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**Working Paper**

## Firm-level and local labor market effects of a large credit shock: Evidence from Brazil

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**DISCUSSION PAPER**

**2924**

**FIRM-LEVEL AND LOCAL  
LABOR MARKET EFFECTS  
OF A LARGE CREDIT SHOCK:  
EVIDENCE FROM BRAZIL**

**CARLOS HENRIQUE CORSEUIL  
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**FIRM-LEVEL AND LOCAL LABOR  
MARKET EFFECTS OF A LARGE CREDIT  
SHOCK: EVIDENCE FROM BRAZIL<sup>1</sup>**

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## Discussion Paper

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## ABSTRACT

A common explanation for the poor performance of entrepreneurs in developing economies is their inability to obtain credit to expand their scale of operation. This paper assesses the aggregate impacts of the Cartão BNDES, a credit line targeted at small and medium enterprises (SMEs) in Brazil, to investigate the role of credit constraints on SMEs performance. We use a major expansion of credit supply within the line to estimate causal effects of credit supply on firm size distribution, entry and exit, and employment. By exploiting the fact that firms can only use the available credit with suppliers that are registered in the credit line's system, we construct a variable that captures a credit supply expansion that varies exogenously across regions. We use an instrumental variable estimator that exploits differential access to the line and the expansion of suppliers to recover these causal effects. Our main result points that a 1% increase in the Brazilian Development Bank (Banco Nacional de Desenvolvimento Econômico e Social – BNDES) card loans has a positive effect on average local formal employment between 6.7% and 10.3%. This increase in employment is driven by the increase in the average size of firms, specially by the average size of new entrant firms. These are relevant results as they suggest that the type of credit provided by BNDES card fosters the dynamics of local labor markets, increasing the entrance of new firms, which are pointed as the group most affected by credit constraints.

**Keywords:** credit; employment; local labor market.

## SINOPSE

Uma explicação comum para o relativo pior desempenho das firmas nas economias em desenvolvimento é a dificuldade de obter crédito para expandir a sua escala de operação. Este artigo avalia os impactos agregados do Cartão BNDES, uma linha de crédito direcionada a pequenas e médias empresas (PMEs) no Brasil, para investigar em que medida uma redução nas restrições de crédito podem dinamizar não apenas as PMEs como também a economia local em que estão inseridas. Utilizamos uma grande expansão da oferta de crédito dentro dessa linha para estimar os efeitos causais da oferta de crédito no emprego e em outros indicadores relacionados ao desenvolvimento de economias locais (microrregiões). Ao explorar o fato de as empresas só poderem utilizar o crédito disponível com fornecedores registrados no sistema da linha de crédito, construímos uma variável que captura uma expansão da oferta de crédito que varia exogenamente entre regiões. Utilizamos um estimador de variável instrumental que explora o acesso diferencial à linha e a expansão de fornecedores para recuperar esses efeitos causais. Nosso principal resultado aponta que um aumento de 1% nos empréstimos com cartão do Banco Nacional de Desenvolvimento Econômico e Social (BNDES) tem um efeito positivo sobre a média do emprego formal local entre 6,7% e 10,3%. Este aumento do emprego é impulsionado pelo aumento no tamanho médio das empresas, especialmente das novas empresas entrantes. Esses resultados são relevantes porque

sugerem que a modalidade de crédito disponibilizada pelo cartão BNDES estimula a dinâmica dos mercados de trabalho locais, aumentando a entrada de novas empresas, que são apontadas como o grupo mais afetado pelas restrições de crédito.

**Palavras-chave:** crédito; emprego; mercado de trabalho local.



## 1 INTRODUCTION

This paper assesses the aggregate impacts of the Cartão BNDES, a credit line of the Brazilian Development Bank (Banco Nacional de Desenvolvimento Econômico e Social – BNDES) targeted at small and medium enterprises (SMEs). In doing so, this report aims to contribute to the general topic of financial constraints and development. This link is explored in a vast literature spanning from theoretical to empirical contributions.

