REGIONAL FUNDING AND REGIONAL INEQUALITIES IN THE BRAZILIAN NORTHEAST

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RESUMO

Este artigo tem como objetivo avaliar os impactos macroeconômicos, regionais e setoriais de um programa de crédito no Brasil: o Fundo Constitucional de Financiamento do Nordeste (FNE). Para isso, são realizadas simulações utilizando um modelo dinâmico e inter-regional de equilíbrio geral computável, calibrado para o ano de 2013, composto por 27 estados brasileiros e 20 setores econômicos. As simulações foram realizadas com base nos dados de investimento setoriais e regionais do FNE para os anos de 2014 e 2015, permitindo isolar o efeito do financiamento nas regiões. Os principais resultados indicam que os gastos do FNE entre 2014 e 2015 têm o potencial de aumentar o PIB do Nordeste em 3,51% até 2025, e os estados mais beneficiados são o Piauí, o Ceará e o Rio Grande do Norte. Além disso, as estimativas mostram uma diminuição da desigualdade regional entre os estados do Nordeste de 0,46%, medida pelo Gini regional. Em geral, os resultados são compatíveis com os objetivos do fundo, embora os efeitos totais, principalmente na desigualdade regional, sejam modestos.

Palavras-chave: Desenvolvimento regional; FNE; Equilíbrio geral computável; Região Nordeste.

ABSTRACT

This paper aims to evaluate the macroeconomic, regional and sectoral impacts of a credit program in Brazil: Northeast Constitutional Financing Fund (FNE). For this, simulations are performed using a dynamic and inter-regional computable general equilibrium model, calibrated for the year 2013, and composed by 27 Brazilian states and 20 economic sectors. The simulations were carried out based on FNE sectorial and regional investment data for the years 2014 and 2015, allowing to isolate the effect of the funding on macro regions. The main results indicate that FNE expenditures between 2014 and 2015 have the potential to increase Northeast GDP by 3.51% until 2025, and the most benefited states are Piauí, Ceará, and Rio Grande do Norte. Additionally, our estimations show a decrease in regional inequality among Northeastern states of 0.46% measured by regional Gini. In general, the results are compatible with the objectives of the fund, although the total effects, mainly on regional inequality, are quite modest.

Keywords: Regional development; FNE; Computable general equilibrium; Northeast region.

Jel-codes: C68; D58; R15; R58.

Área 10 - Economia Regional e Urbana.

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# Introduction

Socioeconomic inequalities are a very deep issue in Brazil. The levels of regional inequalities are among the greatest in the world (Baer, 2007; Shankar & Shah, 2003), although it has decreased in recent decades (Azzoni, 2001; Diniz, 1993, 2006; Ribeiro et al., 2018; Silveira Neto & Azzoni, 2011, 2012). The industrialization process that occurred between the 1950s and 1970s is associated with the increase of regional inequalities in Brazil, since it concentrated the industrial and urbanization advances in the Southeast region, as discussed by Baer and Geiger (1978), Haddad (1999), and Diniz (2006). In this process, other regions, mainly the Northeast, were locked-in a subsistence agriculture, production-based situation that was aggravated by the climatic conditions of the place, since much of the land constitutes the Brazilian semi-arid area.

From the 1990s, when the de-concentration of industrial production process began, the inflation control as well as the minimum wage appreciation policy and the income transfer programs in 2000s, have contributed to alleviate the regional inequality and poverty. However, the Northeast remains as the most unequal region in intra-regional terms (Ribeiro et al., 2018). In addition to the processes and policies cited, regional financing policies have been directed towards poorer regions in an attempt to alleviate regional inequality.

