From Jobs to Wages: Evaluating the Complex Effects of Place-Based Policies in Brazil

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Abstract

The study evaluates the impact of subsidized loans from the FNE, Brazil's primary place-based policy instrument, on benefiting firms. The empirical strategy uses a multi-period difference-in-differences estimator that is robust to heterogeneities, together with a unique set of longitudinal firm-level data for the state of Pernambuco, which allows us to control for the influence of other policies (place-based and non-place-based), such as subsidized loans from Sudene (a federal agency for the development of the Northeast region) and BNDES (the Brazilian federal development bank), as well as tax incentives at the federal and state levels. Our results indicate that FNE loans significantly and sustainably increase the number of employees and reduce the wages paid by firms in the early years. The positive effect on employment is independent of the purpose of the loan, while the negative effect on wages is associated with the use of resources for costing and working capital and the hiring of less skilled workers. We show that the failure to account for the possibility of firms accumulating incentives from different policies leads to a significant overestimation of the effect of the FNE on the number of employees. Comparing the impact of subsidized loans from the FNE with those from the BNDES (a non-place-based instrument) suggests that the better results of the latter are linked to the greater proportion of financing directed at investment.

Keywords: Public Policy, Government programs, Job creation, Regional development, Difference-in-differences multiple periods, Brazil.
JEL Code: O18, G21, J21, O22, L26 and H25

1. Introduction

Place-based policies refer to government programs designed to enhance the economic performance of specific geographic areas. These policies often involve providing subsidized loans and fiscal incentives to generate more job opportunities and increase local income (for recent surveys, see [1] and [2]). Such policies are regularly present in developed and developing contexts despite the lack of consensus among economists about their relevance. On the one hand, some emphasize the loss of efficiency in allocating resources to less productive regions (to the detriment of more productive ones) with uncertain or even negative results (for example, [3]; [4]; [5]). On the other hand, others argue that such actions enable the correction of market failures, the internalization of spillovers, and the generation of agglomeration gains (see [6]; [7]; [8]). Indeed, recently, [9] have argued that when poor families are spatially concentrated can yield equity gains that outweigh their efficiency costs, even when income-based transfers are set optimally.

The causal inference regarding the effectiveness of these policies is relatively recent and still does not overwhelmingly favor either side of the dispute (for surveys of empirical results, see [1]; [10]; and [2]). For example, [11], [12], and [13] provided evidence of positive labor market effects of such policies in Germany, the US, and India, respectively. But [14] found no impact on employment and wages of specific palce-based policies in Germany and [15] evidenced a negative impact on regional innovation due to support for "zombie" firms in China.

This paper examines the impact of the subsidized credits granted by the Northeast Constitutional Financing Fund (*Fundo Constitucional de Financiamento do Nordeste*, FNE) in Brazil. The FNE is Brazil's most significant place-based policy, as the country is known for its historically high regional income inequality ([16], [17], [18]). Our identification strategy utilizes a unique and comprehensive dataset from the northeastern state of Pernambuco. Unlike earlier studies, this dataset allows us to focus specifically on firms that have exclusively benefited from FNE credits over different time periods. Using the Difference in Differences estimator proposed by [19], we can effectively compare firms that have received benefits with those that have not yet received them. The strategy enables us to account for both time-fixed and time-varying factors specific to the firms benefitting from the FNE.

Place-based policies in Brazil have a long history, first established with the creation of Sudene (*Superintendência de Desenvolvimento do Nordeste*),

the federal agency to promote the development of the Northeast region, in 1959 [20, 21]. The Brazilian 1988 Constitution represented an institutional reinforcement of this kind of policy by expanding states' fiscal freedom and creating the FNE.[1] In 2023, for example, the FNE has conceded about US$ 9.0 billion in subsidized credit to firms in the Northeast region and parts of Minas Gerais and Espírito Santo (about 4% of Northeast GDP)[2].

While these policies have a long tradition in Brazil, credible evaluations of them remain rare. Our research seeks to fill this gap and enhance existing literature by analyzing a key place-based policy from a prominent developing country. As noted by [1], while much of the existing evidence focuses on developed countries, evaluations of these policies are particularly critical for developing nations due to their limited resources. In the Brazilian context, income transfer programs that focus on individuals have a notable impact on regional income inequalities, as indicated by [22] and [23]. This effect mainly results from the high concentration of impoverished individuals in economically disadvantaged areas. The findings highlight the opportunity cost associated with implementing place-based policies and underscore the necessity of evaluating such policies in the country.

To the authors' best knowledge, this investigation is the first evaluation of FNE that explicitly considers the potential influence of benefits from other place-based or non-place-based policies in Brazil. Previous evaluations of FNE, such as those by [24], [25], and [26], indicate positive effects on job creation at the firm level, but no effect on wages. At the municipal level, the evidence is mixed. For example, although [27] did not find a significant impact on municipal GDP per capita, [28] reported positive effects of the FNE on this aggregate and the wage bill. However, these works do not consider the benefits of other policies that can operate simultaneously with those of the FNE. Consequently, the findings cannot be attributed solely to the FNE.[3]. In a strategy that avoids this drawback, [29] found that subsidized credit from the FNE increased climate-resilient livestock in the Semi-arid region.

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[1]The law that established the FNE (Law no 7.827/1989) also created funds for other less developed regions: the Constitutional Fund for the Financing of the North (FNO) and the Constitutional Fund for the Financing of the Centre-West (FCO).

[2]https://bit.ly/4cVyJHJ

[3]As discussed in the next section, the problem is far from negligible; in 2017, for example, 27.2% of firms benefited with FNE resources in Pernambuco also received benefits from other policies such as subisied credits from BNDES or tax benefits from Sudene.

However, this research does not provide an evaluation of the FNE itself; rather, it examines the effects of various levels of possible subsidies from the policy in the Semi-arid region.

Unlikely, in our investigation, we are able to identify benefits from all other place-based policies (including subsidized loans from FDNE, *Fundo de Desenvolvimento do Nordeste*, fiscal incentives from Sudene, and fiscal incentives at the state level) and non-place-based policies (subsidized loans from BNDES, *Banco Nacional de Desenvolvimento Econômico e Social*). Our results, thus, reflect solely the effects of the subsidized loans from FNE. Due to data availability, we had to concentrate on formal firms located in the state of Pernambuco, which introduces some limitations to the analyzed firms' universe.

According to FNE reports ([30]), formal companies account for between 60% and 70% of the total volume of FNE loans and financing, depending on the credit line and the stage of implementation of the resources. These formal companies have greater access to more structured and higher-value credit lines, especially in the modalities intended for infrastructure, manufacturing, commerce, and services [30]. Even including formal firms in the agroindustrial and rural sectors, our sample of firms, thus, overlooks the majority of loans individually granted for agriculture and a significant portion of the Semi-arid region[4]. Between 2000 and 2023, Pernambuco remained the third highest in terms of resource allocation to firms, accounting for approximately 13.8% of them[5]. Reflecting the general direction of the FNE, around 67% of the fund's resources in the state are directed to firms located in urban areas.

Based on a difference-in-differences approach, our investigation utilizes unique firm-level information in the period 2000-2017. Our research can obtain, thus, short- and medium-term estimates for the effects of FNE, another important aspect largely ignored in the previous evaluations. Our main results indicate that subsidized FNE loans increase the employment level of benefiting firms on average by 8.9% and reduce employees' salaries by 4.9%. The positive effects on employment last for at least eight years after the firms receive the resources, while the negative effects on wages disappear after six

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[4]Especially loans granted to credit lines for smallholder farmers

[5]The states of Bahia and Ceará regularly receive the highest and second highest amounts of resources from the FNE, respectively.

years from the date of granting the credit. Such results are consistent with FNE resources working to expand activities with the incorporation of less qualified workers.

Before verifying the reasonableness of such an interpretation, we subjected the results to a significant battery of robustness tests. Such tests involve obtaining results separated by geographic regions (Metropolitan Region of Recife and Seimarid) and results with control for the influence of other important policies, including social policies such as *Bolsa Família* Program and *Benefício de Prestação Continuada*, the Cisterns Program, the National Regional Development Policy, and federal investments in economic hubs.

We then explore possible heterogeneities that may inform about the mechanisms behind the obtained results. Consistent with our aforementioned interpretation, the general pattern of employment expansion with wage reduction is observed only for micro and small firms, for jobs with low levels of education, and firms in the services and commerce segments. Notably, we found no effect of FNE on employment for medium and large firms, nor for manufacturing firms.

Our final exercises demonstrate the consequences of not considering the possibility of simultaneous benefits (FNE plus other incentives) when evaluating FNE, as well as the differences between the effects of loans from FNE and BNDES (the Brazilian development bank). The comparison with BNDES loans is particularly useful because these loans are not place-based and are less focused on financing firms' working capital. Two key findings emerge from our analysis. First, we demonstrate that failing to consider the simultaneous effects of FNE funds and other policies results in a significant overestimation of the FNE's impact on employment. Second, unlike the FNE, BNDES loans have a positive effect on both employment and the wages paid by firms ([31], [32]).

In addition to this introduction, the text is organized into six parts. The next section examines the context of FNE and place-based policies in Brazil and Pernambuco. Section three presents our empirical specification and data. Section four presents the baseline results and robustness checks, while section five examines possible channels for the effects and heterogeneities. Section six provides estimates of the impact of the FNE when including firms that accumulate benefits from their loans alongside incentives from other policies, as well as estimates of the impact of BNDES loans. The conclusions of the study are presented in the seventh and final section.

2. Background

2.1. The FNE and place-based incentives in Brazil

The FNE was created by Law No. 7,827 of 1989, which regulates an article of the 1988 Constitution, to contribute to economic and social development through the concession of subsidized credit for companies, individual entrepreneurs, associations and cooperatives [30].With FNE's credit operations under the responsibility of *Banco do Nordeste do Brasil* (BNB), a federal regional bank, the Fund's area of operation currently covers 2,074 municipalities in the nine states of the Northeast region and the north of the states of Espírito Santo and Minas Gerais (37.2% of the country's municipalities).

The resources for FNE loans come essentially from 1.8% of the annual collection of two federal taxes, the *Imposto sobre Produtos Industrializados* (IPI), a tax on manufactured products, and the *Imposto de Renda* (IR), the income tax.[6] The total of the resources also includes the returns and results of their investments, resulting from the remuneration of the resources not currently used. The law also requires the allocation of 50% of the resources to the Semi-arid region (1,477 municipalities).

Interest rates on FNE loans are set by the National Monetary Council (CMN)[7], based on recommendations from the Ministry of Regional Integration and Development, and vary according to four dimensions: the sector of activity the type of use of the resources (investments, working capital and projects in the areas of the environment and science and technology), the size of the companies and the per capita family income in the municipality.[8] In general, the lowest rates are obtained by micro and small firms in rural areas. The FNE rates effectively represent a public subsidy. For example, from 2001 to 2015, the average (weighted by contract value) of these rates varied from 11.7% per year to 9.5% per year, while the corresponding official

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[6]3% of the values of IPI and IR are passed to the three constitutional funds: 1.8% to FNE, 0.6% to FCO (*Fundo Constitucional de Desenvolvimento do Norte*), and 0.6% to FCO (*Fundo Constitucional de Desenvolvimento do Centro-Oeste*).

[7]CMN defines the methodology for calculating financial charges on financing non-rural credit operations with resources from Constitutional Financing Funds. A detailed description of how loan rates are defined and how they vary by region, sector and size is presented in `https://bit.ly/4fOVcc4`.

[8]For details, see `https://bit.ly/4bCHlSA`.

inflation rate varied from 7.7% per year to 10.7% per year.[9]

As highlighted by [33], since the beginning of its implementation, at the end of the 1980s, the volume of FNE loans has shown a significant growth, from R$ 2.5 billion in the 1989/90 biennium to R$ 32.7 billion in 2018 (both at 2018 values). Such resources were distributed among the Manufacturing sector (19.6%), agro-industrial (1.8%), infrastructure (15.6%), commerce and services (21.4%), and rural activities (41.6%). The resources of FNE have also favored small firms (47.3% of total).[10]

In 2023, the loans of the FNE amounted to about R$ 43.7 billion (US$ 9.0 billion, about 4% of the GDP of the Northeast). Since the allocation of resources to firms depends on the demand for firms, states with larger economies end up receiving a larger share of loans. For example, in 2023, Bahia, Ceará, and Pernambuco (the three largest state economies) received 51.2% of FNE resources, with Pernambuco in particular receiving 13.6% or R$ 5.9 billion (1.4% its 2022 GDP).[11]

However, the FNE is not the only place-based policy in Brazil that favors the northeastern states. Since its creation in 1959, Sudene, the federal agency in charge of planning the development of the Northeast, has acted through tax incentives for companies in the region. The current version of these incentives (valid until 2028) offers companies a full exemption from corporate income tax (*Imposto de Renda sobre Pessoa Jurídica*, IRPJ) for the manufacture of machinery, equipment and digital technology devices; a 75% reduction for modernization and expansion projects; and the option to reinvest 30% of the IRPJ in new investments. The incentives are valid for 10 years.[12] In addition, Sudene operates the *Fundo de Desenvolvimento do Nordeste* (FDNE), which also offers subsidized loans to companies. Created in 2001, the FNDE provides subsidized loans of up to 80% of a project's

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[9]See https://bit.ly/4fb41ws. The official inflation rate is measured by the change in the IPCA (*Índice de Preço ao Consumidor Amplo*). Note that the Selic rate (base rate for short-term government bonds) was 15.2% per year at the beginning of 2001 and 14.1% per year at the end of 2015.

[10]By the BNB criteria, the following classification by size is considered (according to income gross operational and/or gross agricultural income): i) mini/micro - up to R$ 360 thousand; ii) small - above R$ 360 thousand up to R$ 3.6 millions; iii) small-medium - above R$ 3.6 million to R$ 16 million; iv) medium - above R$ 16 million to R$ 90 million; and v) large - above R$ 90 million.

[11]The official GDP for 2023 is not available.