One strand of this literature deals with financial frictions in developing countries. Indeed, less developed countries have low levels of financial development, with low availability of formal financial services (e.g. savings accounts and bank loans) and measures of external finance to gross domestic product (GDP) that are orders of magnitude lower than those of developed countries (Banerjee and Duflo, 2005). Another strand emphasizes the relative poor performance on firms outcomes also in developing countries. For instance, firm size distribution seems to have a high concentration in small firms at the expense of a low share of middle sized firms, a regularity coined as missing middle (Tybout, 2000). Additionally, there are evidences pointing to more pronounced miss-allocation of resources among firms in developing countries (Hsieh and Klenow, 2009) and even more among small ones. Hence, a common explanation for the poor performance of entrepreneurs in developing economies is their inability to obtain credit to expand their scale of operation.

Brazil in the 2000 years seems to be an appropriate setting to this investigation. On one hand, we have evidence on both missing middle (Coelho, Corseuil and Foguel, 2017) and on miss-allocation (Vasconcelos, 2017). On the other hand the country experienced an intense expansion in formal employment, with an increase in average firm size, concomitant with an increase in credit opportunities for small firms.

However some others policy shocks challenges a clean identification of the link between credit to small firms and development.<sup>1</sup>

We use the major expansion of credit supply within Cartão BNDES to estimate causal effects of credit supply on firm size distribution, entry and exit, employment, as well as GDP per capita and GDP per formal worker. In order to do that, we rely on a distinguished feature of this credit line to construct a variable that capture a credit supply expansion that varies exogenously across regions. This motivates the use of an

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1. By mid-2000 Brazil intensified target to boost small firms' performance. One is a tax simplification credit line, and the other is a government purchase system.



instrumental variable, difference-in-difference estimator, that exploits differential access to and expansion of registered suppliers to recover these causal effects.

Our dataset combines two unique administrative data from Brazil. The first is the Annual List of Social Information (Relação Anual de Informações Sociais – Rais) data set, a matched employer-employee data that contains the universe of formal firms and workers. The second is the administrative data from the Cartão BNDES credit line, which contains firm-level information on applicants, credit use, expenditures and suppliers. Our analysis focuses on the 2005-2012 period, which is characterized by a rapid expansion of the credit line.

Although the original information is available at a higher disaggregation level, we take a local labor markets approach. The main reason is that the development outcomes emphasized in the related literature cannot be defined at firm level as they are related to characteristics of the firm size cross-section distribution at a higher aggregation level. Further, the same happens with our instrumental variable. We use the micro-regions in Brazil as our measure of local economy. They constitute a grouping of economically integrated and contiguous municipalities that is defined by the National Bureau of Statistics in Brazil (Instituto Brasileiro de Geografia e Estatística – IBGE). As argued in previous papers, micro-regions closely parallel the notion of local economies and have been extensively used as the unit of analysis in the literature that investigates the local labor market effects of trade in Brazil (Kovak, 2013; Dix-Carneiro and Kovak, 2015; 2017). For our period of analysis, we have 545 micro-regions that are consistently defined over time.

Our results point that Cartão BNDES positively affected regional employment, increasing the average firm size as well as the number of firms. An interesting feature of the positive impact on firm size is that it remains valid even when we restrict the analysis to the size distribution of entrant firms.

The remaining of this report proceeds as follows. Section 2 provides some background on the Cartão BNDES credit line, as well a discussion on the data and some basic facts. Section 3 presents the empirical strategy and section 4 the main results.

## 2 BACKGROUND AND DATA

### 2.1 Institutional background: the Cartão BNDES

This paper focuses on one of the main credit lines for SMEs from the BNDES, the Cartão BNDES (henceforth the BNDES Card). Launched in 2003, this credit line was an innovation in the way BNDES supported SMEs. The aim behind its creation was to provide greater and faster credit access to this targeted public.

