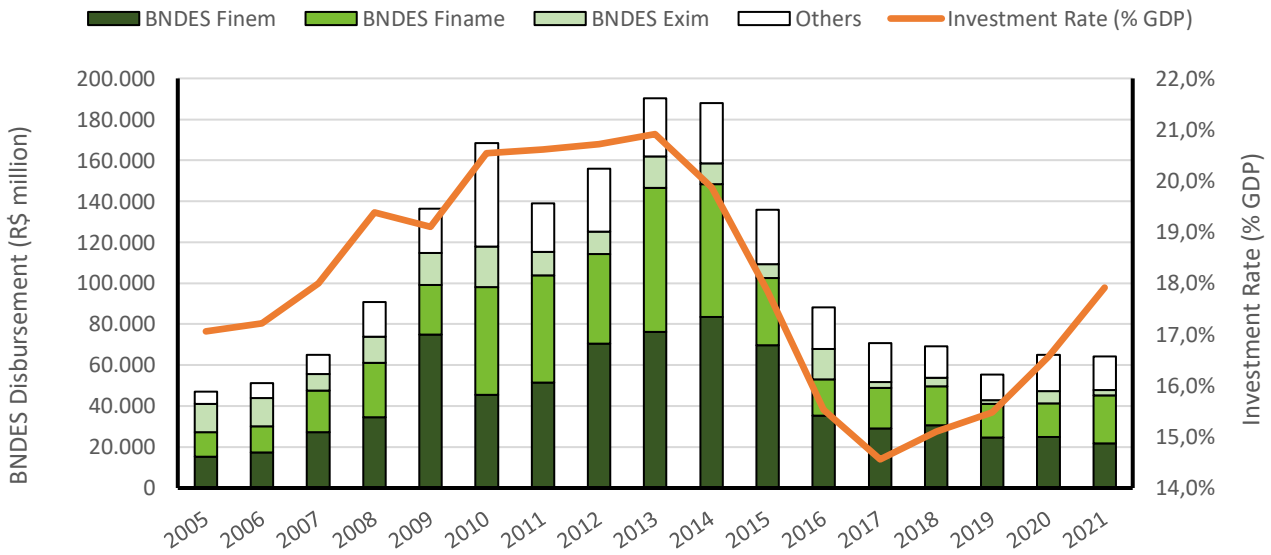
[2] More information about FAT is found at Borça Jr and Horta (2024).

BNDES Automático	Financing for small investment projects, especially those from SMEs.
BNDES Mercado de Capitais	Support Brazilian companies through equity instruments in all stages of companies' growth: pre-operational, nascent, start-up or even companies in more advanced stages of maturity can be supported through private equity funds or through the subscription of securities (direct participation).

Source: BNDES

Because BNDES plays a key role in financing investments, its performance is commonly correlated with the economic activity, especially with the Gross Fixed Capital Formation (GFCF). In fact, during the 2008-2009 financial crisis it also got involved in the countercyclical measures implemented by the Brazilian government, specially through the Investment Sustainment Program (PSI - Programa de Sustentação do Investimento). The PSI was a successful credit program in keeping investment levels in Brazil during the crisis and lasted until 2015. It made the financing conditions of BNDES for the acquisition of domestically produced machinery and equipment more attractive (Machado, Roitman; 2015). Figure 1 shows the distribution of BNDES's disbursements for its main financial instruments and Brazilian investment rate (GFCF/GDP).