[12]See [34] for a recent evaluation of the application of these incentives.

value for a period of up to 12 years. Eligible projects include infrastructure, public services, and investment structuring. The financing limit ranges from 40% to 80% of the project value, with the higher limit applicable to projects in the Semi-arid region and infrastructure areas.

There are no estimates of the cost of Sudene's tax exemptions. In 2023, such exemptions were associated with approximately R$ 34.2 billion of investments in its area of activity, of which R$ 6.8 billion in Pernambuco (19.9% of the total). Aimed at infrastructure works and investment structuring, the FNDE released approximately R$ 2.5 billion for new projects in the region in 2023, of which R$ 811.4 million was allocated to projects in Pernambuco.[13]

With the greater fiscal freedom granted to the states by the 1988 Constitution and a certain weakening of the coordination of territorial policies in the 1990s, the states also established local tax incentive programs based on the *Imposto sobre Circulação de Mercadorias e Serviços* (ICMS), the main tax at the state level. In the state of Pernambuco, for example, the Prodepe (*Programa de Desenvolvimento do Estado de Pernambuco*) was created in 1995 (Law 11,288/1995). The incentive is obtained through the granting of presumed ICMS credit, which varies from 47.5% to 95% (according to the region and activity) and extends for 12 years (may be extended to December 31, 2032). All other eight northeastern states have implemented similar programs.[14] According to the government's calculations, Prodepe's tax exemptions in 2023 amounted to approximately R$ 3.6 billion, benefiting 2,182 firms.[15]

In addition, loans from *Banco Nacional de Desenvolvimento Econômico e Social* (BNDES), the Brazilian development bank, although not based on any spatial criterion, are a regular source of resources for companies in the Northeast region due to their low interest rates. In 2023, for example, R$11.3

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[13]https://bit.ly/3WdR4Jk.

[14]In the State of Maranhão, there is the *Sistema de Apoio à Indústria e ao Comércio Exterior do Estado do Maranhão* (SINCOEX); in Piauí, the *Lei de Incentivos Fiscais do Piauí*; in Ceará, the *Fundo de Desenvolvimento Industrial do Ceará* (FDI); in Rio Grande do Norte, the *Programa de Apoio ao Desenvolvimento Industrial do Rio Grande do Norte* (PROADI); in Paraíba, the *Fundo de Apoio ao Desenvolvimento Industrial da Paraíba* (FAIN); in Alagoas, the *Programa de Desenvolvimento Integrado do Estado de Alagoas* (PRODESIN); in Sergipe, the *Programa Sergipano de Desenvolvimento Industrial* (PSDI); and in Bahia, the *Programa de Desenvolvimento Industrial e de integração Econômica do Estado da Bahia* (DESENVOLVE).

[15]See https://bit.ly/42Kf6Px.

billion in loans were allocated to the region (about 9.9% of the bank's disbursements that year), with firms in the State of Pernambuco receiving about R$ 1.1 billion.[16]

While the comparison of resources involved in the various Brazilian regional policies discussed so far leaves no doubt about the relevance of the FNE, this comparison also shows that other policies (place-based or not) cannot be ignored. The volume of FNE loans is also relevant when compared to the federal government's social income transfer programs, which, despite their non-spatial nature, have the Northeast region as their main destination ([22]). The *Bolsa Família* program (the federal income transfer program for poor families) and the *Benefício de Prestação Continuada* (a program to help the elderly and people with physical disabilities) destinated approximately R$ 64.7 billion and R$ 30.1 billion, respectively, to the Northeast region in 2023. Of these amounts, R$ 11.1 billion and R$ 5.6 billion, correspondingly, went to the State of Pernambuco.[17]

2.2. FNE and Overlapping Incentives in Pernambuco

Since there is no legal obstacle for a company in Sudene's area of activity to receive aid from different development policies (place-based or not), the possibility of accumulating benefits represents an important challenge in evaluating the impact of FNE. We address this challenge by using a unique dataset on firms in the state of Pernambuco, which allows us to identify different benefits received by firms in the state, including loans from FNE, BNDES, and FDNE, and tax incentives from Sudene and Prodepe during the period 2000-2017. Thus, we can consider firms that have only received incentives from the FNE.

Although the exclusive focus on Pernambuco may, in principle, reduce the external validity of the evaluation, we believe that the characteristics of this state strongly mitigate this concern. Historically, the state has been the third-largest recipient of funds from the FNE. With about 9 million people and a GDP of R$ 254.9 billion (US$ 48.8 billion) in 2022, it is the second most populous and has the second highest GDP in the region (16.3% and 17.8% of the Northeast's population and GDP, respectively).([35]). Moreover, due

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[16]See https://bit.ly/444noEi.

[17]The total sums transferred by the *Bolsa Família* program and the *Benefício de Prestação Continuada* in 2023 corresponded to R$ 143.1 billion and R$ 85.1 billion, respectively. See https://bit.ly/4cYkZOo

to its geography, Pernambuco presents all the typical natural environments of the Northeast region (Sea Coast, Atlantic Forest, *Agreste*, and *Sertão*), and approximately 66.5% of its municipalities are located in the Semi-arid region, a priority region for the FNE (See Figure 12 in the 9). Finally, Pernambuco also contains the metropolitan region of Recife, the second largest in the Northeast and the seventh largest in the country (with about 3.7 million people). The presence of such a metropolitan area, together with the importance of its Semi-arid region, makes the state an interesting case for understanding the impact of FNE.

Our final database of information is the result of identifying companies that received various public policy benefits (loans from FNE, FDNE, and BNDES and tax incentives from Sudene and Prodepe) in the microdata of *Realtório Anual da Informaços Sociais* (RAIS), an annual report for the universe of formal companies in Brazil produced by the Ministry of Labor and Employment (MTE). Using the RAIS microdata and information on beneficiaries of various policies, we present the total number of companies in Pernambuco, along with specific breakdowns, in Table 9 in the Appendix. This table includes the total number of companies, the number that received benefits from any policy, the number that benefited specifically from the FNE, and the number that did not receive any policy benefits, for each year from 2000 to 2017. Our information on formal firms in Pernambuco indicates that the accumulation of incentives from different policies is far from rare.

The numbers indicate that in 2017, for example, 12.8% of the 97,261 formal firms in Pernambuco received some production support from the government. The figures also leave no doubt about the important role of the FNE in these benefits: also in 2017, 56% of the benefited firms received support from the FNE (6,948 firms), a percentage that is also increasing over time. Besides, there is a growing tendency of companies benefiting from the FNE to accumulate benefits from other policies. For example, while in 2010 17.6% of FNE beneficiary firms also received productive support from other policies (loans from BNDES and/or FDNE and/or tax incentives from Sudene and/or Prodepe), this share was almost ten percentage points higher in 2017 (27.2%). Finally, we found that among the beneficiaries of public aid in the state between 2000 and 2017, an average annual percentage of 25.6% benefited only from the FNE (a yearly average of about 1,886 companies). Despite the increasing use of various incentives by firms, a significant number of them rely solely on FNE loans.

Considering that the other northeastern states are also in Sudene's area

of operation and have their own state tax incentive programs, the situation is unlikely to be different there. A credible assessment of the impact of the FNE on recipient firms must therefore be able to minimally isolate possible influences from these other policies.

3. Empirical Strategy

3.1. Econometric Specification

To assess the impact of subsidized FNE loans on firms benefiting from this incentive, we use panel data with information on firms that received only FNE loans and a staggered difference-in-differences (DiD) framework. Denoting Y_{it} as the variable of interest of firm i in t, we consider the following DiD specification:

$$Y_{it} = \beta FNE_{it} + X_i \gamma_t + \phi_i + \lambda_t + \epsilon_{it} \qquad (1)$$

Where the variable FNE_{it} equals one if the firm benefits from the FNE at time t, and zero otherwise; the vector γ_t represents a set of time-varying parameters related to the initial characteristics of the firm X_i; ϕ_i denotes firm fixed effect and accounts for time-invariant factors affecting firm activity and the chance of receiving benefits from FNE; λ_t represents the time fixed effect, which captures the impact of the economic environment on business activities and the conditions for accessing FNE loans; and ϵ_{it} represents the error term. We utilize annual data from 2000 to 2017 to obtain a reliable estimate of the parameter β.

We examine three outcome variables to evaluate the economic impact of the FNE on recipient firms: total number of employees, average wage paid, and total payroll value. Analyzing these three outcome variables provides valuable insights into the potential mechanisms behind the functioning of FNE loans. For instance, a positive effect on employment may result from increased productivity within the firm, leading to improvements in the production process and, ultimately, higher employee wages. However, it is also possible that the increase in employment associated with FNE loans results from an expansion of activities that do not improve, or may even reduce, productivity and wages by hiring less qualified workers. To facilitate the interpretation of the estimates, we consider such outcomes in logarithmic form.

We consider a set of initial characteristics to capture heterogeneity across firms through the variables X_i. This set of controls includes the firm's market age, size, industry, and the average age of the employees, the average tenure and the level of education, as well as location information within the geographic environment of Pernambuco (metropolitan region, *Mata*, *Agreste*, *Sertão*, and Semi-arid areas) (see Table 1). In our baseline specification, the control group includes firms that have not yet benefited from FNE loans. This allows us to capture any remaining unobserved effects specific to firms benefiting from the FNE.

To verify the time duration of the FNE effects on these variables and to gather evidence about the hypothesis of parallel trends, we also consider the following dynamic version of Equation 1:

$$
Y_{it} = \sum_{j=-k, j \neq -1}^{k} \beta_j FNE_{it,j} + X_i \gamma_t + \phi_i + \lambda_t + \epsilon_{it} \tag{2}
$$

Where $FNE_{it,j}$ represents a set of dummy variables that equal one if, at time t, there are j periods after (before) the initial period of receiving the FNE loan, and zero otherwise. Using the period before the start of the loan ($j = -1$) as a reference point (normalizing its coefficient to zero), we obtain event study estimates for our three outcomes.

As recently noted by [36], [37], and [38], The estimate of β in Equation 1 obtained using the traditional two-way fixed effect estimator lacks a clear interpretation and can be significantly biased when access to the policy occurs at different times. This result stems from the estimator's inability to deal effectively with the heterogeneities associated with different generations of firms benefiting from the policy ([19]). As shown by [39], this issue extends to the dynamic version of the estimator used to estimate *lead* and *lag* effects (Equation 2). Despite our aforementioned precautions to account for firm heterogeneity, we cannot guarantee that our estimate of the FNE impact is free from this problem. Therefore, we used the estimator proposed by [19] to obtain the parameters related to the effects of FNE in Equations 1 and 2.[18]

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[18]We, thus, prioritized a general measure of the effect of the FNE on firms (Equation 1) and estimates that take into account the duration of exposure to the policy (Equation 2). Both sets of parameters are derived from weighted aggregations of FNE estimates for beneficiary firms categorized by treatment cohort and year obtained using the double

The estimator accommodates arbitrary treatment effect heterogeneity and identifies the impact of policy on treated firms, provided the conditional parallel trends assumption is satisfied. In all our estimations, we use bootstrap standard deviations clustered at the firm level.

3.2. Database

Our final set of information comes from identifying companies in RAIS that receive assistance through various policies. This assistance includes subsidized loans from the FNE, BNDES, and FNDES, as well as tax incentives offered by Sudene and Prodepe. To identify these companies, we utilize their national register number, the *Cadastro Nacional de Pessoa Jurídica* (CNPJ), which is a unique legal identification code.

The strategy has a limitation in that it only considers formalized firms. However, this circumstance is mitigated by the fact that most of the firms benefiting from the FNE are formal sector firms. Moreover, we are convinced that the ability to identify firms that benefit exclusively from the FNE and the richness of the RAIS microdata compensate for this limitation.

From 2000 to 2017, 24,996 firms and individuals in Pernambuco obtained FNE loans. This figure excludes those associated with PRONAF (*Programa Nacional de Fortalecimento da Agricultura Familiar*), PROINFRA (*Programa de Financiamento à Infraestrutura Complementar*), PROGER (*Programa de Geração de Renda*), and loans from unidentified programs. The first two refer to specific groups of people (PRONAF: family farmers) and specific purposes (PROINFRA: infrastructure), while PROGER uses financial resources from the FAT (*Fundo de Amparo aos Trabalhadores*). Out of this total, 15,997 loans are for businesses or individuals with a CNPJ, while 8,999 are for individual loans obtained using the CPF (*Certificado de Pessoa Física*), an individual taxpayer code.

By using microdata from the RAIS system, we identified a unique panel of 10,828 firms out of 15,996 in Pernambuco that obtained loans from the FNE between 2000 and 2017. The discrepancy is likely because, until 2017, individual microentrepreneurs (MEIs) were not required to report information to the Ministry of Labor and Employment (MTE) via RAIS. Table 8 in Appendix A shows the distribution of firms and individuals who took out

robust augmented inverse propensity weighting (AIPW) estimator. Specific estimates for different treatment cohorts and time periods are available from the authors upon request.

loans in Pernambuco between 2000 and 2017, categorized by various characteristics. This information is disaggregated by borrowing agent, via CNPJ for firms and CPF for individuals. It is also disaggregated by firms identified in RAIS. Compared to individuals who obtained FNE loans through their CPF, firms that used their CNPJ are more prevalent in the manufacturing, services, and commerce sectors. These firms are present in the semi-arid region and the RMR and demonstrate a more balanced distribution of loans between investment proposals and financing and working capital. These observations apply to the overall group and the subset of firms identified in the RAIS.

The total number of 10,828 FNE beneficiaries includes those who received other benefits and 8,231 firms receiving only FNE loans.[19] In our baseline specification, we use these 8,231 firms, resulting in a total of 33,956 company-year observations. Additionally, 226,996 firms did not receive any kind of incentive during the period (a total of 1,202,132 company-year observations) and are used in robustness checks.

Table 1 presents descriptive statistics for the outcomes and control variables of three groups of firms in 2008: those that have not yet benefited, those that have already benefited from FNE loans, and those that have never benefited between 2000 and 2017.[20] As this is an interim year, there are a significant number of firms in both categories of benefited firms. The information is derived from the RAIS microdata and makes it possible to perceive its level of detail.