The BNDES Card is an SMEs-earmarked credit line based on the idea of personal credit cards: it is a pre-approved revolving credit<sup>2</sup> based on a fixed credit limit established by the credit card's issuer (explained below). The BNDES Card provides financing for the isolate purchase of a list of financeable products. It finances both inputs (goods and services) and capital goods (mainly machinery and equipment). Each purchase with the card can be paid in equal, consecutive, monthly instalments (up to 48 months).<sup>3</sup>

Up to 2012, firms were eligible if they had gross annual revenues of up to R\$ 90 million – BNDES's SMEs threshold by then – and show proof of compliance with the relevant labor and tax regulations. Even though the revenue ceiling tends not a binding constraint, as most firms in Brazil are to left of this threshold, the latter condition can be binding, as informality among firms is quite high in Brazil.<sup>4</sup>

The BNDES Card was designed based on the idea of an electronic marketplace, hosted by the card's website, the *locus* where buyers meet sellers.<sup>5</sup> This website allows the companies interested in the line to apply for the credit card. The applicant must fill a short online form and choose the issuer of the card. The card's issuer is an authorized financial institution (AFI) that is allowed by BNDES to issue the card for eligible companies.<sup>6</sup> The AFIs are key players in this credit line, as they screen firms,

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2. The company can use the card as many times as it wants as long as the total balance remains under its credit limit.

3. BNDES has a traditional credit line, named Special Agency for Industrial Financing (Agência Especial de Financiamento Industrial – Finame), that is focused on the isolated financing of the purchase of machinery and equipment. However, this line requires an approved financing for each credit operation, which increases the cost of transaction compared to a pre-approved limit as in the case of BNDES card.

4. Even when firms are formally registered, they can have part or all their labor force hired informally (Ulyssea, 2018).

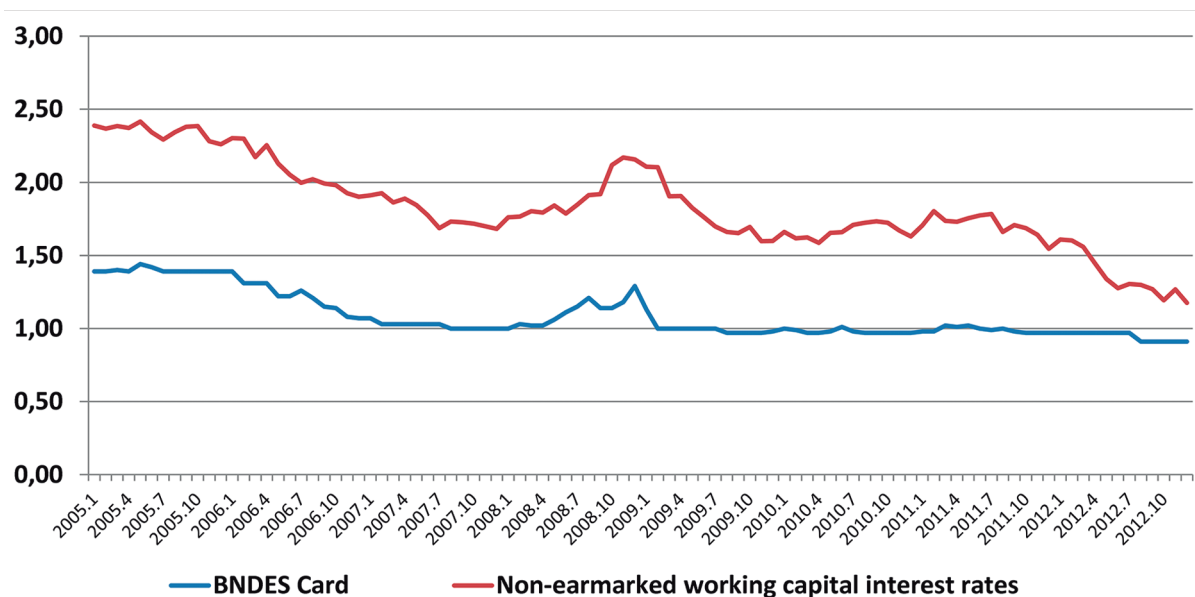
5. Detailed information available at: <https://www.cartaobndes.gov.br/cartaobndes/>.

6. As BNDES has no agencies through the Brazilian territory, it funds financial institutions, like commercial banks, to distribute its SMEs-focused lines.

issue the cards, define the credit limit and bear the client's risk of default, acting as a second-tier lender for the BNDES funding (each applicant could have up to BRL 1 million per AFI).<sup>7</sup> Hence, even though BNDES defines the parameters of this credit line and transfers the funds to the AFIs, it has no direct relationship with the borrowing firms.