Figure 1: BNDES's Disbursements and Brazilian Investment Rate 2005-2021



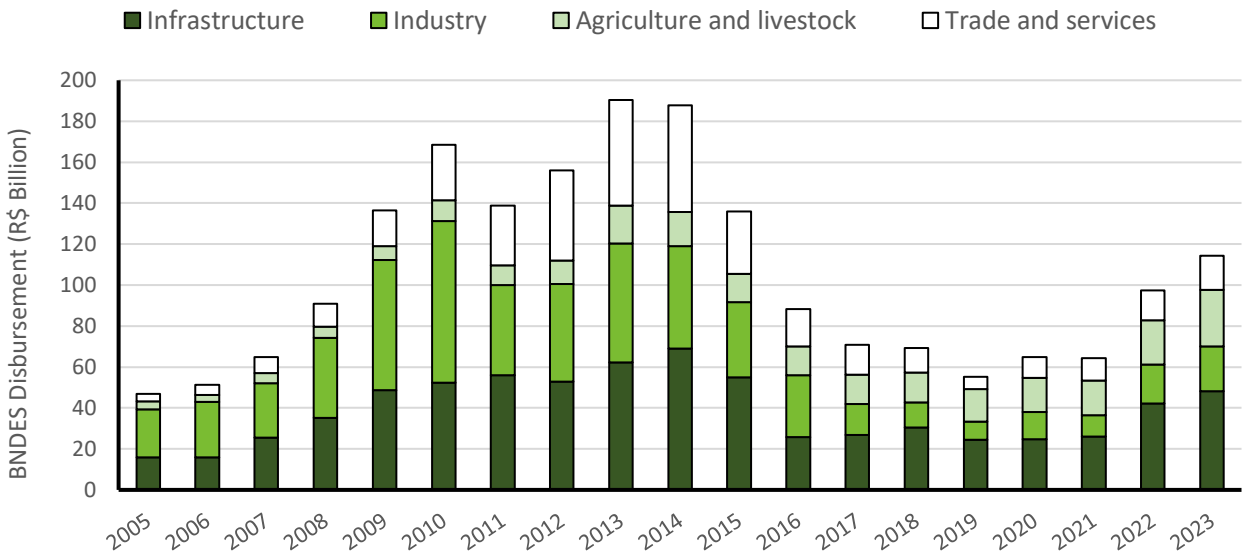
Source: Authors, using BNDES Data

In Figure 1 it is possible to notice a high correlation between BNDES's disbursements and the Brazilian investment rate from 2005 to 2017 and almost no correlation at all since 2018. In fact, this relationship is not very simple to determine, because on one hand the demand for credit by the investment projects influences BNDES's disbursements but on the other hand the support provided by BNDES to the economy has an impact on productive capacity and expectations which can influence the national investment rate. But it can be said that until 2017 there was a clearer synergy between BNDES role and the economy investment and growth.

One can also notice that financing for large projects and for production and acquisition of machinery and equipment have been, in the past couple of decades, the main financial instruments. The support for exports had a relatively expressive share from 2005 to 2016 but significantly declined during the next years.

The evolution of BNDES's disbursements by aggregate economic sectors is depicted in Figure 2. In all years, the support for infrastructure has been relevant as a share of total disbursements, 38% in average. Infrastructure segments include utilities (water, electricity, gas etc), transport, construction and telecommunications. Manufacturing had significant share until 2016 but suffered a decline in the following years, alongside the de-industrialization process in place in Brazil. The share of commerce and services in total disbursements have presented an intermediary level historically with an emphasis from 2011 to 2017 (mainly due to BNDES Card). Agriculture had modest shares from 2005 to 2015 but since 2016 represent, in average, 23% of BNDES's disbursements.

Figure 2: BNDES's Disbursements by Sector 2005-2023



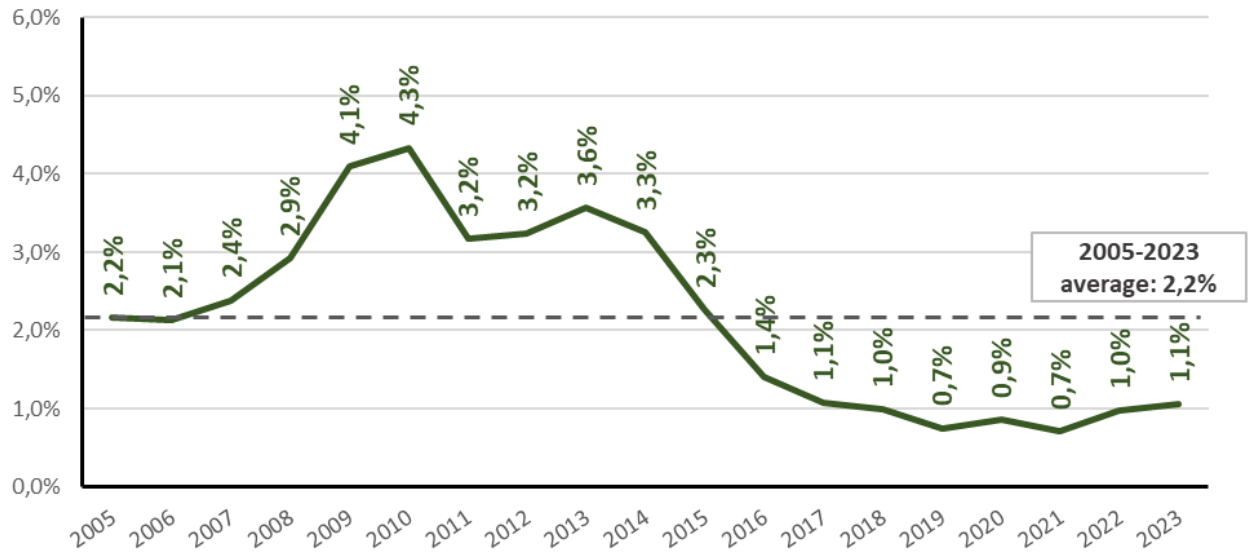
Besides supporting almost all economic activities using a diverse list of financial instruments, BNDES also supports all firm sizes. From 2011 to 2023, 39% of disbursements were destined to small and mid-sized companies and 61% to large companies, in average. BNDES does not have branches and counts on other Brazilian financial institutions to support smaller companies and to achieve better geographic distribution.