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[19]However, the FDNE contained only 3 CNPJs, making the analysis less significant, which is why they were excluded.

[20]Regardless, the noted similarities and differences among the groups remain applicable for other years in the sample. Descriptive statistics for additional years can be provided upon request.

Table 1: **Descriptive Statistics - FNE benefited and non-benefited firms - 2008**

| | Benefited | | | | Non-benefited | |
| | Not yet | | Already | | | |
	Mean	SD	Mean	SD	Mean	SD
Outcomes						
ln (employment)	1.78	0.84	1.88	0.94	1.66	0.99
ln (payroll)	8.46	1.40	8.43	1.52	8.14	1.58
ln (wage)	6.96	0.76	6.82	0.80	6.81	0.78
Employment	8.54	25.63	11.29	30.05	15.74	240.00
Average wage	1,183	668.35	1,046	542.72	1,095	1,080
Payroll	11,486	45,72	14,871	64,628	30,182	685,172
Firm characteristics						
ln(age)	2.05	0.78	2.48	0.65	2.16	0.90
Time in the market	9.26	7.78	13.37	8.31	11.17	9.42
Micro	0.68	0.01	0.69	0.02	0.61	0.02
Small	0.22	0.01	0.21	0.02	0.11	0.02
Medium/large	0.03	0.00	0.03	0.00	0.02	0.00
Agriculture	0.01	0.00	0.01	0.00	0.04	0.01
Manufacturing	0.14	0.00	0.15	0.01	0.10	0.01
Commerce	0.61	0.01	0.64	0.02	0.45	0.04
Services	0.22	0.02	0.19	0.03	0.37	0.04
Construction	0.01	0.00	0.01	0.00	0.03	0.00
Others	0.02	0.00	0.01	0.00	0.04	0.01
Employees						
Age	32.39	6.64	32.57	6.85	34.09	8.04
Age^2	1,093	477.41	1,107	498.82	1,226	602.93
Tenure	30.65	24.94	39.94	34.25	41.41	46.21
$Tenure^2$	1,561	3,224	2,767	6,425	3,850	10,184
Hours	43.39	2.98	43.38	3.08	43.05	3.84
Elementary	0.18	0.29	0.26	0.33	0.32	0.39
High school	0.73	0.33	0.64	0.35	0.57	0.40
College	0.09	0.20	0.10	0.21	0.10	0.24
Location						
Agreste	0.29	0.45	0.27	0.45	0.19	0.39
Mata	0.13	0.34	0.16	0.36	0.10	0.30
Metropolitan	0.29	0.46	0.26	0.44	0.59	0.49
Sertões	0.28	0.45	0.32	0.47	0.12	0.33
Semi-arid	0.55	0.50	0.55	0.50	0.31	0.46
Non-semi-arid	0.45	0.50	0.45	0.50	0.69	0.46
Observations	6,449		1,782		119,855	

Notes: Descriptive statistics of firms benefiting exclusively from the FNE
and firms not benefiting from any policy in the state of Pernambuco in 2008.
Employment refers to the number of employees; Average wage and payroll
are measured in 2017 BRL; Time in the market, employee age, and tenure
are measured in years; Hours refer to weekly hours worked; The other variables
(economic activity, employee education, and location) represent shares of firms.
Source: Author's own elaboration based on microdata from BNB and RAIS.

The control variables include characteristics specific to the firms (age,
time in the market, size, and sector of activity), as well as their employees
(average age, average tenure, education, and average hours worked) and lo-
cation (regions of the state and semi-arid region). It can be observed that
firms benefiting from the FNE are generally larger and have a greater pres-
ence in the manufacturing and commercial sectors than those not benefiting.
In addition, these FNE-supported firms employ more educated workers and

are more likely to be located in semi-arid regions and less likely to be located in the Recife Metropolitan Area. In general, the characteristics of the firms not yet treated in 2008 (6,449 firms) were very similar to those of the 1,782 firms already treated in that year (mainly in terms of size, sectoral and geographical distribution, and education of the workforce).

4. Baseline Results

This section explores the main findings of the study. We present baseline results of the general impact of FNE subsidized credit on employment, average wages, and payroll of benefiting companies. We then present robustness checks for our estimates.

4.1. The Impact of FNE

Table 2 shows unconditional (columns 1-3) and conditional (columns 4-6) estimates of the average impact of the FNE on the number of employees, the average wage and the payroll of firms that benefited exclusively from this policy. Note that the values are obtained by weighting the estimates for the different groups of firms according to the year in which the benefit started, considering the period 2001-2017.

Consistent with the similarity already observed between benefited and not yet benefited firms (the control group), the unconditional and conditional estimates are quite similar in all cases. Conditional estimates show a positive and statistically significant effect of FNE on the number of employees, which increases by 8.9% (column 4), and a negative and statistically significant reduction in wages of 4.9% (column 5). Reflecting these effects in opposite directions, the payroll estimate shows a positive impact of the FNE of around 5.2%, although this is only significant at the 10% level (column 6)).

Table 2: **Effects of FNE loans on benefited firms**

	Employment	**Wage**	**Payroll**
	(1)	(2)	(3)
FNE	0.079***	-0.047***	0.043*
	(0.020)	(0.012)	(0.030)
Controls	-	-	-
Firm FE	√	√	√
Time FE	√	√	√
	(4)	(5)	(6)
FNE	0.089***	-0.049***	0.052*
	(0.021)	(0.012)	(0.030)
Controls	√	√	√
Firm FE	√	√	√
Time FE	√	√	√
FNE Firms	8,231	8,231	8,231
Observations	33,956	33,956	33,956

Notes: Wbootstrap firm-level clustered standard error in paren-
thesis. The control variables include the characteristics of firms,
employees, and location presented in Table 1.
Statistical significance level: (*) $P < 0.1$; (**) $P < 0.05$; (***)$P < 0.01$.

Figure 1 shows estimates of the coefficients associated with FNE in equation (2), considering unconditional and conditional specifications. The values are estimates of the impact of the FNE on beneficiary firms, considering up to 8 years before the treatment (in blue) and up to 8 years after the treatment (in red), taking as reference the period before the receipt of FNE loans. For each estimate, a 95% confidence interval with clustered standard errors at the firm level is also provided.[21]

Although the evidence is less conclusive for the unconditional specification, for all three outcomes we found that the estimates for the conditional specification indicate that there are no differences between treated and control firms in the pre-treatment period. The evidence in Figure 1 also shows that the positive effects on employment and payroll increase over time in the

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[21]We also examined more specific results for the effects of the FNE considering different groups of firms according to the start date of the loan. Due to space limitations, differences between treated groups according to the start date of FNE support are not fully explored here. Such results are available on request.

post-treatment period, reaching close to 21% and 20%, respectively, after 8 years. On the other hand, the effect on wages paid by firms remains negative for at least 6 years after the start of the policy (a period in which this effect reaches almost minus 8%). However, there are signs of a reversal of this trend in the last two years, which may indicate learning by employees within firms.
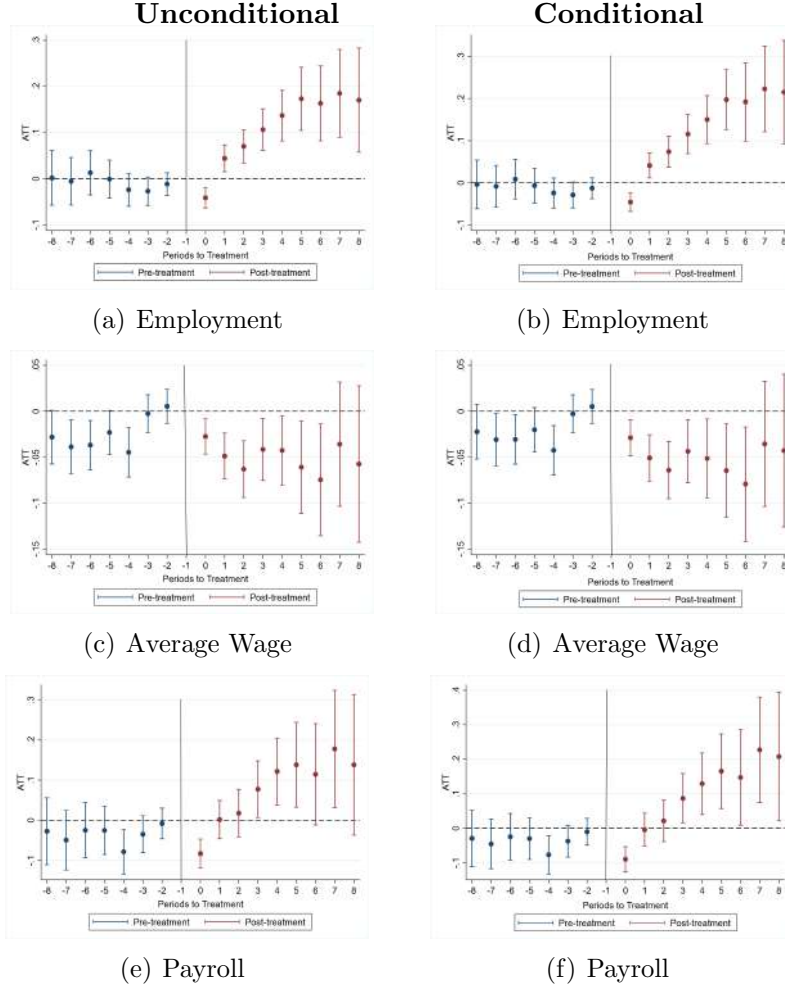
Unconditional   **Conditional**

(a) Employment   (b) Employment

(c) Average Wage   (d) Average Wage

(e) Payroll   (f) Payroll

Figure 1: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment)

Source: Author's own elaboration.

Our estimate of the impact of FNE loans on the number of employees

in firms is quite significant given the regional context. For example, this estimate corresponds to 2.5 and 2.3 times the average annual growth in formal employment between 2002 and 2017 observed in Pernambuco and the Northeast region, respectively.[22] Our estimates of the impact of the FNE significantly differ from previous assessments that also utilized RAIS microdata, but applied different estimators and overlooked the potential accumulation of incentive benefits from various policies. For example, both [25] and [40] found positive effects of FNE on employment but no effect on wages. In particular, according to the results obtained by [40], analysing the period 2000-2008, there were annual increases of 4.7% in employment and 4.4% in payroll associated with the FNE.[23] On the other hand, given the persistent effect of FNE on employment, our results in a sense point in the same direction as those of [29], who found that subsidized FNE loans increased climate-resilient livestock production in the semi-arid region.

Taken together, our results are consistent with the notion that most firms using FNE loans tend to expand their operations by hiring less skilled (lower-paid) workers, with minimal changes in their production technology.[24] If this is indeed the case, then FNE loans contribute significantly to employment growth, but not to productivity improvements in the beneficiary firms. In the next section we present further evidence and discuss this possible mechanism behind the results. First, however, we examined the reliability of these initial estimates.

4.2. Robustness checks

To verify the reliability of the study's results, we conducted several robustness checks. These checks include considering a different control group, analyzing only those firms that have always been in the sample, controlling for the influence of outliers and other policies, and obtaining separate evidence for different regional environments.

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[22]During this period, the average annual growth rates of formal employment in Pernambuco and the Northeast were 3.5% and 3.8%, respectively. These rates, in turn, were higher than the corresponding rate observed for Brazil (3.2%).

[23]In section six of the paper, we explore in more detail the consequences for estimates of not accounting for the possibility of cumulative effects of incentives from different policies.

[24]Note that the figures in Table 1 show that the average wages in both not-yet and never-treated firms are not lower than the average wages in firms benefiting from the FNE.

As we have already argued, the use of firms not yet treated as controls is justified by their greater similarity to firms that previously benefited from the FNE. However, in the absence of anticipation, the use of firms never treated as controls is less restrictive for the conditional parallel trends hypothesis, since it does not require the absence of parallel trends between groups of treated firms ([19]). The first row of Table 3 shows the results when the control group consists of firms that have never received FNE loans, rather than those that have not yet received them, as in our baseline. As can be seen from the figures in the aforementioned table, the estimates obtained for the three outcomes using the new control group show very little variation from those previously obtained. The Figure 13 in Appendix A shows that this similarity in results is also evident in the event study estimates.

Table 3: **Effects of FNE loans - Robustness checks**

	Employment	Wage	Payroll
Never Treated - control group	0.084***	-0.039**	0.059*
	(0.026)	(0.015)	(0.015)
Excludind outliers	0.080***	-0.039***	0.060**
	(0.016)	(0.010)	(0.003)
Surviving firms	0.104***	-0.043***	0.054*
	(0.020)	(0.011)	(0.021)
Bolsa Família Program	0.080***	-0.047***	0.045
	(0.022)	(0.012)	(0.031)
Bolsa Família and *Benefício de Prestação Continuada*	0.081***	-0.049***	0.040
	(0.023)	(0.025)	(0.036)
Cisternas Program	0.082***	-0.026***	0.034
	(0.027)	(0.016)	(0.039)
Política Nacional de Desenvolvimento Regional	0.107***	-0.040**	0.090**
	(0.024)	(0.015)	(0.036)
Investments associated with PAC 1 and PAC 2	0.072***	-0.050***	0.039*
	(0.020)	(0.017)	(0.0351)
RMR	0.084**	-0.064***	0.023
	(0.037)	(0.021)	(0.052)
Semi-arid	0.113***	-0.036**	0.102**
	(0.029)	(0.018)	(0.043)
Controls	✓	✓	✓
Firm FE	✓	✓	✓
Time FE	✓	✓	✓

Notes: Wbootstrap firm-level clustered standard error in parenthesis. The control variables include the characteristics of firms, employees, and location presented in Table 1. "Never Treated": Refers to the results using firms that never received FNE loans or other benefits as the control group, totaling 226,996 firms that were not benefited by any policies, with 1,267,958 observations. "Excluding outliers": Refers to a sample of firms excluding the highest and lowest 2.5%. The group consists of 7,354 firms and 28,443 observations. "Surviving Firms": Refers to firms that survived at least 3 years after benefiting from the policies. This group includes 7,848 firms and 29,489 observations. "*Bolsa Família* Program": Refers to new estimates controlling for the effects of the federal government income transfer program for low-income families. The sample consists of 8,231 firms and 33,956 observations. "*Bolsa Família* and *Benefício de Prestação Continuada*": Refers to new estimates controlling for the effects of both federal income transfer programs. The sample includes 8,231 firms and 33,956 observations. "*Cisternas* Program": Refers to the results using only the 71 municipalities (with 3,904 FNE firms) that were not benefited by the Cisternas Program, totaling 15,276 observations. "*Política Nacional de Desenvolvimento Regional*": Refers to the results obtained by excluding 1 municipality with high income and low dynamism, and 8 municipalities with high income and medium dynamism. The number of firms is 2,764 and of 12,147 observations. "Investments associated with PAC 1 and PAC 2": Refers to the results obtained by excluding municipalities directly benefited by PAC 1 and PAC 2 federal government programs. The group consists of 3,139 firms and 13,432 observations. "RMR": Refers to the results for firms located in the Recife Metropolitan Region, totaling 2,599 firms and 9,537 observations. "Semi-arid": Refers to the results for firms located in the semi-arid region, with 4,369 firms and 18,750 observations.
Statistical significance level: (*) $P < 0.1$; (**) $P < 0.05$; (***)$P < 0.01$.