Another important feature is that the pre-approved credit limit used to be provided at subsidized (below market level) interest rates. Figure 1 illustrates the extent of this subsidy.

**FIGURE 1**  
Market rates versus BNDES Card's rates  
(In %)



Source: BNDES and Central Bank of Brazil.

Obs.: Monthly interest rates for non-earmarked working capital credit operations for firms.

BNDES card's website also allows the application of suppliers to sell their products through the card's financing. Companies that manufacture or resell products within the financeable items list can apply to be a registered supplier. BNDES is then responsible for screening the applicants and allowing them to include products on the website's marketplace. There is one main restriction for credit usage within this

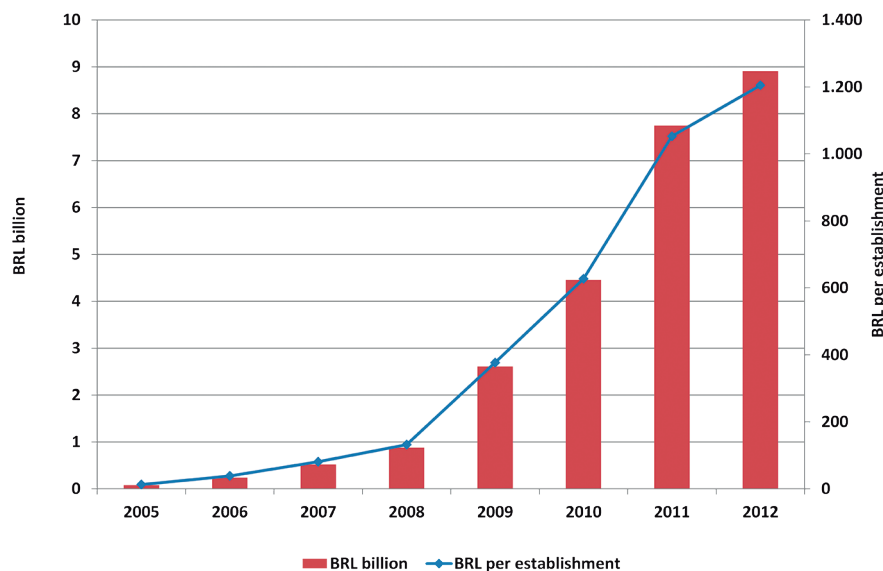
7. In 2009 there were two important changes in the eligibility card's rules: i) The firm's revenues threshold was increased from 60 to 90 million; and ii) the credit limit per AFI went from BRL 250,000 to 1 million. Hence, the credit line was substantially expanded in different dimensions in 2009, which increased its reach. We explore these two distinct phases in our empirical analysis.

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credit line: firms can only use this credit line to purchase new products that are manufactured in Brazil (or that have most of its components manufactured in the country)<sup>8</sup> and therefore it cannot be used to finance imports. Thus, all transactions depend on the availability of registered products on the website, although buyers can reach physical stores of the registered supplier to acquire products. The fact that a BNDES card supplier must be a company registered by BNDES plays a central role in our identification strategy, as it is discussed below.<sup>9</sup>

Despite its creation in 2003, the credit line effectively starts in 2005, with a very limited number of cards issued and a low volume of credit supplied. However, as Figure 2 shows, the total volume of credit increases substantially from 2008 onwards, reaching a total of BRL 9 billion in outstanding credit in 2012. Additionally, the ratio of credit per establishment also shows a huge elevation, going from BRL 132 in 2008 to 1.2 in 2012.

**FIGURE 2**  
Evolution of BNDES card: credit volume (2005-2012)



Source: BNDES and Rais.

Obs.: The right-hand axis shows the ratio between BNDES Card total credit and the total number of formal establishments in Rais.

8. BNDES establishes a 60% threshold of local content for product inclusion in the list of financeable items.

9. The availability of suppliers is important for the card's use, as one may have its supplier not registered in the BNDES card's marketplace. Machado, Parreiras and Peçanha (2011), for example, evaluates the effects of the BNDES card on firm's formal employment exploiting latter activation of the card.