Regional financing funds began to be adopted when the Brazilian Constitution of 1988 addressed regional inequalities. The document has established not only direct transfers from the Federal Government to the states and municipalities (States Participation Fund – FPE, and Municipalities Participation Fund – FPM[[6]](#endnote-1)), but also investment policies called Northern (FNO), Midwest (FCO), and Northeast (FNE) Financing Constitutional Funds. The main goal of this policy is to provide long-term financing for investment projects, focusing mainly on small business and family farmers employed in dynamic sectors. This policy would increase the participation of these poor regions in the national economy. Furthermore, Stiglitz et al. (1993) argue that the existence of incomplete credit markets is one of the conditions for the inefficient allocation of financial resources, and government action is essential to correct such market failure, increasing access to credit.

According to Banerjee and Newman (1993) and Galor and Zeira (1993) constitutional funds can contribute to reducing inequalities by reducing credit asymmetry through two mechanisms: (i) by financing the private agent who does not have initial wealth as collateral but who needs it to break such a vicious circle; or ii) allocating credit to regions and/or private agents that do not have a large amount of assets to provide as collateral.

There is a large literature analysing the effectiveness of the European Structural Funds regarding the impacts on growth and regional disparities in less developed regions. However, there is still no consensus about the impacts. Dall’Erba and Le Gallo (2008) evaluate the impact of structural funds on the convergence process, and investigate the presence of spillover effects using spatial econometric models. They find that the funds have no impact on the regional convergence. Rodríguez-Pose and Fratesi (2004), using cross-sectional and panel data analyses, find only a modest impact of the funds on economic indicators. These authors highlight that supporting the agricultural sector brings positive effects on growth in the short-run, and only investments in education and human capital have positive impact in the medium-run. Some papers look to the impacts of funds on specific countries, such as Greece (Lolos, 2009) and Italy (Agovino et al., 2018), and they find, respectively, positive impact on growth and no impact on reducing inter-regional gaps. In other words, in what regard the European structural funds, the literature is not convinced about the effects of the regional policy.

In a similar way, there is also no consensus in the analysis of the Brazilian Development Funds. Some papers have studied the impact of these regional financing funds on employment, income, and other variables, such as Rodrigues and Guilhoto (1998), Oliveira and Domingues (2005), Silva et al. (2007), Almeida et al. (2007), Resende (2014), Soares et al. (2014), and Nascimento and Haddad (2017). However, there is no consensus about the impacts of the program.

This paper addresses macroeconomic, regional, and sectorial impacts of FNE. This paper contributes to the literature through the analysis of the FNE program using an inter-regional and dynamic computable general equilibrium (CGE) model, calibrated for 2013[[7]](#endnote-2) for the 27 Brazilian federation units. Through this model, we are able to identify the long-run impacts of FNE for a very detailed set of investments that have locally specific characteristics.

The paper is divided into five sections after this introduction. Section two presents the literature review on credit policies in developing regions, highlighting the public policies in Brazil that aim to reduce regional inequalities, more specifically, the FNE. The following section describes the main characteristics of the CGE model, whereas section four explains the database. The two final sections present the results and main conclusions.

# Public policies and regional development

Many policies to support and finance private enterprises have been adopted in Brazil, especially at the end of the 1990s, after macroeconomic stabilization, when concerns about regional inequalities were intensified. The regional (North, Northeast, and Midwest) Financing Constitutional Funds, whose main goal is to integrate less-developed regions in Brazil to a national level through credit availability to more productive sectors, were created. These funds were established by the Brazilian Federal Constitution in 1988 and, since then, have provided long-term credit to entrepreneurs, including family farmers, micro and small farmers, and have remained committed to developing dynamic areas, using a lower interest rate when compared to the market interest, and extra benefits, such as longer terms and a compliance bonus[[8]](#endnote-3).

The origin of the Constitutional Funds consists of 3% of the revenue of Income Taxes and Industrialized Product Taxes (IPI[[9]](#endnote-4)), collected in the previous year. 0.6% of the collected money goes to FNO, 0.6% goes to FCO, and the remaining 1.8% goes to FNE. In addition to taxes revenue, interest payments and unused resources from previous years compose the fund. This paper analyzes the economic impacts of FNE, whose area of activity includes the whole Northeastern region of the country, in addition to the north of Minas Gerais and Espírito Santo states. Although these two states are not part of the Northeast region, they are under the supervision of the SUDENE[[10]](#endnote-5), the institution responsible for analysis and for stimulation of economic growth in the Northeastern region of Brazil.