In the second set of robustness tests, we examined the importance of possible biases associated with outliers and sample selection. In this respect, it should be noted that we have no singleton units and that 82.5% of the FNE beneficiary firms (treated and not yet treated) remained in the RAIS

over the entire period of the analysis. Furthermore, for our treated and not yet treated firms, we find that eased operations or disappeared and always present firms in RAIS have similar profiles in observables (see Table 10 in Appendix A). The second line of Table 3 presents new estimates excluding firms with outcomes that fall within the extremes defined by the lowest 2.5% and the highest 2.5%, considering all years. In the third row, we obtained estimates using only firms identified in RAIS that remained active during the analyzed period (2000 to 2017). Firms that ceased operations or disappeared from RAIS are excluded.[25] Both sets of new estimates for the impact of the FNE on our outcomes show values close to those previously presented. Once again, Figures 14 and 15 in Appendix A show that the corresponding event study estimates are also close to our previous evidence.

The third set of robustness checks examines whether the results might be affected by the combined impact of important social policies. Specifically, we examine whether the *Bolsa Família* program (BF) and the *Benefício de Prestação Continuada* (BPC) program may affect our results. BF and BPC are income transfer programs for the low-income population and the poor elderly and disabled, respectively, and mainly benefit residents of the Northeast, given the high concentration of poor people in the region ([22], [23]). For both BF and BPC, we included the per capita value of municipal transfers from these programs in the year before receiving FNE aid as an additional control variable. The fourth and fifth rows of Table 3 provide new estimates of the impact of the FNE. Figures 16 and 17 in Appendix A show the event study estimates for the corresponding specifications. The new estimates in Table 3 and the figures indicate that the estimates are again very close to our initial ones.

Our fourth set of robustness checks examines the potential influence of other spatially based policies or specific spatial circumstances. Established in 2003, the *Cisternas* Program (CP) aims to assist low-income families in rural areas by providing cisterns that ensure water security for both consumption and agricultural production, primarily in the Northeast region. The available evidence suggests that the program has a positive impact on family income ([41]).[26] We obtained new estimates by excluding firms in munici-

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[25]We are maintaining the restriction to consider only firms that received aid exclusively from the FNE.

[26]From 2003 to 2015, approximately 1.2 million cisterns were delivered, with 11.7% distributed across 114 municipalities in Pernambuco. See `https://bit.ly/438Nt4k`.

palities benefiting from the program in Pernambuco, a total of 4,327 firms. New estimates are also obtained by excluding firms located in microregions identified as high income in 2007 by the *Política Nacional de Desenvolvimento Regional* (PNDR) of the Ministry of Regional Integration (a total of 2,764 firms located in nine municipalities)[27]. These areas tend to have higher revenue potential, which may lead to a higher number of FNE loans. We conclude this set of evidence with estimates that exclude firms located in the main municipalities directly affected by public investments associated with the federal government's *Programa de Aceleração do Crescimento* (PAC) 1 and 2. As pointed out by [42], Pernambuco particularly benefited from these investments, which included the construction of a refinery and shipyard in the Suape Industrial Port Complex, investments related to the construction of a stadium for the 2014 World Cup, and the establishment of a vehicle assembly plant.[28]

These three new sets of estimates are presented in the fourth, fifth, and sixth rows of Table 3; the corresponding estimates from the event study are presented in Figures 18-20 in Appendix A. Once again, the new estimates for the FNE effects show little difference from those obtained in the previous subsection.

As a final robustness check, we obtain separate estimates for the two most distinct spatial environments in the state: The Recife Metropolitan Region (RMR) and the semi-arid region.[29] Considering the significant differences between the two contexts, this exercise provides a valuable assessment of the effectiveness of FNE loans and the broader applicability of initial findings. These new estimates are shown in the last two rows of Table 3, with the corresponding estimates from the even study presented in Figures 21 and 22 of Appendix A. The values indicate that the impact on the number of workers is not significantly different between the two regions. However, the negative impact on wages and the positive impact on payroll are more pronounced in

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[27]Until 2017, microregions were defined as groups of economically integrated neighboring municipalities. The 185 municipalities of Pernambuco were categorized into 19 microregions. See `https://bit.ly/3FeJiKZ`.

[28]Firms located in the municipalities of Cabo de Santo Agostinho, Camaragibe, Goiânia, Ipojuca, Jaboatão dos Guararapes, Moreno, Olinda, Recife, and São Lourenço da Mata were excluded.

[29]The firms in RMR and semi-arid represent about 30% and 55%, respectively, of the total sample.

the semi-arid region. This could be due to the generally lower wage levels in this area. Anyway, in both cases, in line with our initial findings, FNE loans contibute to increase employment while simultaneously lowering wages.

5. Channel and heterogeneities

In this section, we explore possible mechanisms behind the results obtained for the effects of FNE loans on firms. In addition, we present new evidence for such effects, considering heterogeneities that help us understand how the incentive works.

5.1. Loan purposes and employees' skills

As we have seen, our findings indicate that the employment expansion associated with FNE loans is accompanied by a reduction in the wages paid by firms, suggesting the inclusion of less skilled workers. This response is consistent with output expansion without changes in production technology or capital growth, as such changes could potentially increase labor productivity. We, thus, examine how the impact of FNE differs according to the purpose of the loan. We then analyze the impact of FNE loans by employee skill level.[30]

Note that of our total number of 8,231 firms that borrowed only from the FNE, 78% of them used the funds exclusively for operating expenses or working capital, while the remaining portion used the funds for investment. Panel A of Table 4 presents estimates of the effects of FNE loans based on the purpose for which the loans are used. The results in columns (1) to (3) present estimates for cases where the funds are used exclusively for operating costs and working capital. In contrast, the estimates in columns (4) to (6) focus on cases where the funds are used exclusively for investment purposes. Finally, columns (7) to (10) provide estimates for situations where the funds are allocated for both investment and operating costs or working capital. The numbers in Table 4 highlight the importance of the intended use of FNE loans.

Estimates related to the allocation of resources to operating costs and working capital show results consistent with previous findings: There is an increase in employment, accompanied by a decrease in wages paid by firms

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[30]Note that the new estimates are obtained by maintaining the same set of control variables used in the baseline specification.

(columns (1) and (2)). In contrast, when resources are allocated exclusively to investment, we observe a more substantial increase in employment - 18.0% - without a statistically significant reduction in wages (at least at 5%) and an important payroll expansion (column (6)). The estimates in columns (7)-(9) of Table 4 seem to reflect a combination of the two results obtained separately, resembling our baseline estimates. Importantly, the evidence on the combined use of FNE loans for both investment and operating expenses, as well as working capital, suggests that the differences observed based on the purpose of the loan cannot be attributed to the generally higher values of loans used for investment.[31]

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[31]In 2017, for example, average values of FNE loans for working capital and the combination of investment and working capital corresponded, respectively, to 61.1% and 163.4% of the average value of FNE loans designated for investments only.

Table 4: Effects of FNE Loans - Different loan purposes and employees' skills

Panel A: Loan purposes	Employment	Wage	Payroll
	(1)	(2)	(3)
FNE - Operating and working capital	0.045**	-0.051***	0.004
	(0.021)	(0.016)	(0.036)
FNE Firms	6,421	6,421	6,421
Observations	15,483	15,483	15,483
	(4)	(5)	(6)
FNE - Investiment	0.166***	-0.037*	0.170***
	(0.088)	(0.022)	(0.062)
FNE Firms	1,564	1,564	1,564
Observations	10,781	10,781	10,781
	(7)	(8)	(9)
FNE - Investment, operating, and working capital	0.171***	-0.054**	0.162***
	(0.043)	(0.020)	(0.062)
FNE Firms	1,811	1,811	1,811
Observations	7,598	7,598	7,598
Panel B: Employees' skills	Employment	Wage	Payroll
	(10)	(11)	(12)
FNE - Elementary and secondary	0.113***	-0.028**	0.105***
	(0.055)	(0.020)	(0.031)
FNE Firms	7,858	7,858	7,858
Observations	30,245	30,245	30,245
	(13)	(14)	(15)
FNE - College	0.058	0.025	0.037
	(0.055)	(0.025)	(0.070)
FNE Firms	7,444	7,444	7,444
Observations	26,512	26,512	26,512

Notes: Wbootstrap firm-level clustered standard error in parenthesis. All regressions include control variables, firm fixed effects, and time fixed effects. The control variables include the characteristics of firms, employees, and location presented in Table 1. Statistical significance levels: (*)$P < 0.1$; (**) $P < 0.05$; (***)$P < 0.01$.

Figures 2 and 3 display event study estimates when FNE resources are allocated to cost and working capital and investment, respectively. Appendix A, Figure 23, presents evidence regarding loans for investment, operating, and working capital. In all three figures, we obtain evidence favoring the hypothesis of common parallel trends between treated and untreated firms in the pre-policy period.. For the allocation of loans for operating expenses and working capital, we highlight the fact that the negative effects on wages paid by firms tend to increase over time, reaching almost 12% in the eighth year after the financing. On the other hand, in the case of the allocation of funds to investments, the positive effects on employment increase over time,

reaching almost 30% in the eighth year.

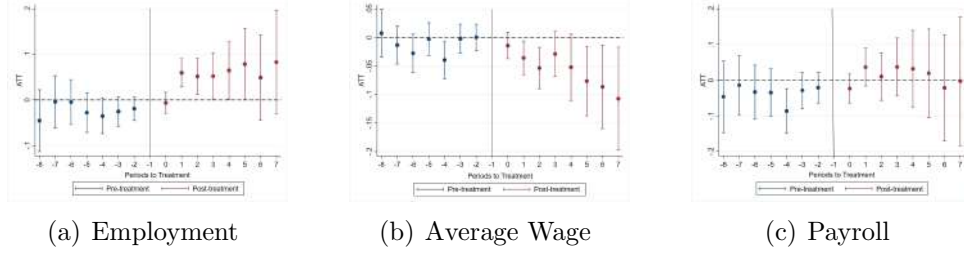(a) Employment   (b) Average Wage   (c) Payroll

Figure 2: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Operating and working capital
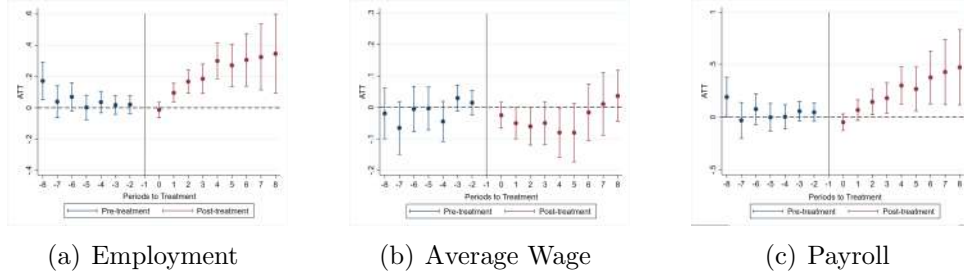
Source: Author's own elaboration.

(a) Employment   (b) Average Wage   (c) Payroll

Figure 3: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Investment

Source: Author's own elaboration.

Panel B of Table 4 shows the estimated effects of FNE loans according to the educational attainment of employees of the benefiting firms. Columns (10)-(12) present estimates for employees with elementary or secondary education degrees, while columns (13)-(15) focus on employees with higher education (college degree). The corresponding estimates of the dynamic specification of the model (event study) are presented in Figures 4 and 5.

For low-skilled workers, the new estimates indicate average effects similar to previous findings about employment and wages. However, the impact on payroll is more pronounced (about 11.1%). In contrast, when college-educated employees are taken into account, the estimates show no effect of FNE loans on the benefiting firms.