## 2.2 Regional credit shocks

The main goal of this paper is to assess the effects of the credit supply shock brought about by the BNDES card. It is typically hard to isolate the effects of credit supply, as one usually observes credit use and not supply per se. In order to overcome this challenge, we exploit the design of the credit line discussed in the previous section to develop a *regional credit supply* shock within the BNDES card. We exploit the fact that firms can only use the available credit with suppliers that are registered in the credit line's system. Therefore, a greater availability of registered suppliers implies a greater *de facto* credit availability within the credit line.

We use as the departure point the time series of available suppliers at the country level for each 6-digit industry. Of course, not all industries benefit equally from increases in the number of suppliers in the cement industry, for example. Thus, it is necessary to connect the aggregate growth in available suppliers in each specific 6-digit industries to those industries that will directly benefit from it. In order to do that, we use two sets of technical coefficients: i) the standard coefficients from the Input-Output (I-O) Matrix (2005), from the IBGE, which captures the percentage share of costs for intermediate inputs in total output; and ii) the coefficients from the analog of an I-O matrix on investment flows, which captures the percentage share of costs of inputs in total investment.<sup>10</sup> In both cases, the number of effective suppliers in industry  $s$  in a given year  $t$  is given by

$$Sup_{st} = \sum_j \omega_{sj} Suppliers_{jt} \quad (1)$$

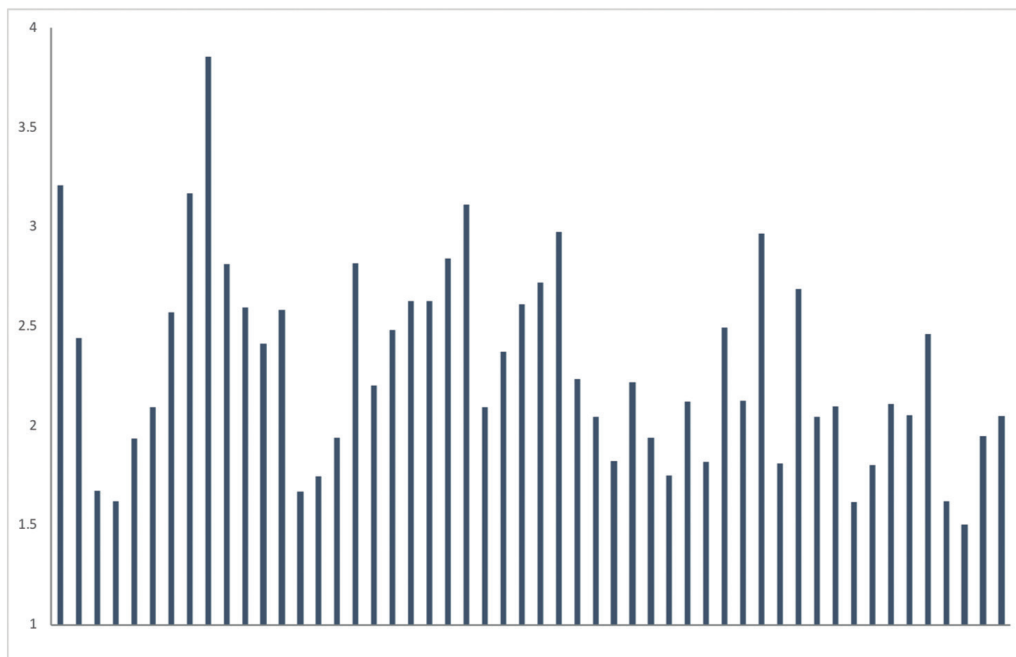
Where the  $\omega_{sj}$  denotes the technical coefficients used. The first set of coefficients provides a technical measure of how relevant inputs from industry  $j$  (at the 6-digit level) are for firms in a given industry  $s$ , while the second provides information on how relevant capital goods from industry  $j$  are for investment in industry  $s$ . This provides an industry level measure of (potential) credit availability within the credit line.

Figure 3 shows the log-changes in the number of effective suppliers at the industry level, using the technical coefficients from the matrix of investment flows (Panel (a)) and the coefficients from the standard I-O matrix (Panel (b)). It is seen that both measures show sizeable variation across industries even though the second one has a much larger degree of variation.