Half of this fund should be directed towards projects located in the semi-arid area, which is a subarea of the Brazilian Northeast whose socioeconomic development is still very underdeveloped when compared to the whole region. The policy focuses on some specific sectors, such as infrastructure, agro-industry, livestock, irrigation, mining, etc. According to Oliveira and Domingues (2005), one of the problems is that ultimately these funds are allocated according to the demand, which concentrates applications in more developed regions.

One of the first papers analyzing the efficiency of the FNE was written by Rodrigues and Guilhoto (1998). The authors used an input-output model to analyze the efficiency in terms of the allocation of the funds and the impact of the policy on income, employment, output, and imports between 1991 and 1993. They found the result pointing in the same direction that Almeida et al. (2006) and Almeida et al. (2007) found almost ten years later: funds were transferred primarily to the sectors with bigger potential effects over production, income, and employment. On top of that, the authors argue that there were positive effects of FNE on income, employment, and output.

From a partial equilibrium perspective, using econometric models, Almeida et al. (2006) and Almeida et al. (2007) have analysed how the Brazilian program is allocated among the municipalities, and they have found that the loans are allocated primarily in more dynamic municipalities, instead of in lower income municipalities, as was intended by the goals of the program. According to the authors, the program contributes to a decrease in inter-regional inequalities, which is a primary focus of the policy, but also with the increase of intra-regional inequality, given that more dynamic areas are located in wealthier municipalities.

In the last years, the literature on the FNE impacts has intensified (Almeida et al.*,* 2007; Resende, 2014; Silva et al., 2007; Soares et al., 2014, among others). However, there is still no consensus in the literature about the effects of the program on municipalities’ growth rates. Soares et al. (2014), for example, have found a positive effect on economic growth of most of the Brazilian Northeastern municipalities. On the other hand, Silva et al. (2007), using Propensity Score Matching, have not found any effect of the same policy on employment and wages from 1995 and 2000. For the analysis in the sub-period between 1995 and 1998, the authors found a positive impact on employment, which means that, on average, firms that have received funding from the policy have increased the number of employees more than firms without the treatment.

CGE models allow a distinct perspective, through an integrated analysis about the potential impacts of FNE in different regions (Northeastern states and the rest of Brazil) and economic sectors, taking into account spillover and feedback effects among regions in a general equilibrium setting. The simulations allow the creation of a counterfactual situation where the fund effect can be isolated from other economic shocks and policies. The following section describes the main characteristics of the model we use in this paper to analyze the economic impacts of FNE.

# Methodology

We use an inter-regional CGE model with recursive dynamic mechanism developed for the 27 federative units of Brazil, calibrated for 2013. The model is specified for 20 industries[[11]](#endnote-6), four final users (households, investment, government and exports) and imports, three productive factors (land, labour, and capital), two margins (trade and transport), a tax aggregate production, and indirect taxes for each of the 27 regions. The database represents the productive structure of the Brazilian economy in 2013, including the trade flows among regions.

The model is a Johansen (1960) type CGE model, based on the Australian tradition in CGE modelling, in which the mathematical structure is represented by a set of linearized equations and the solutions are obtained in a growth rates form. It is a bottom-up model and follows the theoretical structure of the TERM (The Enormous Regional Model) (Wittwer, 2012).

One of the major features our model is its computational ability to work with many regions and sectors from a simple database. This feature stems from the more compact structure of the database compared to other regional CGE models and from simplifying assumptions in the modelling of multi-regional trade (Horridge et al., 2005).

The presence of cost-minimizing sectors and utility-maximizing households compose the structure of our model. Each sector produces only one commodity using intermediate inputs, as well as primary factors (labour, capital, and land). The mix of primary factors and intermediate inputs is obtained in fixed proportions, by a Leontief function. Industries produce in constant returns of scale. Households, industries, and investors choose between domestic and imported goods or inputs (from another country) using a CES specification (Armington hypothesis), based on the purchase price from each source. Household demand equations are specified as a CES / Klein-Rubin preferences function.