It is also useful to analyze the evolution of the relation between BNDES's size and the Brazilian gross domestic product across periods of economic booms and crises. From 2004 to 2010, the Brazilian economy presented its highest growth rates in the 21st century and this phenomenon was reinforced by increasing BNDES disbursements in the same period. This period was characterized by improvements in income distribution, reduction in poverty, controlled inflation and important drives of macroeconomic gains were household consumption and credit. BNDES's share on GDP reached a record of 4,3% in 2010. Since 2011, the Brazilian government reoriented economic policy by reducing public sector role and adopted restrictive fiscal and monetary policies which led to lower, yet positive, growth rates in the following years. In this period, BNDES maintained a high level of support to the economy and disbursements peaked at about R$ 190 billion in 2013. The disbursement/GDP ratio was kept over 3% until 2014 and began to consistently drop from 2015 onwards, reaching a mere 0,7% in 2021. Three recessions (the most recent caused by Covid-19), restrictive economic policies adopted mainly since 2017 and low average GDP growth characterized

the 2015-2022 period. The government introduction, in 2017, of a much less competitive interest as the reference to BNDES's loans has undermined the bank's capacity to foster investment and economic growth and was responsible for the lowest disbursement levels in decades. The TLP (Taxa de Longo Prazo or Long Term Interest Rate) is based on the government total debt cost and substituted the TJLP (also a long term interest rate) which was fixed by a monetary committee.

In 2023, BNDES began a new cycle of recovering in its role to Brazilian development both in terms of disbursement size and of policy complexity. Disbursements significantly rose in relation to previous years and although the GDP ratio reached only 1,1% the institution strategy planning contains the goal to achieve 2% until 2026.

Figure 3: BNDES's Disbursements in relation to GDP 2005-2023



Source: Authors

3. An Input-Output Model for BNDES

3.1. A Brief History of Input-Output at BNDES

Input-output (IO) analysis has been used by BNDES staff since the second half of the 1990's, starting with Najberg and Vieira (1997) and Najberg and Ikeda (1999). However, these analyzes did not evaluate the impacts of BNDES disbursement, their goal was to identify which sectors had the greatest potential for job creation in the Brazilian economy using the Brazilian IO for the years of 1990 and 1996, respectively.

The first attempt to develop an IO model to estimate the impact of BNDES disbursement was made by Freitas and Dweck (2010). Despite they do not present numerical results, the report contains a detailed methodological description of the model. The authors present an employment extended IO model using the official Brazilian IO matrix for 2005 (IBGE, 2008) and, beyond the traditional direct and indirect effects, it also contained an income effect based on Miyazawa (1976). Regarding converting BNDES disbursement data into the final demand vector, the authors suggested that BNDES Finem and BNDES Finame should have specific methodologies (the other financial instruments are not mentioned). The results obtained with this methodology were used by BNDES

mainly to compile its Annual Reports, where the direct and indirect jobs resulting from its financing are reported.

Although the methodology proposed by Freitas and Dweck (2010) has undergone some revisions over the following years, it had remained mostly the same until Santos and Miguez (2022) started a new improvement agenda. The list of modifications included replacing the 2005 IO matrix (IBGE, 2008) for the 2015 IO matrix (IBGE, 2018) and estimates for the impacts on the wage bill and value added in addition to employment. Nonetheless, Santos and Miguez (2022) did not processed BNDES disbursement separately by instrument, but a filter was applied to exclude those not related to the gross fixed capital formation (ex: working capital and exports) and domestical production (imported capital goods). At the end of the paper, there is also a list of planned improvements, some of them were implemented at the present paper.

Finally, it is also worth mentioning that BNDES is not the only development bank (or agency) that uses the IO framework. The Eximbank mentions in its Annual Reports (ex: Eximbank, 2024) that it uses an input-output modelling framework to estimate jobs supported with its loans. The African Development Bank used input-output framework (partial hypothetical extraction) to study the economic effects of the Covid-19 pandemics in Angola (AfDB, 2021). Even the International Monetary Fund has been using the IO framework for multiple topics, from global value chains (Chau et al., 2024) to remittances in Sub-Saharan countries (Dridi et al., 2019). However, despite the BNDES and Eximbank cases, it seems that the IO framework is not yet largely used by development banks to evaluate the impacts of its own loans.

3.2. The Input-Output Static Model with Exogenous Extensions

The IO framework at BNDES has been applied mostly to estimate the number of employments related to the implementation of investment projects and the purchase of machinery and equipment, for which the bank is widely known as one of the main sources of financing in Brazil. This means that the IO model at BNDES focus on the employments through the supply chain needed to produce the capital goods and to attend the construction yards that build industrial warehouses and all sorts of infrastructure.

Like Dweck and Freitas (2010), the model consists of a static model as proposed by Leontief (1951) and Leontief (1985) and summarized as follows:

$$\mathrm{X} = \mathrm{A}.\mathrm{X} + \mathrm{F} \qquad (1)$$

In equation (1) 'X' represents the production of the economy, 'A' is the national coefficient matrix and 'F' is the final demand sector. Solving the model for 'X' we have:

$$\mathrm{X} = (\mathrm{I} - \mathrm{A})^{-1}.\mathrm{F}$$

Replacing $(\mathrm{I} - \mathrm{A})^{-1} = \mathrm{L}$

$$\mathrm{X} = \mathrm{L}.\mathrm{F} \qquad (2)$$

$$\Delta\mathrm{X} = \mathrm{L}.\Delta\mathrm{F} \qquad (2')$$

In equation (2), 'L' is known as the Leontief inverse matrix (or impact matrix) that calculates the direct and indirect production needed to meet the final demand 'F'. Equation (2') indicates that it is possible to use the Leontief inverse in partial or additional sources of final demand, due to the linearity of IO models.