The evidence presented in Figures 4 and 5 provides important insights that complement the more general findings. In line with our baseline results,

the effect on the number of less-skilled employees increases over time and exceeds 20% after eight years. Moreover, the negative impact on wages for these workers dissipates after the sixth year. For college-educated employees, we observe no statistically significant positive effect of FNE loans. Note, however, that we also obtain a negative effect on wages in the first and second years after the incentive.
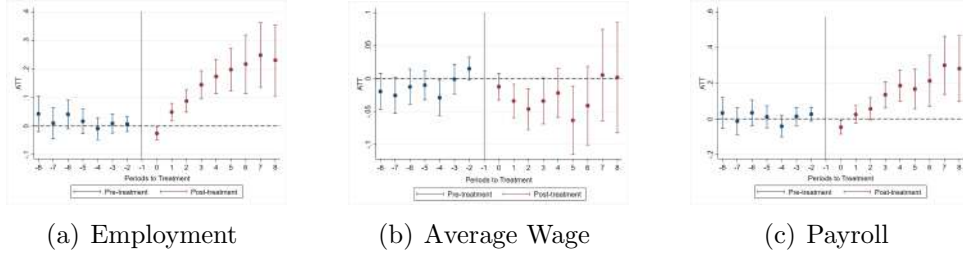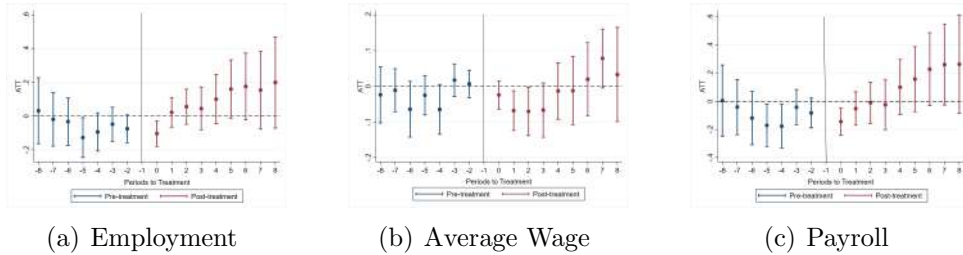

(a) Employment　　　　(b) Average Wage　　　　(c) Payroll

Figure 4: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Elementary and secondary degrees

Source: Author's own elaboration.

(a) Employment　　　　(b) Average Wage　　　　(c) Payroll

Figure 5: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - College

Source: Author's own elaboration.

The two new sets of results suggest that FNE loans promote employment growth by allowing resources to be allocated to current expenditures as well as to the expansion of productive capacity. However, the initial negative impact on wages seems to be related to the allocation of resources mainly to operating expenses and working capital and involves the hiring of low-skilled workers.

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5.2. Firms' size and economic activities

To broaden our understanding of the effects of FNE loans on benefiting firms, we examine possible heterogeneities associated with firm size and industry.

With reduced assets serving as collateral, micro and small businesses tend to have more severe credit restrictions, since they have fewer financing alternatives (stocks and private bonds, for example). This situation may make public credit relatively more important for them ([43]). In the Brazilian case, [24] found positive effects on employment growth in micro and small companies benefiting from the FNE, and [44] pointed out the positive influence of BNDES loans on investment and productivity in the case of small and medium-sized companies. Such works, however, did not consider the possibility of the simultaneous use of different sources of public financing by firms.

Using the [45] classification for different firm sizes, we obtain new estimates for the effects of FNE loans separately for micro and small firms and medium and large firms.[32] It should be noted that micro and small companies account for 93.8% of the firms benefiting from the FNE analyzed in the study, with the remaining portion being made up of medium or large companies. The two groups differ little concerning the loan purposes, with operating and working capital being the destination of the loans for approximately 80% and 76.1% of micro and small firms and medium and large firms, respectively.

Panel A of Table 5 shows the new set of estimates. Unsurprisingly, in the case of micro and small firms, the estimates indicate very similar effects (quantitatively and qualitatively) to those initially presented. However, for medium and large firms, no statistically significant effect is found (which may be influenced by the much smaller number of firms) (columns (4)-(6)). Indeed, despite lacking statistical significance, the point estimate for the

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[32]The classification uses specific sectoral criteria to define the size of firms. A microenterprise has up to 19 employees in manufacturing and up to 9 employees in commerce, services, agriculture, and other activities. A small enterprise is defined as one with 20 to 99 employees in industry or 10 to 49 employees in commerce, services, agriculture and other sectors. A medium-sized enterprise has 100 to 499 employees in industry or 50 to 99 employees in commerce, services, agriculture and other sectors. Finally, a large enterprise is defined as one with 500 or more employees in industry or 100 or more employees in commerce, services, agriculture and other sectors.

effects on wages paid is positive.

Table 5: Effects of FNE loans - Heterogeneities: Size and economic activity

Panel A: Firm size	Small and Micro Firms			Medium and Large Firms		
	Employment	Wage	Payroll	Employment	Wage	Payroll
	(1)	(2)	(3)	(4)	(5)	(6)
FNE	0.073***	-0.040***	0.049*	0.069	0.086	0.015
	(0.018)	(0.014)	(0.029)	(0.088)	(0.082)	(0.127)
FNE Firms	7,719	7,719	7,719	512	512	512
Observations	31.490	31.490	31.490	2.470	2.470	2.470
Panel B: Economic activity	Manufacturing			Commerce and Services		
	Employment	Wage	Payroll	Employment	Wage	Payroll
	(7)	(8)	(9)	(10)	(11)	(12)
FNE	-0.042	-0.135***	-0.201**	0.120***	-0.031**	0.116***
	(0.060)	(0.038)	(0.087)	(0.021)	(0.014)	(0.031)
FNE Firms	1,280	1,280	1,280	6,942	6,942	6,942
Observations	5,104	5,104	5,104	27,987	27,987	27,987

Notes: Wbootstrap firm-level clustered standard error in parenthesis. All regressions
include control variables, firm fixed effects, and time fixed effects. The control
variables include the characteristics of firms, employees, and location presented in Table 1.
Statistical significance levels: (*)$P < 0.1$; (**) $P < 0.05$; (***)$P < 0.01$.

Figures 6 and 7 below present event study estimates for the two groups
of firms. The evidence presented in Figure 6 further supports the similarity
with the results obtained earlier for the dynamic analysis. It shows that the
positive effects on employment and wages increase over time, while the ad-
verse effects on wages last until the sixth year and then become insignificant.
In the case of medium and large firms, Figure 7 indicates that FNE loans do
not have a lasting impact on the number of employees or payroll. However,
we do see positive effects on wages starting from the sixth year after receiv-
ing the incentive, with an increase of 16.2% by the eighth year. Overall, the
results are in line with the idea that smaller firms suffer from more severe
credit constraints and are therefore more sensitive to access to public credit.

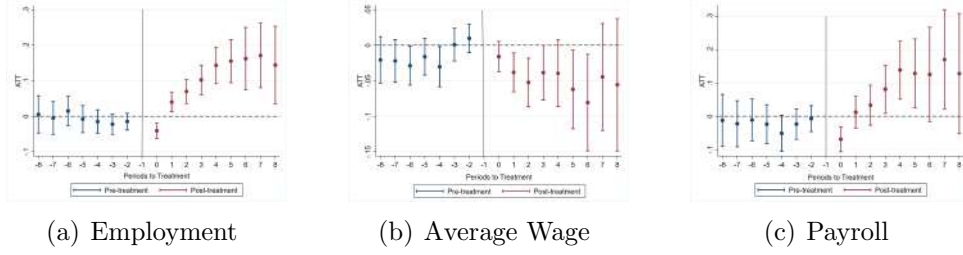(a) Employment   (b) Average Wage   (c) Payroll

Figure 6: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Small and micro firms
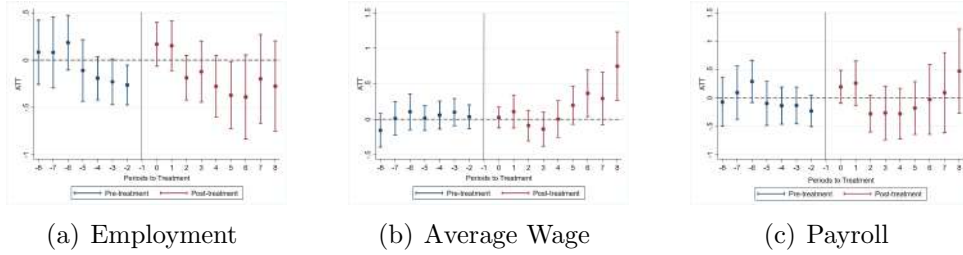
Source: Author's own elaboration.

(a) Employment   (b) Average Wage   (c) Payroll

Figure 7: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Medium and large firms

Source: Author's own elaboration.

We also obtain further estimates according to the economic activities in which firms operate. In addition to differences in the potential collateral associated with physical production capital, the sectors differ regarding the regional origin of capital ownership and geographic mobility. These factors can affect the need for external resources, financing alternatives, and bargaining power. It should also be noted that the high concentration of the Brazilian manufacturing sector in the richest regions of the Southeast and South ([46]) has historically been used as justification for the implementation of space-based incentive policies ([47, 48]).

The sectoral breakdown of firms that received FNE loans in Pernambuco between 2000 and 2017 shows that the benefits are not limited to the manufacturing sector. In our sample of firms benefiting from the FNE, 17.8% belonged to the manufacturing sector, while 78.2% were engaged in commerce and services. The remaining beneficiaries were in agriculture and

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livestock, and construction.[33] Here we obtain separate estimates for firms in the manufacturing sector and for firms in the services and commerce sectors. The limited number of firms prevents us from examining evidence for other activities. Once more, it should also be noted that for these sectors the distribution of firms according to the purpose of the loan (operating/working and investment) is close to that observed for the total number of firms.[34] Panel B of Table 5 presents these new estimates of the overall average effects of FNE loans.

The new estimates reveal clear differences between sectors. For the commerce and services sectors (columns (10)-(12)), the evidence is qualitatively similar to that previously obtained, although the positive effects on the number of employees and on the payroll (about 12.0% and 11.6%, respectively) are more important here. As indicated in column (11) of the aforementioned table, the expansion of employment also occurs with a reduction in wages, which is consistent with the initial hiring of less qualified workers. In contrast, as indicated in columns (7)-(9) of Panel B of Table 5, the FNE loans do not affect the number of employees in manufacturing firms and contribute to significant reductions in wages and payroll (respectively, of 14.4% and 22.3%).

Figures 8 and 9 show the event study estimates for the two sets of industries. Once again, the evidence for commerce and services is similar to that previously obtained. For manufacturing firms, reductions in employment and wages were observed only in the first year following the aid. On the other hand, the negative effects of FNE loans on the wages paid by firms persist at least until the 7th year, when they reach about 22%.

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[33]We also note that the distribution of FNE in Pernambuco ends up favoring the manufacturing sector. Considering the total number of firms in the RAIS in the state (regardless of whether they benefited from FNE loans or not) in the same period, on an annual average, 10.6% of the firms were in the manufacturing sector, while 81.2% belonged to the commerce and services segments.

[34]The percentages of firms in commerce and services that borrowed exclusively for operating expenses and working capital and exclusively for investment were 64.9% and 28.4%, respectively. The corresponding percentages for manufacturing firms were 66.7% and 22.4%.

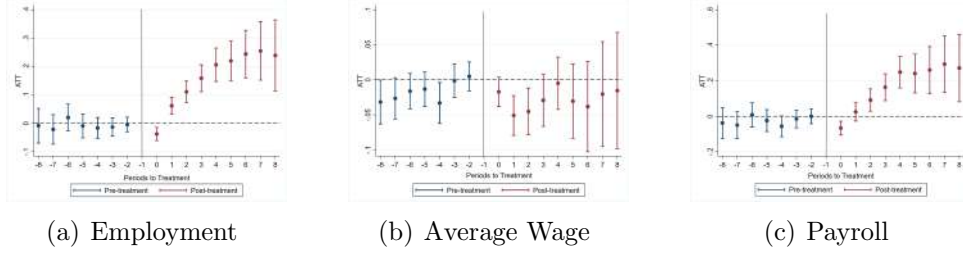(a) Employment   (b) Average Wage   (c) Payroll

Figure 8: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Commerce and services sector

Source: Author's own elaboration.
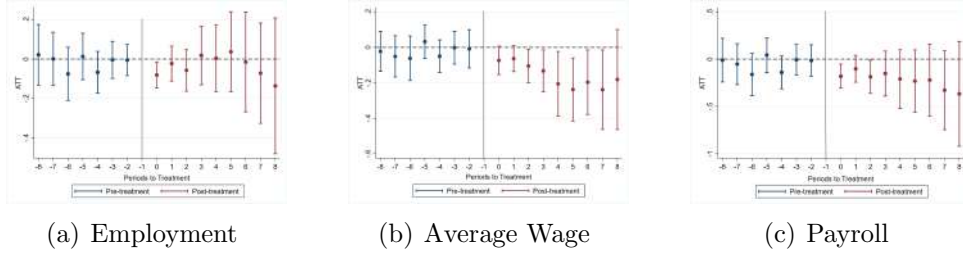

(a) Employment   (b) Average Wage   (c) Payroll

Figure 9: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Manufacturing

Source: Author's own elaboration.

The challenges of providing guarantees and securing financing from non-local sources may be behind the significant impact of the FNE on employment in the commerce and services sectors. The evidence is also consistent with the observed shift in production structures in favor of services, both in the country and globally.([49], [50]). While it is difficult to identify the exact reasons for the lack of impact on employment and the negative effects of FNE loans on wages in industrial companies, it is possible that these results stem from a reduced reliance on local resources. Additionally, this situation may be linked to the increased competition the sector experienced in the 2000s. As shown by [51], the influx of Chinese manufactured goods during this period had a negative impact on the wages paid by Brazilian firms in this sector. Our evidence suggests that FNE loans allowed for an even more significant wage adjustment in the benefiting firms.

6. The FNE and other incentive policies

Our final set of evidence considers the relationship between FNE loans and other policies (place-based or not). More specifically, we first examine the consequences of ignoring the fact that firms that benefit from FNE loans may also benefit from other public policies (fiscal or credit). We then compare the impact of FNE loans to that of BNDES loans. Considering the differences between firms and the amounts financed by these two options, this new evidence enhances our understanding of the FNE.[35]

6.1. Not just FNE: Overlapping incentives

As we have highlighted, about 27% of the total beneficiaries of the program in Pernambuco between 2000 and 2017 are firms that received loans from the FNE and also benefited from other forms of incentives, such as tax exemptions or additional loans. However, existing evidence on the impact of the FNE has often ignored these overlapping incentives, making it difficult to understand the FNE's impact fully. In our first exercise, we estimated the impact of the FNE on firms that benefited from it, ignoring the possibility that these firms might also benefit from other types of incentives, such as loans or tax benefits. That is, we considered as treated by the FNE both firms that benefited only from FNE loans and those that received FNE loans together with tax incentives from Prodepe (state) and Sudene (federal), and/or loans from BNDES.[36]

Columns (1)-(3) of Table 6 present the new estimates of the impact of FNE loans when adding firms also benefited from other incentives without control variables (unconditional), while columns (4)-(6) present the estimates with such additional regressors (conditional).[37] The two sets of estimates indicate qualitatively indistinguishable and quantitatively similar effects. The

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[35]Due to the smaller number of companies and the empirical strategy used, it was not possible to compare the FNE with each of the other policies separately. Note that we are still using firms that have not yet been treated as a control group and considering the same control variables.