There is market equilibrium for all goods, both domestic and imported, as well as in the factor market (capital, land, and labour) in each region. The demands for margins (transport and trade) are proportional to the flows of goods to which the margins are connected. Purchase prices for each of the use groups in each region (producers, investors, households, exporters, and government) are the sum of basic values, direct and indirect taxes on sales, and margins. The recursive-dynamics is based on a sequence of solutions for each year, among which, investment and capital stocks are adjusted according to regional and sectorial rates of return[[12]](#endnote-7).

The model database was developed through a regionalization procedure of information from the 2013 National Accounts System to Brazil (IBGE, 2017), based on the procedures developed by Horridge (2012) adapted to the Brazilian case. This methodology ensures the consistency of the database with the official information available for the country. Carvalho et al. (2017) and Ribeiro et al. (2018) apply this procedure to regionalize the official database for Brazil in an Amazon micro regions–Rest of Brazil and a Northeast micro regions–Rest of Brazil database, respectively. Our model accounts for the 27 Brazilian federative units, contemplating in a separate way the nine states that compose the Brazilian Northeast, as well as the trade flows between these and the other states of Brazil[[13]](#endnote-8).

The next section presents the simulation strategy adopted to access the macroeconomic, regional, and sectorial impacts of the FNE program.

# Simulation strategy

In order to evaluate FNE impacts, the simulation is divided in two types: baseline and policy scenarios. The baseline simulation allows updating of the model database for the historical period, for which we already have information on key macroeconomics variables and forecast the economy trajectory in a ‘Business as Usual’ perspective.

For the historical period (2014–2016), we used observed information on real GDP, investment, household consumption, government expenditure, exports, imports prices, consumer price index, and regional population growth as exogenous shocks. From 2017 to 2025, we used only two exogenous data: real GDP and government expenditure. For the period 2017–2018 Brazilian GDP estimates correspond to the values projected by the Brazilian Central Bank (2017), 0.7 and 2.7%, respectively, and from 2019 to 2025 we assumed a homogeneous growth scenario of 3% per year. Government consumption is assumed to grow 1% less than GDP, accounting for fiscal adjustments commitment assumed in 2017 (Senado Federal, 2016). Therefore, baseline simulations allow the projections for the economy from 2014 to 2025 without any further intervention in regional investments. Therefore, regional growth and investment are generated endogenously by our model in the baseline scenario[[14]](#endnote-9).

Policy scenario, by its turn, includes regional and sectorial detailed investment from FNE for 2014 and 2015 as an exogenous change (shocks) in the economy, allowing a deviation from the baseline scenario. The data provided by the Brazilian Northeast Bank allows identification not only of the region and the sector that receives the funding, but also the purpose of the fund, whether investment or for any other kind of expenditure. Selecting only the resources for which the finality was defined as investment, data reveals the funding is deeply concentrated in agriculture activities, and the largest beneficiary is the state of Bahia; however, looking for the share of FNE over total investment by sector and region, it was possible to see that FNE is also important for education activities and for other states like Piauí, where total investment is very low (Annex 1). All those differences, especially, in relative terms, are the main drivers of our results, which are detailed in the next section.

# Results and discussion

This section presents our results from four perspectives: i) aggregated, from showing the impact of FNE on the Northeast region; ii) regional, through the economic impacts on GDP and employment among the Brazilian states; iii) sectorial, from the identification of ‘winners’ and ‘losers’ in terms of sectors; and iv) regional inequality, comparing GINI variation in 2025 between the baseline and policy scenarios. Figure 1 demonstrates Northeast GDP growth in the baseline scenario and in the policy scenario. These results show how FNE funds would be able to positively impact the regional growth, moving the cumulative deviation in 2025 from 19.35%, to 23.54%, a cumulative difference of 3.51% in eleven years. As the deviation from baseline captures the policy effect, all the following results are presented as cumulated differences from the baseline scenario.