It is possible to use equations (2) and (2') to find not only the production needed ('X' or 'ΔX') to meet some final demand ('F' or 'ΔF'), but also other variables, such as employment, value added, taxes or emissions, provided that you have the corresponding data sets compatible with your IO data. These variables can be treated as exogenous and used in IO models if converted into sectoral output coefficients. For example, let 'e' be the matrix of sectoral employment coefficients, where 'e_i' is the employment-to-output ratio of sector i, and 'E' is the vector of sectoral employment, where E_i is the total employment in sector i. Then, the employment required to produce 'X' can be expressed as follows:

$$\mathrm{E} = \mathrm{e}.\mathrm{X} \tag{3}$$

Replacing 'X' in equation (3) considering equations (2) and (2'), the total amount of employment needed to meet some final demand ('F' or 'ΔF') is expressed as follows:

$$\mathrm{E} = \mathrm{e}.\mathrm{L}.\mathrm{F}$$

Replacing $\mathrm{e}.\mathrm{L} = \bar{\mathrm{L}}$

$$\mathrm{E} = \bar{\mathrm{L}}.\mathrm{F} \tag{4}$$

$$\Delta\mathrm{E} = \bar{\mathrm{L}}.\Delta\mathrm{F} \tag{4'}$$

In equation (4), $\bar{\mathrm{L}}$ represents the Leontief inverse matrix for employment, meaning that, instead of representing the direct and indirect production 'X' needed to meet final demand 'F', it represents the direct and indirect employment needed to meet the same final demand 'F'. The same process can be applied to other exogenous variables to derive specific Leontief impact matrices.

3.3. Data used

There are three data sets required to work with equation (4): the Leontief inverse matrix, the sectoral employment coefficient and the final demand vector. The Leontief inverse matrix comes from Alves-Passoni and Freitas (2023), employment data comes from Instituto Brasileiro de Geografia e Estatística (IBGE - the Brazilian official statistical office) and the final demand vector represents a portion of BNDES disbursements to build a vector 'F^{BNDES}'. As previously mentioned, the goal of this paper is to assess the employment impact of BNDES financing on the Brazilian economy calculating 'E^{BNDES}'. So we can rewrite equation (4) as follows:

$$\mathrm{E}^{BNDES} = \bar{\mathrm{L}}.\mathrm{F}^{BNDES} \tag{5}$$

Regarding the Leontief inverse matrix 'L', IBGE has IO data available only for 2010 and 2015. Therefore, instead of using IBGE's data, this paper utilizes annual IO data calculated by Alves-Passoni and Freitas (2023). These authors estimated annual IO matrices from 2010 to 2021 (at current prices) using the generalized RAS method, combing IBGE's IO data for 2010 and 2015 with IBGE's

annual supply and use tables. Both the IBGE and the data from Alves-Passoni and Freitas (2023) contain 67 sectors, which are listed in Appendix 1.

The employment coefficient 'e' is also calculated using IBGE's annual supply and use tables. Total sectoral employment 'E' is found in the use tables, while sectoral production 'X' is found in the supply tables. To obtain 'e', simply rewrite equation (3) as $'e = E/X'$. Rember that $\bar{L} = e.L$.

At last, the final demand vector 'F^{BNDES}' represents a portion of BNDES disbursements. Considering that 'L' and 'e' are given data, the methodological novelty of this paper lies in the process of constructing 'F^{BNDES}'. The conversion of financial and operational data from BNDES into a sectoral final demand vector compatible with IO models required a specific methodology that reflected the differences in its financial tools, as shown in Table 1.

Taking into account the usual components of final demand vectors in IO models, BNDES is mainly connected with Gross Fixed Capital Formation (GFCF) and Exports[3]. For this reason, the first step was to exclude BNDES disbursements not related with these two components, such as working capital, securities not directly associated with investment projects and acquisition of imported equipment[4]. The selected annual disbursements were then organized in the 67 sectors considering the client sector[5].

However, note that the final demand vector 'F^{BNDES}' must not represent BNDES's clients. It should be composed of the sectors responsible for providing the goods and services purchased by these clients. This means that the 'F_i' elements that make 'F^{BNDES}' represent what is needed to accomplish the investment projects, as this is the demand side of BNDES's loans. For example, a loan given to a water supply investment project would not be included in 'F^{BNDES}' in the water supply sector, but rather in the sectors contracted by the water supply company to execute the project, such as construction (ex: to build water treatment stations or install water tubes) and machinery and equipment (Ex: water pumps and automation equipment).

Indeed, considering the information presented in Table 1, it is notable that the nature of what can be purchased with BNDES financial instruments is different. For example, BNDES Finame only allows the financing of machinery and equipment acquisition. On the other hand, BNDES Finem also allows the financing of construction and other types of services needed for large investment projects. Hence, these differences must be considered because it changes the activities that might make up the final demand vector 'F^{BNDES}'. While in BNDES Finame the 'F_i' elements would basically be those from the capital goods sectors, with BNDES Finem 'F_i' elements would also include construction and other services[6].