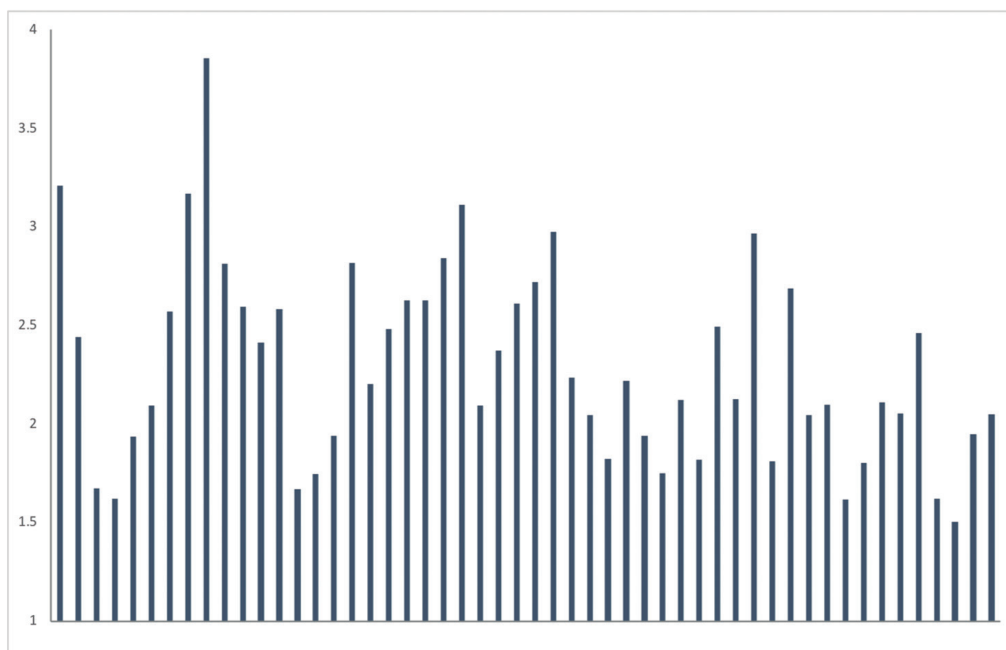
10. We use the coefficients from the investment flow matrix computed by Miguez et al. (2017) in collaboration with the IBGE. For an earlier application of the concept used by these authors, see for example Scherer (1982).

**FIGURE 3****Log-changes in the number of effective suppliers ( $S_s$ ) across industries (2005-2012)**

3A – Weights: coefficients from investment flow matrix



3B – Weights: coefficients from I-O matrix



Authors' elaboration.

Obs.: The number of effective suppliers in industry  $s$  is computed as described in expression (1).

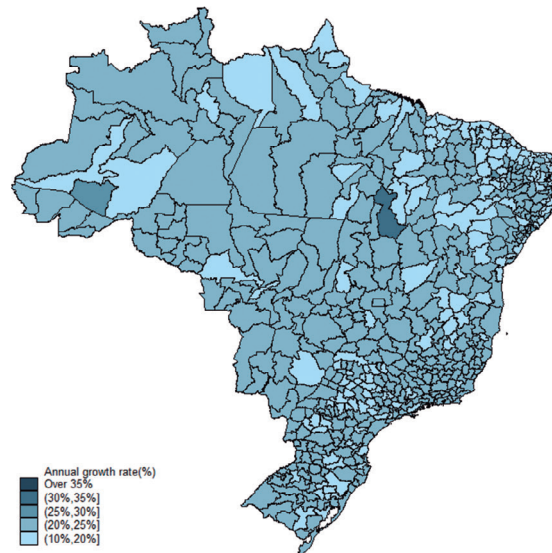
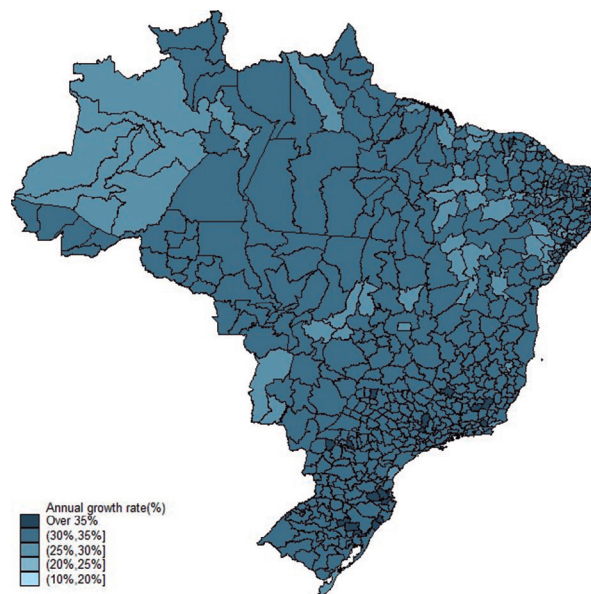
In order to obtain a regional credit supply shock, one must connect these industry-level shocks to local economies. We follow the literature on the local labor market effects of trade (Autor, Dorn and Hanson, 2013; Kovak, 2013; Dix-Carneiro and Kovak, 2015; Dix-Carneiro, Soares and Ulyssea, 2018) and employ a shift-share design that uses the baseline (prior to the credit line) sectoral distribution of establishments. The intuition of this approach is analogous to the local trade shocks used in the aforementioned literature: local economies that are more concentrated in industries that observe a higher increase in the number of effective suppliers (Expression 1) are more likely to be affected by the BNDES card credit expansion. The measure is constructed as follows:

$$RCS_{rt} = \sum_s \lambda_{rs} \sum_j \omega_{sj} Suppliers_{jt} \quad (2)$$

Where  $\lambda_{rs} = \frac{n_{rs}}{\sum_s n_{rs}}$  denotes the share of establishments of industry  $s$  in region  $r$  in the baseline (2002) and  $\omega_{sj}$  denotes the technological linkages between sectors  $s$  and  $j$ .

The  $RCS_{rt}$  thus provides a supply side shock to the local availability of credit within the BNDES card. It exploits three sources of variation: i) cross-industry variation in the availability of registered suppliers (at the national level); ii) cross-industry variation in technical linkages between industries, i.e. the relative intensity of use of either inputs or capital goods from different industries (embodied in the  $\omega_{sj}$  coefficients); and iii) variation across local economies in terms of the baseline industry composition of establishments. Put differently, it combines the aggregate changes in the availability of suppliers (the “shift” in shift-share) with the technical linkages between industries and the pre-determined structure of production in local economies (the “share” in shift-share). Figure 4 shows the variation between the initial and final years in our sample of the two regional credit supply shocks (capital and inputs). As the maps show, there is substantial regional variation in the regional supply shock in both measures.



**FIGURE 4****Changes in the regional credit shock ( $RCS_{rt}$ ) (2005-2012)**4A –  $\Delta RCS$ : technical linkage based on investment flow matrix coefficients4B –  $\Delta RCS$ : Technical linkage based on I-O matrix coefficients

Source: BNDES and Rais.

Obs.: 1. Changes in regional credit shocks,  $RCS_{rt}$  computed according to the expression (2).

2. Figure whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

$\lambda_{rs}$  are based on sector "s" establishment shares in microregion "r" at baseline;  $\omega_{sj}$  coefficients rely on an investment matrix that brings information on capital goods from different industries in 4A and an I-O matrix in 4B.

### 2.3 Outcomes of interest

There is a large literature that discusses how greater credit access can affect firms' decisions and key outcomes, such as entry, production, growth, investment and survival. If firms must incur in substantial fixed entry costs, greater availability of credit would lead to larger entry in local economies more affected by the credit shock than regions less affected. If these credit constraints were binding for high productivity entrepreneurs, then this greater entry could come together with an increase in the average size of entrants.

Greater availability of cheaper credit can also affect incumbents' behavior. Firms can use this credit lines to invest in capital goods and expand their operations and, consequently, their labor force. They might also be able to better cope with negative shocks, which could increase their survival probability. This might be particularly important to smaller and younger firms, which might lack established relationships with financial institutions or suppliers, which could also provide formal and informal credit to firms hit by unexpected negative shocks.