<Insert Figure 1>

As well as GDP, all the other macroeconomics variables in the Brazilian Northeast would be positively impacted by FNE investments, as shown in Figure 3. It is important to highlight that the impact on the Brazilian economy as a whole would be 0.70%. This result agrees with Nascimento and Haddad (2017) about the positive impacts of the FNE in the Brazilian GDP, even though the effects founded in our study are sensitively higher. Nascimento and Haddad (2017), using a static CGE model, estimate that the elimination of FNE would result in a reduction of 0.19% of Brazilian real GDP.

We found that in monetary terms, in 2025 the Northeast GDP would have increased around 18.2 BRL billions at 2013 prices, and the Brazilian economy would be 37.3 BRL billions bigger. The effect in monetary terms is higher in the rest of Brazil than in the region itself, which means that there is a significant leakage effect. This occurs because the Northeast’s productive structure is incipient when compared to the more developed regions of the country, as pointed out by Ribeiro et al. (2018). Nevertheless, the Northeast region is able to increase its participation in national GDP from 13.17% (baseline) to 13.43% (policy scenario).

As expected, the main component of the final demand that would contribute to the positive impacts on GDP would be investment, whose variation peaked at 9.16% in 2016 (Figure 2). This is mainly due to the adopted simulation strategy, which increased investment in the sectors which received FNE investments in 2014 and 2015.

In our model, according to the capital adjustment process, when a sector receives exogenous investment, as FNE resources, in period , the sector uses these resources for capital formation, i.e., buying machinery, equipment, construction services, and other goods in order to improve its production capacity in period . Therefore, in the next period, that industry will become more competitive, either attracting more investments or encouraging investments in other related industries. In this way, the investment generates cumulative effects in all regions directly affected and, in their surroundings, provoking positive effects throughout the economy.

<Insert Figure 2>

Aggregate employment follows the same trajectory of GDP growth, since the expansion of the economy implies greater use of primary factors in production, however, with the intensification of capital usage (due to investments), employment growth is slightly lower, increasing 2.75% in the end of the simulation period. Household consumption follows employment very closely and increases 2.78%, above the baseline scenario in 2025 (Figure 2).

Figure 3 shows the FNE’ impact on exports and imports of the Brazilian Northeast. It shows a relative growth in imports compared to exports, which can be explained by changes in terms of trade. The demand for investments from the benefited sectors by the FNE would increase their production costs, since the capital usage becomes more expensive. These sectors, in turn, would pass on the increase in its costs to final consumers through price increases, which would imply domestic goods relatively more expensive than imported goods.

Given the model’s mechanism of substitution effect, this would stimulate imports (positive changes throughout the period) and discourage exports, which would show negative variations during the investments’ period (2014 and 2015). Furthermore, the increase in production contributes to the increase of imports, whose cumulative deviation in 2025 would be 3.74% against 0.43% of exports.

<Insert Figure 3>

In order to measure FNE impacts in the Northeast and identify the spatial effects in the rest of Brazil, Figures 4 and 5 show the impact on GDP and employment among the Brazilian states in 2025. The greatest impacts, as expected, would be in the Northeast states, which are directly benefited by FNE resources. However, there is heterogeneity from the point of view of the impact magnitude within the region itself. Piauí – PI (5.69%), Ceará – CE (5.39%) and Rio Grande do Norte – RN (5.06%) would be the states with the largest accumulated GDP deviation in 2025, while the other states would grow around 3% above the baseline scenario. It is important to note that, the major impacts in these regions are associated with the greater share of FNE resources in total investment, since they are small economies.

<Insert Figure 4>

Although Bahia, in absolute terms, received the largest share of FNE resources, its impact (2.41%) would be the lowest among the Northeastern states. This can be explained as a result of Bahia having the largest economy in the region and therefore the contribution of FNE over total investment is less representative compared to other Federal Units.