[3] As reported in UN (2009), the usual components are the final consumption from household, non-profit institutions serving households (NPISHs) and general government; capital formation (GFCF and inventories); and exports.

[4] Imported goods and services must be excluded because they represent the rest of the world economy and therefore impact other economies rather than Brazil.

[5] Brazilian companies are officially classified at the National Treasury by the Classificação Nacional de Atividades Econômicas (CNAE), which is the Brazilian version of the International Standard Industrial Classification (ISIC).

[6] For example, investment projects in infrastructure sectors, primarily financed with BNDES Finem, are more intensive in construction than machine and equipment.

Consequently, the second step to build 'F^{BNDES}' is separating the disbursements by BNDES financial instruments. In this paper we considered only the disbursements for 'BNDES Finem', 'BNDES Finame' and 'BNDES Automático', already applying the filters explained in the first step. It was not possible to develop specific methodologies for the other financial instruments yet. However, these three instruments represent a considerable part of the BNDES disbursements as shown in Figure 1.

As each of 'BNDES Finame' loans represent a single transaction between a machinery and equipment company and a client, it is quite simple to convert this data into the requirements for 'F^{BNDES}'. The specific capital goods sector at which the supplier company belongs to represents the 'F_i' sector. For example, if one client finances the purchase of $100 in agricultural machines, it goes to 'F^{BNDES}' as $100 in the '$F_i$' sector where agricultural machines are classified, which is '2800 - Mechanical machinery and equipment manufacturing'.

Nevertheless, for 'BNDES Finem' and 'BNDES Automático', the process is not that simple. In these cases, the loans are given for investment projects, not for spot acquisitions of machinery and equipment. This means that, depending on the sector, the proportion of machinery and equipment, construction, and other services needed can vary significantly. For example, an automotive production plant likely requires a larger proportion of machinery compared to construction, whereas a highway project would demand more construction than machinery.

To overcome this issue, we use the Capital Flow Matrices (CFM) proposed by Miguez and Freitas (2021). The CFMs contain the sectoral GFCF by product and its estimations use Alves-Passoni and Freitas (2023) data, meaning they are totally compatible. In this paper we take the monetary values in the CFMs and use the corresponding sectoral proportions as the average demand for machinery and equipment, construction and other services needed in each project. For example, let the proportion of water supply projects needs given by the CFM, in a certain year, be 75% 'Construction', 15% 'Mechanical machinery and equipment manufacturing' and 10% 'Electrical machinery and equipment manufacturing'. Then, a $1000 loan from 'BNDES Finem' or 'BNDES Automático' to the water supply sector would go to F^{BNDES} as $750 to 'Construction', $150 to 'Mechanical machinery and equipment manufacturing' and $100 'Electrical machinery and equipment manufacturing'. So, the CFM is needed to convert the client loan in the sectoral demand they hire to execute the project.

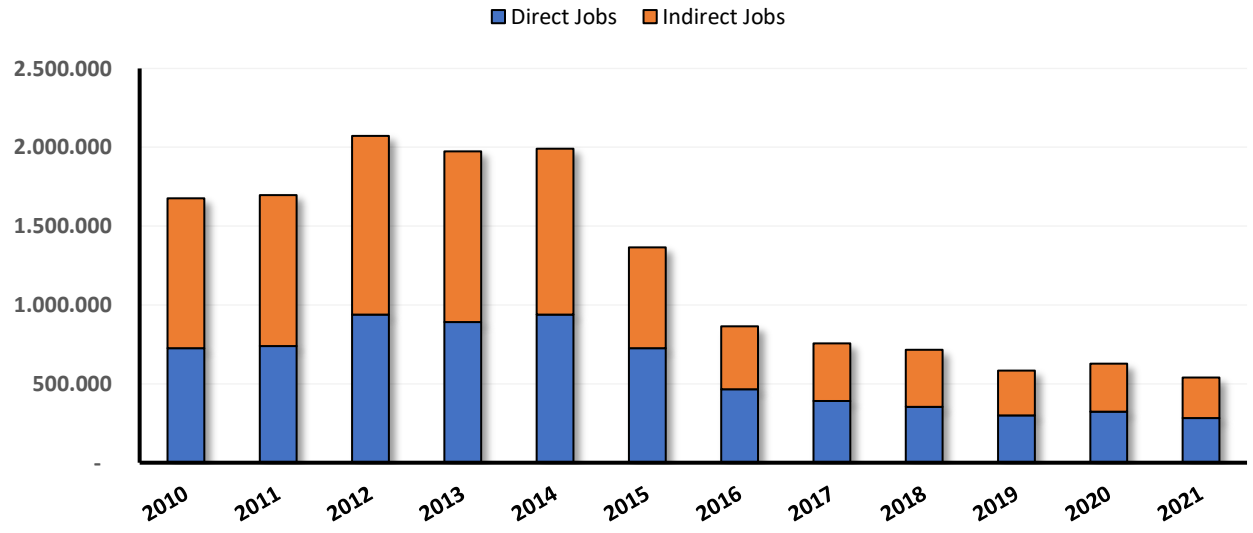
In conclusion, depending on what the financial instruments allow the clients to purchase and how the financial and operational data is organized at BNDES, a specific treatment is necessary to the data. It is worth noting that we believe other development banks and agencies could adapt this methodology to make its own final demand vector and use the IO framework to evaluate the economic impacts of its loans.