[36]Of the 3,021 firms that received loans from the FNE and also benefited from at least one additional incentive, the distribution was as follows: 6.0% received support from both the FNE and Prodepe; 2.2% from the FNE and Sudene; 84.3% from the FNE and BNDES; 1.3% from the FNE, Prodepe, and Sudene; 3.7% from the FNE, Prodepe, and BNDES; 1.5% from the FNE, Sudene, and BNDES; and 1.0% from the FNE, Prodepe, Sudene, and BNDES.

[37]Notice that in the sample that includes firms benefiting from additional policies, the

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values indicate positive effects on employment and payrolls, exceeding our previous estimates, but negative effects on wages paid by firms. More specifically, the conditional specification shows that the estimated effects of FNE loans on the number of employees and payroll are now about 43% and 51.1%, respectively.

Table 6: Effects of FNE loans - Firms with or without other incentives

	Employment (1)	Wage (2)	Payroll (3)
FNE	0.388***	-0.024**	0.284***
	(0.018)	(0.011)	(0.030)
Controls	-	-	-
Firm FE	√	√	√
Time FE	√	√	√
	(4)	(5)	(6)
FNE	0.358***	-0.030**	0.413***
	(0.022)	(0.012)	(0.032)
Controls	√	√	√
Firm FE	√	√	√
Time FE	√	√	√
FNE firms	10,828	10,828	10,828
Observations	46,789	46,789	46,789

Notes: Wbootstrap firm-level clustered standard error in parentheses. The sample includes any firm benefiting from FNE loans. The control variables include the characteristics of firms, employees, and location presented in Table 1. Statistical significance levels: $(*)P < 0.1$; $(**)\ P < 0.05$; $(***)P < 0.01$.

The following Figure 10 shows the estimates for the conditional dynamic specification. Note that, in addition to the evidence favoring the parallel trends hypothesis in the pre-treatment period, we obtain a negative effect on wages observed up to year 5 (when they are about 5% lower for firms benefiting from FNE), and the effects on employment and payroll grow over time at least up to year 7. According to the estimates, seven years after receiving FNE loans, the number of employees and payroll increased by approximately 38% and 49.2%, respectively.

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distribution of loans by purpose is similar to that of the baseline sample. Specifically, 26.2% of loans are exclusively for investment, while 69.2% are exclusively for operating costs and working capital.

Importantly, this new set of results indicates that previous evaluations of the impact of the FNE on beneficiary firms based on microdata tend to significantly overestimate the positive effects on employment and payroll (the effect on the number of employees, for example, is approximately 4.6 times greater than the baseline value we obtained). The use of aggregated data, e.g. from municipalities (see, for example, [28, 26]) does not solve this problem and may make the assessment of FNE even more difficult due to the spatially differentiated influence of other policies.[38]

(a) Employment   (b) Average Wage   (c) Payroll
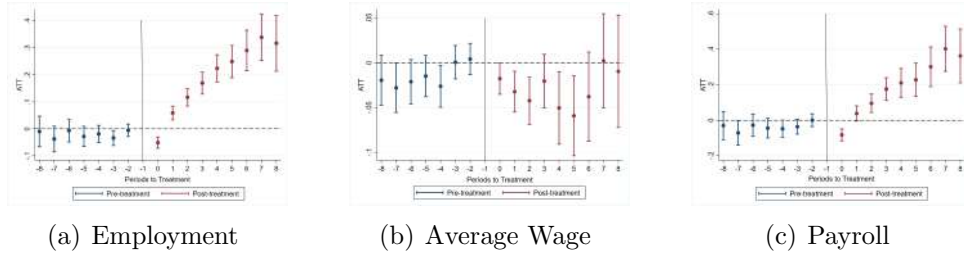
Figure 10: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - FNE with or without other policies (conditional)

Source: Author's own elaboration.

6.2. FNE Loans versus BNDES Loans

Lastly, we compare our findings on the impact of FNE loans with those obtained when firms use only BNDES loans. This comparison is particularly revealing for two reasons. First, it provides further evidence on the impact of subsidized loans in a relatively poorer region of the country. In a broader sense, therefore, this new evidence serves as a robustness check on the effectiveness of this particular type of incentive. Second, the lack of territorial restrictions on the allocation of these funds,[39] along with differences in their implementation, distinguishes them from FNE funds.

From 2000 to 2017, the average annual share of total BNDES loans was 11.9% for the Northeast region and 2.3% for Pernambuco. These percent-

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[38]For example, approximately 50% of BNDES loans in Pernambuco from 2000 to 2017 were concentrated in just 14 municipalities within the metropolitan region of Recife.

[39]Recall that, unlike FNE loans, BNDES subsidized loans are not typically place-based incentives.

ages closely correspond to each area's contributions to the country's GDP.[40] Unlike FNE funds, BNDES resources are mostly directed to legal entities (formalized firms), and most BNDES funds are implemented indirectly through accredited institutions responsible for risk analysis. Over the period 2000-2017, an average of 53.8% of disbursements per year were made through these institutions. Priority is given not only to micro and small businesses, but also to medium-sized companies. On the other hand, BNDES loans can also be used for operating expenses, working capital, and investments.[41] But a significant portion of the loans are for investment purposes; for example, in our database for Pernambuco, 41.5% of the companies benefiting from BNDES between 2000 and 2017 used the Finame line, which is for financing the acquisition of machinery and equipment.[42]

The BNDES financing rates also vary according to the specific financing lines. However, they all include three main components: a basic reference rate, which reflects the BNDES' cost of raising funds; an additional rate, which represents the Bank's remuneration; and, in the case of indirect loans, another remuneration rate of the accredited institution. Terms can generally be up to ten years with grace periods of up to 60 months for investments and 12 months for working capital.[43] For the loans obtained from BNDES by the firms in our RAIS sample between 2000 and 2017 in Pernambuco, the average interest rate was 8.9% per year, not much higher than the average TJLP (7.58% per year) and the average annual inflation rate (6.5%) in the same period.

Table 11 in Appendix A shows the characteristics of the firms that borrowed only from the BNDES or the FNE.[44] The figures in the table show that,

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[40]In 2017, the shares of the Northeast and Pernambuco in Brazilian GDP were 14.5% and 2.8%, respectively. See `https://bit.ly/4ktNgyo`.

[41]`https://bit.ly/4k6KCPe`. See [52] for a more detailed characterization of BNDES loans.

[42]Finame is the acronym for the BNDES financing line for the acquisition of machinery and equipment - *Financiamento de Máquinas e Equipamentos*.

[43]The basic rate may include the following rates: Long-Term Interest Rate (TLP) (inflation plus fixed rate), average Selic rate (public bonds), BNDES fixed rate (TFB), and reference rate (TR). The Long-Term Interest Rate (TJLP) was established by Provisional Measure No. 684 of 10/31/94 and was considered the basic cost of BNDES loans until 2017. In January 2018, it was replaced by the TLP. See `https://bit.ly/44L6tXM`

[44]Note that of the total of 10,690 companies identified in RAIS that received only loans from BNDES, we discarded 39 firms that used credit lines that included investments in

compared to firms that obtained loans exclusively from the FNE, firms that obtained loans from the BNDES tended to be larger (less presence of micro firms and greater presence of medium-sized firms), less focused on commerce and more focused on services, and more present in the RMR and less in the semi-arid region. In our database, we also notice that the loans granted by the BNDES tend to be larger on average than those granted by the FNE. For example, while the average value of these loans in 2017 was R$ 529,800.50 in the case of BNDES, the average for the FNE was R$ 351,875.80. Such differences are in line with the analysis of the differences between BNDES and BNB loans made by [53]. As these authors have shown, compared to BNB loans, BNDES loans in the Northeast region tend to have a smaller spatial scope, being concentrated in the most developed municipalities, a greater relative participation of large and medium enterprises, and a higher contract value.[45]

Columns (1) to (3) of Table 7 present estimates of the general effects of BNDES loans on companies that benefit only from this incentive between 2000 and 2017. The results were obtained using the same strategy applied in the evaluation of FNE resources, that is, we considered the same econometric specification, control variables, and control group, also formed by companies that have not yet benefited from BNDES loans. Column (1) of Table 7 indicates a mean positive impact of 10.7%, a magnitude close to that obtained for FNE loans. On the other hand, unlike in the FNE case, we now obtain a mean positive impact of 4.2% of the BNDES credits on the average wage paid by the benefiting companies (column (2)). The combination of the positive effects on employment and wages explains the positive impact of about 17% on the payroll of the benefiting companies (column (3)).

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local infrastructure. This would be the case, for example, for loans from Finem line - *Financiamento a empreendimentos.*

[45]There are also other differences between our study and the work of these authors in terms of the scope of the loans considered. In the case of the BNB, the authors include in their analysis all of the bank's credit programs and not just the FNE, i.e. they include, for example, loans from the *Crediamigo* and *Agroamigo* programs, which benefit small producers and entrepreneurs, as well as loans to individuals. As far as BNDES loans are concerned, the aforementioned work also includes loans for infrastructure projects and for state and municipal governments. According to the authors' figures, from 2010 to 2019, the average value of the BNDES loan contract corresponded to R$ 530,944.25, while the corresponding value reached R$ 39,111.11 in the case of BNB loans (2019 values).

Table 7: Effects of BNDES loans

	Employment	Wage	Payroll
	(1)	(2)	(3)
BNDES	0.102***	0.041***	0.157***
	(0.031)	(0.012)	(0.046)
BNDES Firms	10,651	10,651	10,651
Observations	57,209	57,209	57,209
	(4)	(5)	(6)
BNDES Finame	0.121***	0.039***	0.201***
	(0.033)	(0.015)	(0.045)
Controls			
BNDES Firms	4,758	4,758	4,758
Observations	9,545	9,545	9,545
	(7)	(8)	(9)
BNDES Non-Finame	0.072**	-0.004*	0.039
	(0.033)	(0.016)	(0.06245)
BNDES Firms	5,676	5,676	5,676
Observations	47,664	47,664	47,664

Notes: Wbootstrap firm-level clustered standard error in parentheses.
BNDES: Firms benefiting only from BNDES loans; BNDES Finame:
Firms benefiting from the BNDES Finame line but not benefiting from
incentives from sources other than BNDES; BNDES Non-Finame:
Firms benefiting exclusively from BNDES loans but not from the
Finame line. All regressions include control variables, firm fixed effects,
and time fixed effects. The control variables include the
characteristics of firms, employees, and location presented in Table 1.
Statistical significance levels: (*)$P < 0.1$; (**) $P < 0.05$; (***)$P < 0.01$.

Figure 11 shows estimates from the dynamic version of the model for the three outcomes. In none of the three cases is there statistical significance for the coefficients during the pre-treatment period. For the post-treatment period, the estimates indicate increasing effects until at least the seventh year for the three outcomes. After 8 years of the policy, the estimates show a difference of 49.2% for the numer of employees and a similar difference for firms' payroll. As for salaries, the positive difference reaches 10.9% after seven years and then decreases.

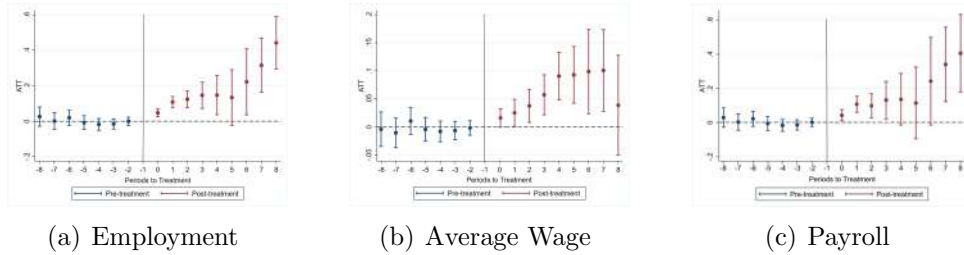(a) Employment   (b) Average Wage   (c) Payroll

Figure 11: Effects of BNDES loans by time of exposure (post-treatment) and time before the policy (pre-treatment).

Source: Author's own elaboration.

Although they show important differences with respect to the effects already obtained for FNE loans, our results for the effects of BNDES loans are consistent with previous assessments of loans from this bank. The results of [31] point to positive effects of these loans on employment and exports of the benefiting firms. Exploring changes in the legislation in the definition of small and medium enterprises (which have more favorable credit conditions), [44] find that BNDES loans increase investment and productivity of the benefiting firms.

While our evidence does not allow us to definitively identify the reasons for the differences between the effects of FNE and BNDES loans, we highlight two possible non-exclusive reasons for such differences. First, there is a clear difference in the weight of financing according to the purpose of the loans. In our BNDES sample, 41.5% of the financing was provided through the BNDES Finame line, which is aimed at the purchase of machinery and equipment, a percentage that is much higher than that of FNE financing. To the extent that such allocation may imply changes in production processes and increases in labor productivity, it is consistent with an increase in wages. Second, the fact that the majority of BNDES' lending in Pernambuco (and in the Northeast) is through accredited institutions (with which it shares the risks of the loans), which are more present in more developed locations, may lead to the selection of better projects, also in terms of the impact on productivity.

Here we examine evidence for the importance of the first of these explanations. Columns (4)-(6) of Table 7 present estimates of the impact of BNDES loans for firms that benefited from the bank's Finame line and received no incentives from any source other than BNDES. Columns (7)-(9) present estimates for firms that received loans exclusively from the FNE, but not from

the Finame line. Notably, for the Finame line, the estimates obtained for the three outcomes indicate similar results to those obtained for all firms benefiting from BNDES (columns (1)-(3)). For this group of firms, BNDES loans increase the number of employees, wages, and the payroll by 12.7%, 4.0%, and 22.3% per year, respectively. On the other hand, for firms which benefited from BNDES loans but not from the Finame line, the evidence indicates a positive impact only on the number of employees (about 7,4%).[46]

This new set of estimates suggests that the greater concentration of BNDES in loans for investment purposes through the Finame line is part of the explanation for the differences between the effects of these loans and those of the FNE. While it is not possible to determine whether the channel responsible for the differences is the purpose of resource allocation or a possible better evaluation of projects in this specific credit line, we note that this result is consistent with that already obtained for the estimates of the impact of FNE loans according to their different purposes.