Excluding Mato Grosso – MT (-0.25%), all other Brazilian states would present positive impacts as a result of the indirect effects of FNE investments. Following the mechanisms of our model, this occurs both because the intermediate demand of inputs from the Northeast sectors benefited from the FNE and the increase of the Northeast’s final demand in relation to the other states of Brazil. The FNE was allocated in consideration of the priority sectors and the demand for resources, concentrating funds to the agriculture and livestock of the Northeast. Given that Mato Grosso is an important agricultural producer in the country, this state suffers a type of competitive effect due to the relative improvement of agriculture in the Northeast. It is worth mentioning that in terms of employment impact (see Figure 6), there would be no losers, i.e., employment would increase in all of the Brazilian states as a consequence of FNE investments. Furthermore, the impact distribution in the Northeast is similar when compared to the GDP impact (Figure 4).

<Insert Figure 5>

Figure 6 shows the sectorial impact on output and employment as the accumulated difference between 2014 and 2025 relative to the baseline scenario. There are no losers related to the baseline scenario, which means all of Northeast’s sectors would have a positive impact on output and employment in the region as a whole.

The two most benefited sectors of FNE investments, i.e., agriculture, forestry and livestock and mining industry, are the same that would have the greatest impact on output and employment. In contrary, public sectors such as public administration and social security, public education, and public heath, would present the lowest impacts once these activities become ineligible to receive resources from FNE.

<Insert Figure 6>

In order to assess the impact that FNE investments could have on Brazilian regional inequality, the method used by Ribeiro et al. (2017, 2018) was adopted. GINI index from Brazilian states’ GDP distribution was calculated at current prices in the baseline and policy (considering the FNE investments) scenarios. According to Ribeiro et al. (2018, p. 737), ‘the idea is to see if there would be a positive (concentration) or negative (deconcentration) variation of the GINI index’. Table 1 shows the GINI index calculated in the baseline scenario and impacted by FNE investments and their relative variation for Brazil (taking into account all of the 27 states) and for Northeast region (only their states). The first one could reflect the impact on inter-regional inequality, once the last on intra-regional inequality.

<Insert Table 1>

Our estimations show a modest decrease in regional inequality among Northeast states of 0.46% measured by regional GINI. It is important highlight that we do not assume any income change among households in the same federal unit, but only on regional GDP distribution. A similar result was found by Nascimento and Haddad (2017). According to these authors, FNE acts in a way to deconcentrate the production and keep it less unequal throughout the national territory.

For sectorial specific investments, similar result was found by Ribeiro et al. (2017). These authors have shown using input-output simulations and GINI index variation that the domestic tourism expenditure spent in Northeast states also contributes to reduce regional inequalities. On the other hand, Ribeiro et al. (2018) have shown that structuring investments in the Brazilian Northeast increase regional inequalities.

# Final remarks

Regional policies have been adopted in Brazil since the Brazilian Constitution of 1988, addressing, in particular, the promotion regional economies and aiming to reduce poverty and inequality. The Northeast Financing Constitutional Funds (FNE) is one of the most important regional policies of the country, since the Northeast has some of the poorest regions in Brazil. Many studies have addressed the impacts of the FNE program on employment, income, and other aspects, even though there is no consensus about these impacts. The aim of this paper is to contribute, along with the available literature, through the analysis of the FNE program in Brazil using an inter-regional and dynamic computable general equilibrium (CGE) model, calibrated for 2013 for all Brazilian states.

The results show that FNE would increase, mainly, the output of the states and sectors that receive more of FNE resources in the Northeast: agriculture, forestry and livestock, and the mining industry. Sectors such as manufacturing industries, construction, and information services are also among the most positively impacted, both due to the indirect effects caused by the expansion of the regions that benefited the most, and due to the direct effects, given the greater relative participation of the investment generated by the FNE in the total investment of these sectors. The positive impact on all of the Northeast’s sectors’ output would cause a positive impact on the regional GDP. Thus, the simulation proposed here shows the positive impacts of FNE over the years on regional and sectorial economic growth. The results suggest important positive effects for the Northeast, and also for Brazil.