4. Results of BNDES Loans on Employment

The results were calculated for the 2010-2021 period. The results can be decomposed in: (i) direct jobs, which occur in the sectors that provide goods and services directly to BNDES clients execute their investment projects (for example construction, equipment manufacturing and engineering services); and (ii) indirect jobs, which correspond to the occupations in the supply

chains of these previous sectors (for example, steel industry, electric material, and cement). The Figure 4 presents the number of jobs directly and indirectly involved in BNDES disbursements.

Figure 4: Jobs directly and indirectly involved in BNDES disbursements



Source: Authors.

Obs.: BNDES disbursements are a portion of 'BNDES Finame', 'BNDES Finem' and 'BNDES Automático'.

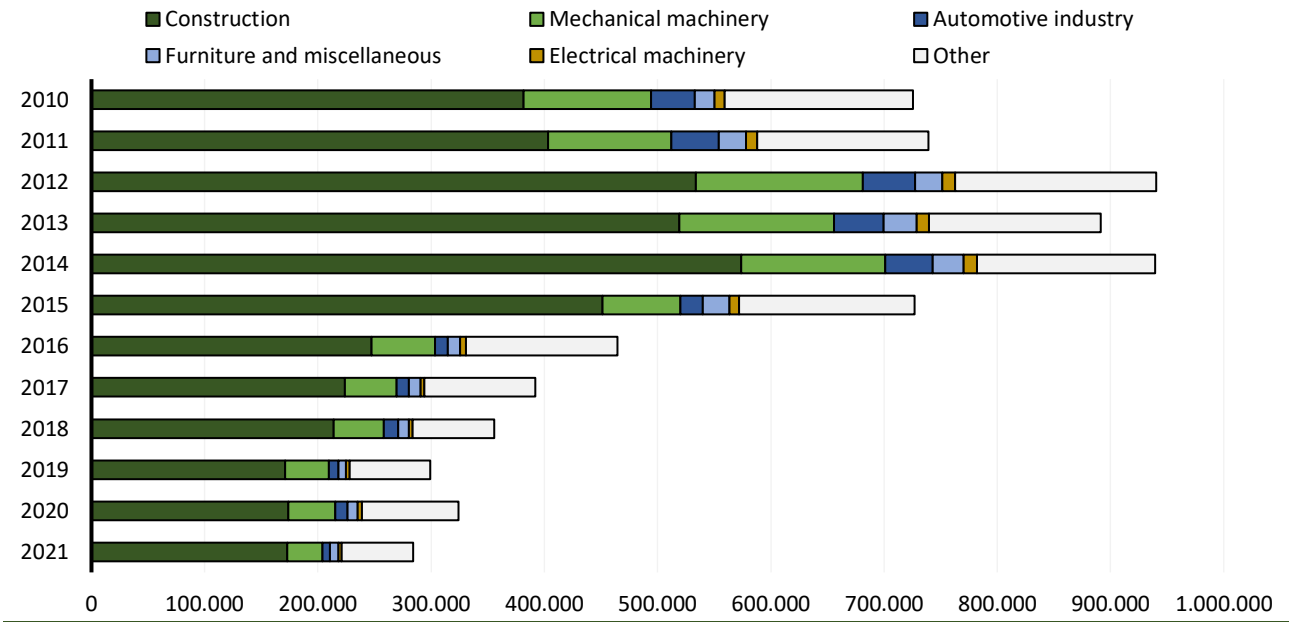
Looking at Figure 4 it is possible to see a strong correlation between the number of jobs involved in BNDES disbursements and the path these same disbursements had during the period as presented in Figure 1. The highest contributions occur during the period 2010-2014, when the share of BNDES disbursements in the Brazilian GDP (Figure 3) also had its highest values. In 2010 and 2011, BNDES loans were responsible for more than 1.5 million jobs in the Brazilian economy and from 2012 to 2014, almost two million jobs[7]. In the following years, there is a fall in the numbers of jobs involved, reaching almost 500.000 jobs in 2021, due to a combination of the Brazilian recession and the institutional changes at BNDES that led to a reduction in its disbursements.

It is also worth mentioning that there are a few changes in the proportion between direct and indirect jobs. It starts 2010 as 43,3% for direct jobs and 56,7% for indirect jobs. It constantly changes in favor of direct jobs over indirect jobs until 2016, reaching 53,7% and 46,3%, respectively. It slightly matches until 2018, reaching a share of 49,7% for direct jobs and 50,3% for indirect jobs, and in 2021 it reached a share of 52,7% of direct jobs and 47,3% for indirect jobs. More research is needed to better understand the relationship between these movements and the share of BNDES disbursements among its financial instruments and sectors involved.