7. Conclusions

Place-based policies refer to government programs designed to improve the economic performance of specific geographic areas. The FNE is the most important place-based policy in Brazil, a country with a history of large regional disparities in income and welfare. This fund provides subsidized loans for long-term investments, working capital, and operating expenses to firms located in the Northeastern states and parts of the states of Minas Gerais and Espírito Santo. Using a unique set of information that allows the identification of firms benefiting from the FNE and other state or federal incentives in the northeastern state of Pernambuco, we provide an evaluation of the impact of the FNE loans on employment, wages, and payroll of benefiting firms.

The research findings contribute to the literature and Brazil's long history of place-based policies in three key directions. First, to the best of the authors' knowledge, this is the first evaluation of the FNE that explicitly

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[46]Estimates for the dynamic versions of the model (event study) are presented in Figures 24 and 25 in Appendix A. For the firms benefiting from the Finame line, the positive effect on employment lasts until the fourth year, while the positive effect on wages increases and remains positive until at least the eighth year after the loan. For non-Finame firms, the positive effect on employment is increasing over time.

considers the possible influence of benefits from other place-based or non-place-based policies in Brazil. Second, by analyzing the period from 2000 to 2017, we were able to estimate the short- and medium-term effects of the FNE. This aspect, essential for regional development, has been largely neglected in previous work. Third, we present evidence on the impact of FNE loans on benefiting firms by loan purpose (investment vs. operating and working capital) and compare the impact of FNE loans with that of BNDES (The national development bank) loans, a non-place-based incentive.

In order to identify the effects of the FNE on the firms benefiting from the incentives, we use a detailed longitudinal database with information on firms and a difference-in-differences strategy that accounts for possible heterogeneity of the treatment cohorts. This set of information allows us to follow the trajectory of firms over time and to use firms treated in later periods as a control group. Our results indicate that FNE loans stimulate job creation and reduce the average wage paid by formal firms, while the total wage bill is zero. Specifically, we find that FNE loans lead to a total annual increase in employment of about 9% and a reduction in wages of 5%. This positive effect on employment increases over time, reaching about 21% after 8 years from the introduction of the subsidy, and the negative effect on wages disappears after 6 years. These findings are robust to the use of a different control group, the presence of outliers and self-selection of firms in the sample, the effects of social policies and other programs, and are confirmed for both metropolitan and semi-arid regions.

We show that while the positive effect on employment levels is independent of the purpose of the loan (investment or costing and working capital), the negative effect on wages is associated with the use of resources for costing and working capital and the hiring of less skilled workers. Consistent with expectations, subsidized FNE credits are more important for micro and small firms. Such loans also do not guarantee the expansion of employment in manufacturing, but only in commerce and services. While supporting the idea that small and micro firms are more subject to credit constraints, this set of results suggests that subsidized FNE credit is mainly directed to low productivity activities.

Our results indicate that the failure to consider the possibility of the accumulation of benefits by firms, a common practice in previous FNE assessments, tends to seriously overestimate the positive impact of FNE credits on firms' employment and payroll. The results of the paper also show that, contrary to the results obtained for the FNE, the impact of subsidised loans

from the BNDES, a non-place-based incentive from the national development bank, is positive for both employment and wages paid by firms. This result is related to the fact that they are largely used for the purchase of machinery and equipment and relatively less for operating expenses and working capital.

Overall, our evidence supports the effectiveness of FNE loans in expanding low-skill employment in environments likely to experience severe credit constraints. However, our results also suggest that, in general, such an incentive does not act to increase the productivity of the beneficiary firms, a channel for sustainable income growth. Whether such conclusions are related to the place-based nature of the policy is an open question. In any case, reserving resources for mandatory use in certain areas may mean financing less productive activities, as the comparison between FNE and BNDES loans suggests.

8. Acknowledgements

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9. Appendix A

Table 8: Descriptive statistics - Firms and Individuals that took out FNE loans - 2000-2017

	Total	With CNPJ	With CPF	RAIS
Services and Commerce	54.42	85.04	0.0	80.5
Manufacturing	35.96	12.74	0.96	16.5
Others	9.62	2.2	99.04	2.9
Metropolitan region of Recife	25.83	35.90	7.93	28.8
Semi-arid	67.88	55.84	89.29	54.5
Operating and working capital	44.21	68.98	19.62	61.3
Investment	48.23	30.14	80.38	32.2
Observations	24,996	15,997	8,999	10,828

Notes: Total: Firms and individuals that took out FNE loans between 2000 and 2017. Loans related to PRONAF (family farmers), PROINFRA (infrastructure), PROGER (FAT resources), and funding for unspecified purposes are excluded from this universe. With CNPJ: Firms and individuals with CNPJ who took out FNE loans between 2000 and 2017. With CPF: Individuals who took out FNE loans between 2000 and 2017. RAIS: Firms with a CNPJ that took out a loan from the FNE between 2000 and 2017 and were identified in RAIS. Source: Author's own elaboration based on microdata from BNB and RAIS.
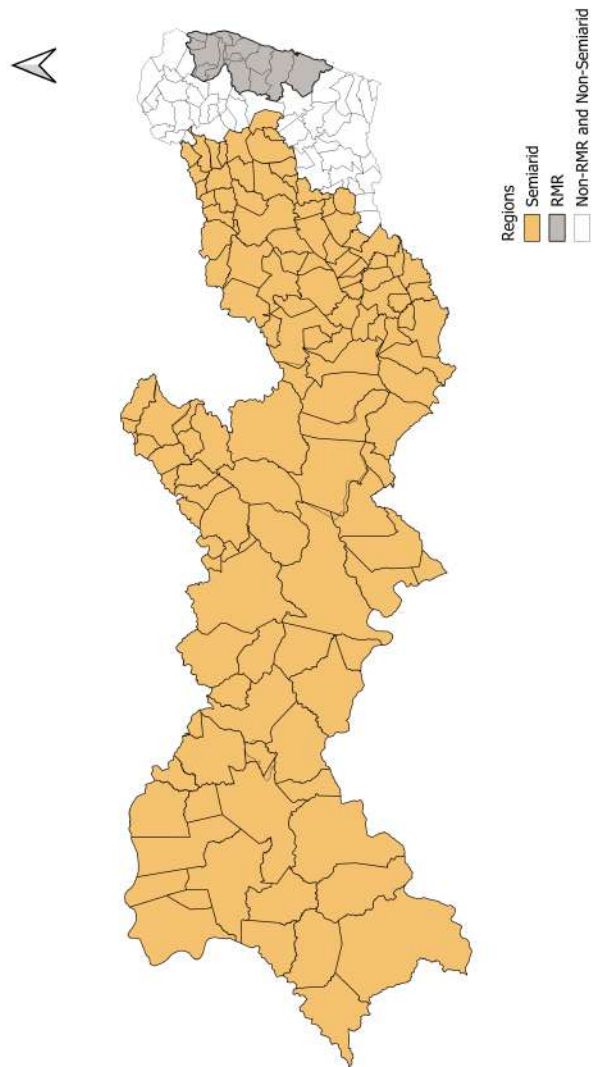
Figure 12: Municipalities and regions of the state of Pernambuco

Source: Author's own elaboration.

Table 9: **Firms benefited and not benefited by credit and fiscal incentives - spatial-based and non-spatial-based policies - Pernambuco**

Year	Total (A)	Firms benefited (B)	% (B/A)	Firms benefited by the FNE				Firms not benefited by the FNE			
				FNE (C)	% (C/B)	Only FNE (D)	% (D/B)	Other policy (E)	% (E/B)	No policy (F)	% (F/A)
2000	48,389	336	0.7	28	8.3	25	7.4	308	91.7	48,053	99.3
2001	50,573	501	1.0	31	6.2	25	5.0	470	93.8	50,072	99.0
2002	53,366	681	1.3	40	5.9	31	4.6	641	94.1	52,685	98.7
2003	55,077	928	1.7	82	8.8	67	7.2	846	91.2	54,149	98.3
2004	57,757	1,071	1.9	184	17.2	148	13.8	887	82.8	56,686	98.1
2005	60,802	1,421	2.3	387	27.2	320	22.5	1,034	72.8	59,381	97.7
2006	63,811	2,105	3.3	829	39.4	715	34.0	1,276	60.6	61,706	96.7
2007	66,122	2,798	4.2	1,286	46.0	1,108	39.6	1,512	54.0	63,324	95.8
2008	69,147	3,603	5.2	1,782	49.5	1,508	41.9	1,821	50.5	65,544	94.8
2009	73,344	4,834	6.6	2,364	48.9	1,949	40.3	2,470	51.1	68,510	93.4
2010	79,360	7,442	9.4	2,969	39.9	2,227	29.9	4,473	60.1	71,918	90.6
2011	84,850	9,487	11.2	3,496	36.9	2,511	26.5	5,991	63.1	75,363	88.8
2012	90,698	11,077	12.2	4,148	37.4	2,880	26.0	6,929	62.6	79,621	87.8
2013	95,008	12,024	12.7	4,655	38.7	3,180	26.4	7,369	61.3	82,984	87.3
2014	99,548	12,862	12.9	5,287	41.1	3,612	28.1	7,575	58.9	86,686	87.1
2015	100,212	13,090	13.1	5,929	45.3	4,114	31.4	7,161	54.7	87,122	86.9
2016	98,164	12,819	13.1	6,344	49.5	4,481	35.0	6,475	50.5	85,345	86.9
2017	97,261	12,408	12.8	6,948	56.0	5,055	40.7	5,460	44.0	84,853	87.2
Total	**1,343,489**	**109,487**	**8.1**	**46,789**	**42.7**	**33,956**	**31.0**	**62,698**	**57.3**	**1,234,002**	**91.9**

Note: (A) Total number of firms established in the state of Pernambuco; (B) Total number of firms benefited by any policy; (C) Firms benefited by the FNE; (D) Firms benefited only by the FNE; (E) Firms not benefited by the FNE but benefited by other policy at some point; (F) Firms not benefited by any policy. Firm-year data are considered for the panel from 2000 to 2017.

Source: Author's own elaboration based on information from BNB, BNDES, Sudene, Prodepe, and RAIS microdata.

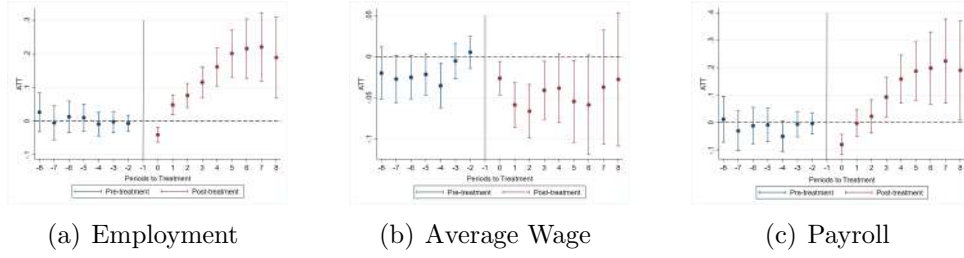(a) Employment   (b) Average Wage   (c) Payroll

Figure 13: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Control group: Never treated.

Source: Author's own elaboration.

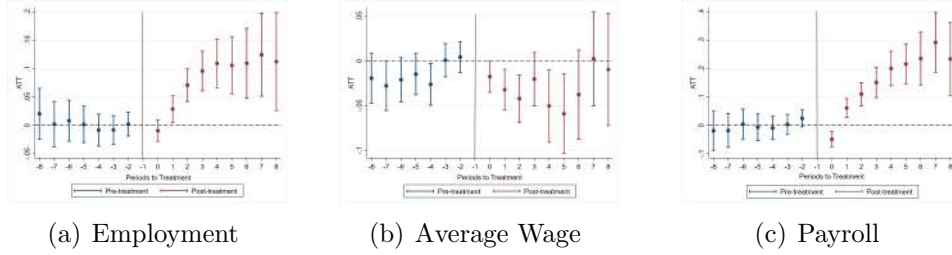(a) Employment   (b) Average Wage   (c) Payroll

Figure 14: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Sample excluding outlier firms.
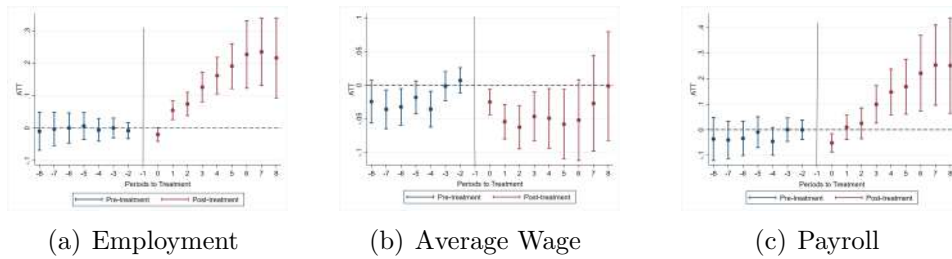
Source: Author's own elaboration.

(a) Employment   (b) Average Wage   (c) Payroll

Figure 15: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Sample of surviving firms
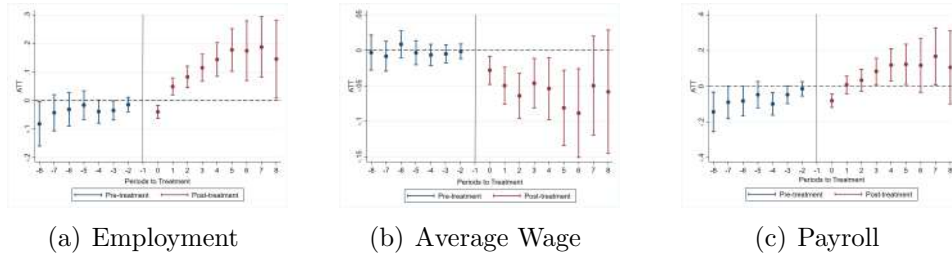
Source: Author's own elaboration.