In terms of regional inequality, we found that the FNE program has positive impacts in regional inequality in Brazil given the direct and indirect effects of investment in the Northeastern states and the system of complementarities among the sectors. A more important result, however, is about its effects in reducing intra-regional inequality. Our results suggest that the investment funding has larger generator effects on small economies, such as Piauí, Ceará, and Rio Grande do Norte, while Bahia, the largest economy of the Northeast, is the least impacted. This effect occurs because FNE is less representative than the total investment in the less-developed federation units.

Thus, we can conclude that the FNE funding has been applied for a long time, and it has been an important source for local investment, especially for small producers, and underdeveloped areas.

Finally, we can point out some considerations that could be explored in further developments. Agriculture is a priority sector for the FNE policy, being the main target of resources, since it employs the poorest population of the Northeast. In terms of this objective, our results indicate that the FNE has been successful, since the sectorial results reinforce that priority sectors have been clearly benefited, and the spillover effects induce growth even in sectors that are not directly affected by the policy. An interesting point to be explored, however, would be the profile of agricultural production that has been promoted by the program– whether it directly benefits familiar agriculture or whether it creates jobs in large-scale production. The information about the production size could allow for this type of analysis in a model with household classified by income levels. Another important question is to investigate whether the current allocation of the FNE resources is maximizing the impacts on reducing inequality or if there is another composition of investment that would bring more benefit for this target. CGE models can be used not only for policy evaluation, but especially for ex-ante analysis of alternative policy designs. The alternative scenarios can also be connected to more specific policy goals, for instance, exploring the trade-off between allocation efficiency and inequality reduction.

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# Tables and Pictures

Table 1: Impacts on regional inequality –GINI indexes of regional GDP in 2025 in the baseline and policy scenarios

|  |  |  |  |
| --- | --- | --- | --- |
|  | GINI baseline | GINI FNE scenario | Variation % |
| Brazillian states | 0.643 | 0.641 | -0.26% |
| Northeast states | 0.393 | 0.391 | -0.46% |

Source: Authors’ own elaboration based on CGE simulations.

Figure 1: GDP results in the Brazilian Northeast, Baseline and Policy Scenarios – accumulated growth rate (%)

Source: Authors’ own elaboration based on CGE simulations.

Figure 2: Macroeconomic results in the Brazilian Northeast: accumulated deviation 2014–25 compared with the baseline (%).

Source: Authors’ own elaboration based on CGE simulations.

Figure 3: FNE impacts on Northeast’s exports and imports: accumulated deviation 2014–25 compared with the baseline (%).

Source: Authors’ own elaboration based on CGE simulations.



Figure 4: FNE impacts on Brazilian states’ GDP: accumulated deviation 2014–25 compared with the baseline (%).

Source: Authors’ own elaboration based on CGE simulations.



Figure 5: FNE impacts on Brazilian states’ employment: accumulated deviation 2014–25 compared with the baseline (%).

Source: Authors’ own elaboration based on CGE simulations.