Meanwhile, the IO framework also gives these direct and indirect results disaggregated by sectors, which are shown in Figure 5 and Figure 6, respectively.

[7] This is a relevant outcome considering that in 2014 Brazil had about 40 million people working in formal occupations.

Figure 5: Direct jobs involved in BNDES disbursements separated by sectors

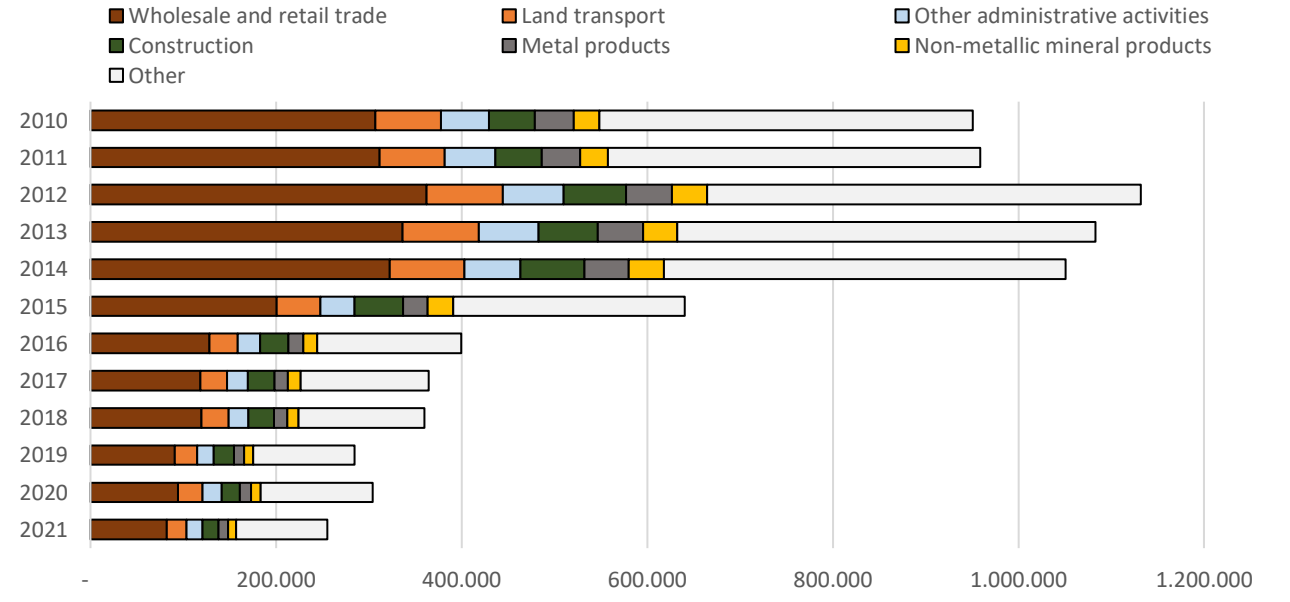


Source: Authors

Obs.: BNDES disbursements are a portion of 'BNDES Finame', 'BNDES Finem' and 'BNDES Automático'.

Figure 5 shows that 'Construction' and 'Mechanical machinery' are the sectors with more jobs involved. This result is expected considering that BNDES finances investment projects mostly related to acquisition of fixed assets, which is also connected to the other highlighted sectors 'Automotive industry' (where trucks and buses are classified), 'Furniture and miscellaneous' and 'Electrical machinery'.

Figure 6: Direct jobs involved in BNDES disbursements separated by sectors



Source: Authors

Obs.: BNDES disbursements are a portion of 'BNDES Finame', 'BNDES Finem' and 'BNDES Automático'.

Looking now at the sectors most involved in indirect jobs at Figure 6, the scenario is quite different. Firstly, the aggregation of 'Other' activities represents a larger share of total indirect jobs rather than in total direct jobs. This is a result of a more spread distribution among all sectors

considering that in the IO framework the indirect relations involve all levels of interactions through the supply chain. Secondly, the most affected sectors are 'Wholesale and retail trade' and 'Land transport', this reflects a structural characteristic of these sectors as "pass-through sectors" and the continental size of the Brazilian territory, which is mostly covered by land. Finally, 'Metal products' and 'Non-metallic mineral products' (where cement is classified) also relevant as an indirect employer. These two sectors are strongly correlated with 'Construction' (which also appears in Figure 6) and 'Mechanical machinery', the main sectors in Figure 5, revealing the importance of a developed supply chain to raise the multiplication effects.

5. Final Remarks

The objective of this study was to present improved estimates for the jobs associated with the implementation of projects supported by BNDES using an IO model. The BNDES is a crucial source of long-term funding for the Brazilian economy, supporting various economic sectors such as agriculture, manufacturing, services, and infrastructure. It offers a diverse range of financial instruments, including financing for large investment projects, machinery and equipment, export financing, support for small investment projects, and equity instruments. BNDES's performance is closely correlated with economic activity, particularly with Gross Fixed Capital Formation (GFCF), and it has played a significant role in countercyclical measures during economic crises.