(a) Employment	(b) Average Wage	(c) Payroll

Figure 16: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - *Bolsa Família*

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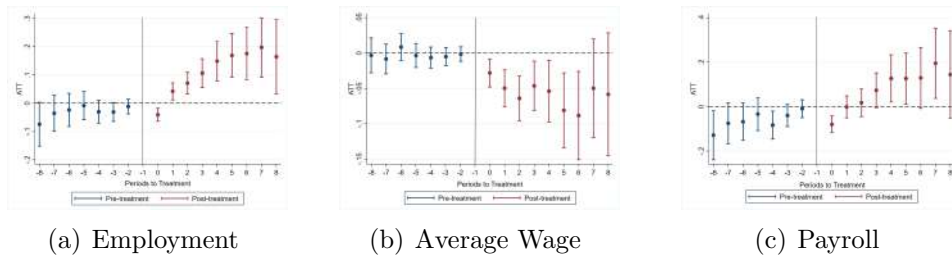
Source: Author's own elaboration.

(a) Employment	(b) Average Wage	(c) Payroll

Figure 17: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - *Bolsa Família* and *Benefício de Prestação*

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Source: Author's own elaboration.

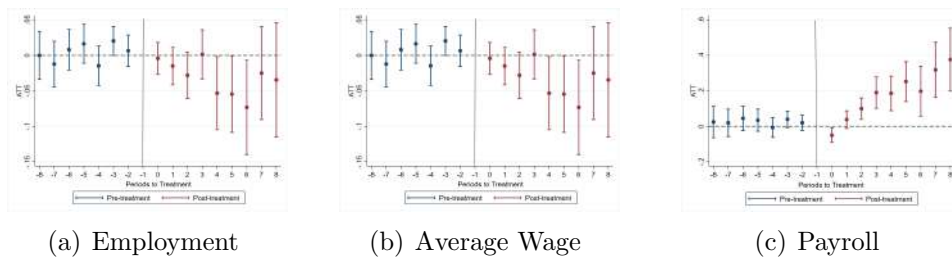|		
(a) Employment	(b) Average Wage	(c) Payroll

Figure 18: Effects of FNE by time of exposure (post-treatment) and time before the policy (pre-treatment) - *Cisternas* Program.

Source: Author's own elaboration.
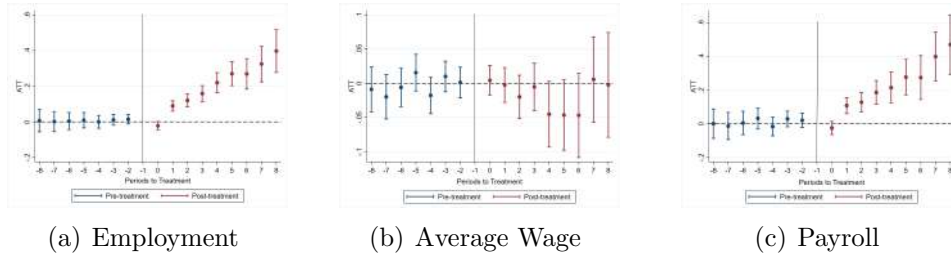
(a) Employment (b) Average Wage (c) Payroll

Figure 19: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - *Política Nacional de Desenvolvimento Regional*

Source: Author's own elaboration.
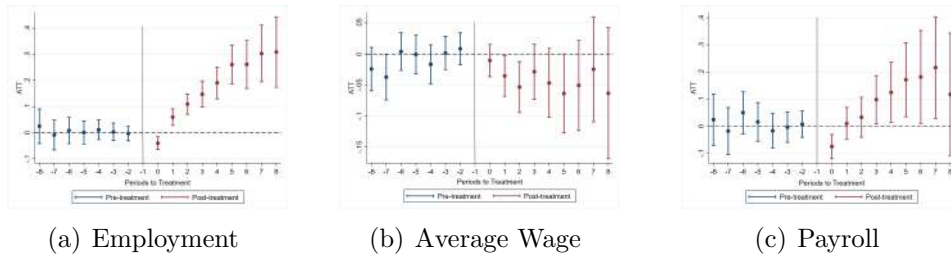

(a) Employment (b) Average Wage (c) Payroll

Figure 20: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Investments associated with PAC 1 and PAC 2

Source: Author's own elaboration.

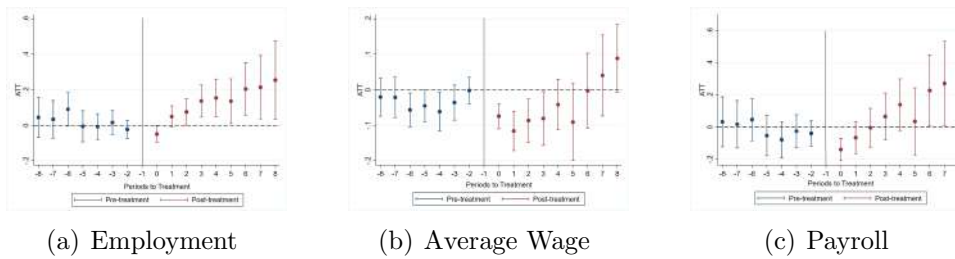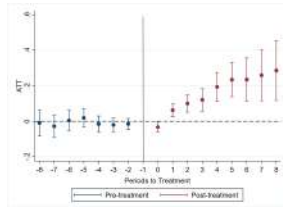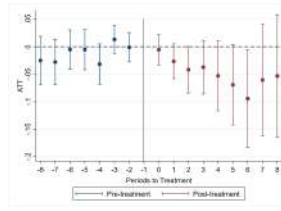(a) Employment (b) Average Wage (c) Payroll

Figure 21: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Metropolitan Region of Recife
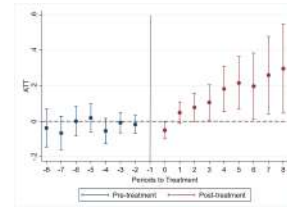
Source: Author's own elaboration.

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(a) Employment   (b) Average Wage   (c) Payroll
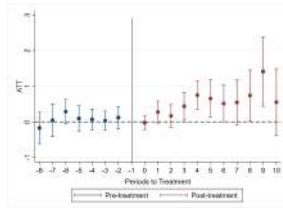
Figure 22: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Semi-arid
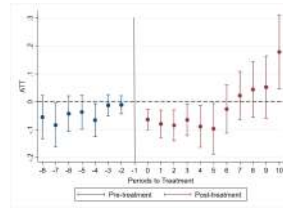
Source: Author's own elaboration.

Table 10: Descriptive statistics - Always present and disappeared firms - FNE

| Variables	Disappeared firms		Always present firms	
	Mean	Std. Dev.	Mean	Std. Dev.
(ln)employment	1.76	0.96	1.82	0.87
(ln)payroll	8.40	1.61	8.45	1.43
(ln)wage	6.95	0.89	6.91	0.76
employment	11.62	53.64	9.37	25.04
wage	1,217.43	782.20	1,132.16	622.02
payroll	15,765.53	75,029.88	12,477.99	51,530
Simples nacional	0.79	0.41	0.79	0.41
(ln) age of the firm	1.73	0.92	2.21	0.75
Time in the market	7.45	7.92	10.77	8.17
Large firm	0.01	0.00	0.01	0.00
Medium-sized firm	0.02	0.00	0.02	0.00
Micro-enterprises	0.69	0.01	0.68	0.01
Small firm	0.22	0.01	0.22	0.01
Other sectors	0.02	0.00	0.02	0.00
Agriculture	0.01	0.00	0.01	0.00
Industry	0.16	0.00	0.16	0.00
Services	0.20	0.02	0.19	0.02
Commerce	0.60	0.01	0.60	0.01
Worker's age	32.21	6.77	32.46	6.71
Age squared	1083.69	475.26	1099.08	485.40
Employment time	24.46	25.02	34.34	28.92
Time squared	1223.92	3935.88	2015.51	4647.36
Hours hired	43.40	3.01	43.38	3.02
Elementary school	0.16	0.29	0.21	0.31
High school	0.73	0.34	0.70	0.34
College	0.10	0.22	0.09	0.20
Agreste	0.26	0.44	0.29	0.45
Mata	0.14	0.34	0.14	0.35
Metropolitan Recife	0.37	0.48	0.28	0.45
Sertão	0.12	0.32	0.17	0.38
São Francisco	0.12	0.32	0.12	0.33
Semi-arid	0.48	0.50	0.56	0.50
Observations	1,743	1,743	33,956	33,956

Notes: Employment refers to the number of employees; Average wage and payroll
are measured in 2017 BRL; Time in the market, employee age, and tenure
are measured in years; Hours refer to weekly hours worked; The other variables
(economic activity, employee education, and location) represent shares of firms.
Source: Author's own elaboration based on microdata from BNB and RAIS.
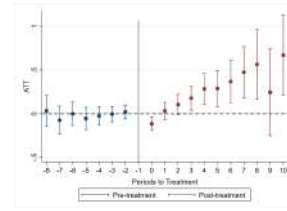
(a) Employment (b) Average Wage (c) Payroll

Figure 23: Effects of FNE loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Investment, operating, and working capital

Source: Author's own elaboration.

Table 11: Characteristics of firms benefiting exclusively from FNE or BNDES

Variables	BNDES		FNE	
	Mean	Std. Dev.	Mean	Std. Dev.
(ln)Employment	2.41	1.29	1.81	0.87
(ln)Payroll	9.26	1.82	8.45	1.44
(ln)wage	7.05	0.78	6.91	0.77
Employment	54.05	457.36	9.48	27.25
Wage	1,315.48	665.34	1,136.54	631.50
Payroll	98,533.63	1,219,343	12,646.74	52,994.08
Simples nacional	0.58	0.49	0.78	0.40
(ln) age of the firm	2.47	0.67	2.19	0.76
Time in the market	13.51	9.32	10.61	8.19
Large firm	0.03	0.00	0.03	0.00
Medium-sized firm	0.04	0.01	0.03	0.00
Micro-enterprises	0.62	0.02	0.77	0.01
Small fimr	0.27	0.02	0.16	0.01
Other sectors	0.04	0.00	0.01	0.00
Agriculture	0.03	0.00	0.01	0.00
Industry	0.10	0.02	0.16	0.00
Services	0.36	0.05	0.19	0.02
Commerce	0.45	0.05	0.60	0.01
Worker's age	34.57	6.41	32.45	6.71
Age squared	1,236.84	476.65	1,098.28	484.89
Employment time	38.97	29.73	33.83	28.81
Time squared	2,403.12	5,265.12	1,974.88	4,616.76
Hours hired	43.46	2.55	43.38	3.01
Elementary school	0.26	0.31	0.20	0.30
High school	0.64	0.32	0.69	0.33
College	0.08	0.17	0.09	0.20
Agreste	0.21	0.41	.28	0.45
Mata	0.15	0.36	0.14	0.34
Metropolitan Recife	0.50	0.49	0.28	0.44
Sertão	0.07	0.25	0.16	0.37
São Francisco	0.05	0.21	0.12	0.33
Semi-arid	0.33	0.47	0.55	0.49
Non-semi-arid	0.66	0.47	0.44	0.49
firms	10,651	10,651	8,231	8,231
Observations	57,209	57,209	33,956	33,956

Notes: BNDES: Firms benefiting exclusively from the BNDES loans; FNE: Firms benefiting exclusively from the FNE loans. Employment refers to the number of employees; Average wage and payroll are measured in 2017 BRL; Time in the market, employee age, and tenure are measured in years; Hours refer to weekly hours worked; The other variables (economic activity, employee education, and location) represent shares of firms.Firm-year data for the panel from 2000 to 2017 are considered.
Source: Author's own elaboration based on microdata from BNB, BDNES, and RAIS.

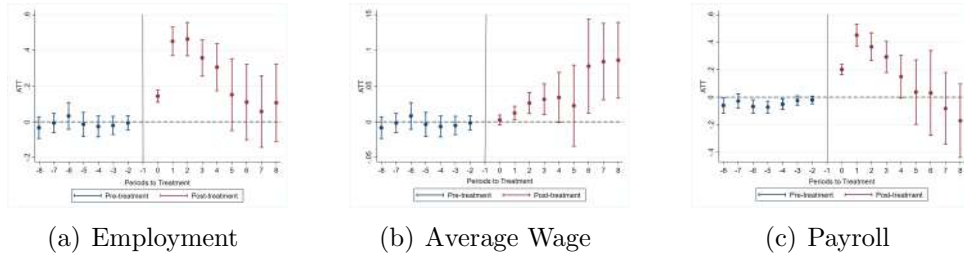(a) Employment   (b) Average Wage   (c) Payroll

Figure 24: Effects of BNDES loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Finame
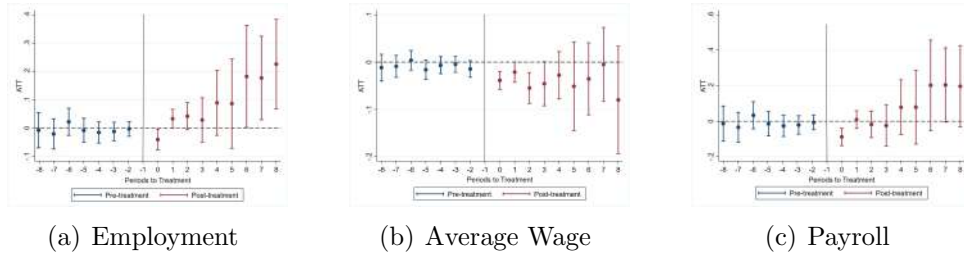
Source: Author's own elaboration.

(a) Employment   (b) Average Wage   (c) Payroll

Figure 25: Effects of BNDES loans by time of exposure (post-treatment) and time before the policy (pre-treatment) - Non-Finame

Source: Author's own elaboration.