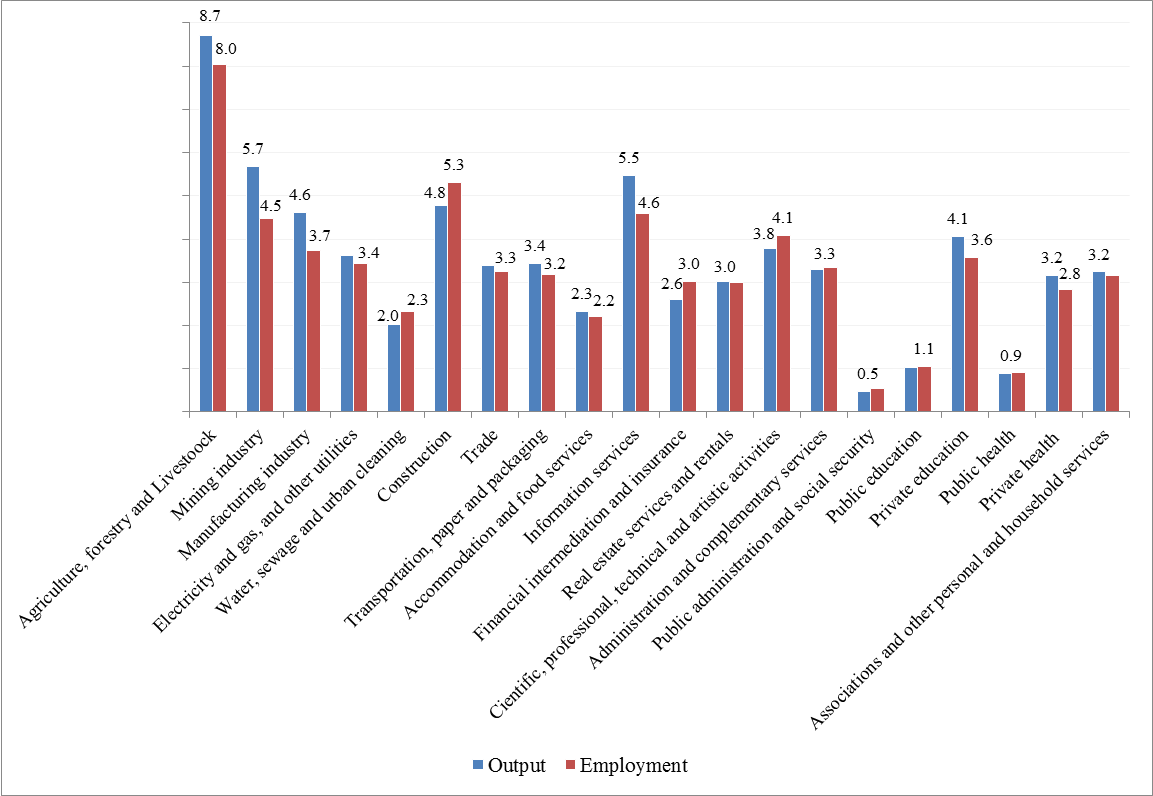


Figure 6: Impacts on sectorial output and employment in the Northeast region - accumulated deviation 2014-2025 compared to baseline (%)

Source: Authors’ own elaboration based on CGE simulations.

Annex 1 – Sectorial and regional distribution of FNE resources

(a)

(b)

(c)

(d)

Source: Authors’ own elaboration based on data provided by the Brazilian Northeast Bank and CGE data.

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6. Most of the acronyms are written as if in Portuguese. [↑](#endnote-ref-1)
7. The authors thank the Bank of Northeast (BNB) for providing the database. [↑](#endnote-ref-2)
8. *Superintendência de Desenvolvimento do Nordeste*. For more details about FNE characteristics, see Almeida et al. (2006). [↑](#endnote-ref-3)
9. From Portuguese ‘Imposto Sobre Produtos Industrializados’. [↑](#endnote-ref-4)
10. The simulation was made using data for investment in the Northeastern states. [↑](#endnote-ref-5)
11. Aggregated from 67 industries in the Brazilian input-output database. [↑](#endnote-ref-6)
12. For a complete description of equations and solution method see Dixon and Rimmer (2002) and Wittwer (2012). [↑](#endnote-ref-7)
13. In the regionalization process, it was assumed that the regional industries have the same technology (input-output coefficient) of the respective national industry, both for intermediate inputs (domestic and imported) and for primary factors. The regionalization of the final demand vectors (consumption, investment, exports, and government consumption) was based on specific information to each of these components. See Carvalho et al. (2017) and Ribeiro et al. (2018) for more information about the regionalization procedure. [↑](#endnote-ref-8)
14. With the exception of the regional population growth variable, the baseline scenario does not incorporate other regional characteristics; accordingly regions follow national macroeconomic trends. [↑](#endnote-ref-9)