The history of input-output (IO) analysis at BNDES dates back to the late 1990s, primarily focusing on identifying sectors with high potential for job creation. A more comprehensive IO model for estimating the impacts of BNDES disbursements was developed by Freitas and Dweck (2010). Subsequent improvements, initiated by Santos and Miguez (2022), involved updating the IO matrix and estimating impacts on employment, value added, and the wage bill. The methodology involves converting BNDES disbursement data into final demand vectors compatible with IO models, considering the specific nature of BNDES financial instruments.

The results in this paper covered the period from 2010 to 2021, focusing on direct and indirect employment impacts of BNDES-supported investment projects. Despite fluctuations in BNDES disbursements over the years, a significant number of jobs have been associated with these projects, with over 80% of estimated jobs concentrated in sectors such as 'Construction', 'Mechanical machinery', 'Wholesail and retail trande' and 'Land transport'. The number of jobs calculated are highly correlated with BNDES's disbursements and the estimations points that its highest contribution occurred from 2012 to 2014, when more than two million jobs were related to its loans. However, the results declined in the following years around 500.000 jobs in 2021.

The upcoming methodological improvements in the use of IO models in BNDES will include: (i) approach for generating final demand vectors for the remaining financial instruments such as BNDES Exim (support for exports); (ii) a mapping of the projects expenditures that will allow the use of BNDES-customized sectoral allocation of final demand instead of using the Capital Flow Matrices (CFM); (iii) employment results segregation by job qualification; (iv) recalculation of Santos and Miguez (2022) impacts on value added and taxes.

As part of the last years contemporary political economy trends, BNDES is restrengthening its role in promoting industrial and innovation policies. The use of up to date, customized and multi-

output driven IO models places an opportunity to better understand the socio-economic impacts of BNDES' financial support. The development and consolidation of the IO framework as an effectiveness evaluation tool by BNDES (or other development banks) has the potential to contribute to the improvement of its policies.

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Appendix 1: Listo of the 67 activities in Alves-Passoni and Freitas (2023)

Code	Description
0191	Agriculture, including agricultural support and post-harvest
0192	Livestock, including livestock support
0280	Forestry production; fishing and aquaculture
0580	Coal mining and non-metallic minerals extraction
0680	Oil and gas extraction, including support activities
0791	Iron ore mining, including beneficiation and agglomeration
0792	Non-ferrous metal ores mining, including beneficiation
1091	Slaughtering and meat products, including dairy and fish products
1092	Sugar manufacturing and refining
1093	Other food products
1100	Beverage manufacturing
1200	Tobacco products manufacturing
1300	Textile products manufacturing
1400	Garments and accessories manufacturing
1500	Footwear and leather goods manufacturing
1600	Wood products manufacturing
1700	Pulp, paper, and paper products manufacturing
1800	Printing and reproduction of recordings
1991	Oil refining and coke production
1992	Biofuel manufacturing
2091	Organic and inorganic chemicals, resins, and elastomers manufacturing
2092	Pesticides, disinfectants, paints, and miscellaneous chemicals manufacturing
2093	Cleaning products, cosmetics/perfumes, and personal hygiene products manufacturing
2100	Pharmaceutical and pharmochemical products manufacturing
2200	Rubber and plastic products manufacturing
2300	Non-metallic mineral products manufacturing
2491	Pig iron/alloy iron production, steelworks, and seamless steel tube production
2492	Non-ferrous metal metallurgy and metal foundry
2500	Metal products manufacturing, except machinery and equipment
2600	Computer equipment, electronic, and optical products manufacturing
2700	Electrical machinery and equipment manufacturing
2800	Mechanical machinery and equipment manufacturing
2991	Automobiles, trucks, and buses manufacturing, except parts
2992	Motor vehicle parts and accessories manufacturing
3000	Other transportation equipment manufacturing, except motor vehicles
3180	Furniture and miscellaneous industries manufacturing
3300	Maintenance, repair, and installation of machinery and equipment
3500	Electric power, natural gas, and other utilities
3680	Water, sewage, and waste management
4180	Construction
4500	Motor vehicle and motorcycle trade and repair
4680	Wholesale and retail trade, except motor vehicles
4900	Land transport
5000	Water transport
5100	Air transport
5280	Storage, auxiliary transport activities, and mail

Code	Description
5500	Accommodation
5600	Food services
5800	Publishing and integrated publishing with printing
5980	Television, radio, cinema, and sound/image recording/editing activities
6100	Telecommunications
6280	Systems development and other information services
6480	Financial intermediation, insurance, and private pension plans
6800	Real estate activities
6980	Legal, accounting, consulting, and business head offices
7180	Architecture, engineering, testing/technical analysis, and R&D services
7380	Other professional, scientific, and technical activities
7700	Non-real estate rentals and intellectual property asset management
7880	Other administrative activities and complementary services
8000	Surveillance, security, and investigation activities
8400	Public administration, defense, and social security
8591	Public education
8592	Private education
8691	Public health
8692	Private health
9080	Artistic, creative, and performance activities
9480	Associative organizations and other personal services