At the aggregate level, these distinct effects could translate into changes in total number of formal establishments and overall formal employment. The latter can be further decomposed into changes in hirings and separations using micro data on job flows, which can shed further light into the mechanisms through which credit shocks affect firms' employment decisions. These firm-level effects can also impact the firm size distribution in the economy. In particular, the firm size distribution can become more skewed to the left or to the right depending on the nature of the firm-level responses mentioned above. If low productivity (and smaller) firms disproportionately benefit from the credit shock considered here, they would survive with greater probability therefore increasing the presence of smaller firms in the economy. In the opposite direction, greater credit access could foster firm growth, which could lead to an increase in average firm size or the overall presence of larger firms relative to the baseline (without increased credit access). Of course, the net effect at the aggregate level is an empirical question.

### 2.4 Regional unit and data

We use micro-regions, which constitute a grouping of economically integrated and contiguous municipalities defined by the IBGE, as our definition of local labor markets. These are analogous to Commuting Zones in the United States, and have been extensively used as the unit of analysis in the literature that investigates the local labor market effects of trade in Brazil (Kovak, 2013; Dix-Carneiro and Kovak,

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2015; Dix-Carneiro, Soares and Ulyssea, 2018). For our period of analysis, we have 545 micro-regions that are consistently defined over time.

Our analysis relies on two unique administrative data sets. The first is an administrative matched employer-employee data set collected by the Ministry of Labor, the Rais. It contains the universe of formal workers and firms, including those that report zero employees (i.e., self-employed firms). We use the information on establishments' location and on job flows at the establishment level to compute hirings, separations, and total formal employment at the micro-region level. We also use this data set to compute outcomes related to firms, such as average establishment size, average size of entrants and share of small firms (with up to 3 employees). Finally, we use the panel structure of Rais to compute entry and survival rates. We also use data on GDP at the municipality level provided by the Brazilian Census Bureau (IBGE) to compute GDP per capita and per formal worker.

Table 1 shows the descriptive statistics (at the micro-region level) for the entire period. It shows there is great dispersion across micro-regions and over time in all the outcomes.

**TABLE 1**  
**Descriptive statistics**

	Mean	Standard deviation	Minimum	Maximum
Log(Total Employment)	9.343	1.678	3.434	15.424
Log(Hirings)	8.837	1.771	2.773	15.030
Log(Separations)	8.665	1.814	2.079	14.965
Log(Establishments)	8.457	1.206	5.017	13.690
Size < 3 (share)	0.869	0.052	0.691	0.994
Avg. Firm Size	2.949	1.852	0.183	17.714
Avg. Firm Size: Entrants	1.082	1.165	0.010	22.239
Entry Rate	0.086	0.021	0.023	0.336
Survival Rate	0.862	0.040	0.330	0.957
Log(GDP p.c.)	9.234	0.687	7.613	12.036
Log(Output p/formal worker)	11.998	0.651	10.586	14.835
Regional Credit Shock – Capital	0.056	0.018	0.021	0.117
Regional Credit Shock – Inputs	0.009	0.004	0.002	0.023
Population (thousands)	322.5	842.2	17.1	13,319.7
Observations	4.464	4.464	4.464	4.464

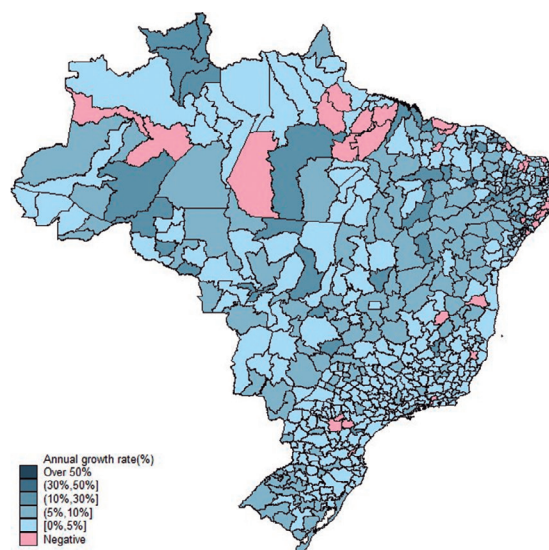
Authors' elaboration.

To further illustrate the type of variation that we explore in our empirical strategy, figure 5 shows the evolution of total employment and number of establishments in the formal sector across micro-regions. For both outcomes, the annual growth rate across regions varies from negative values to rates over 30% per annum.

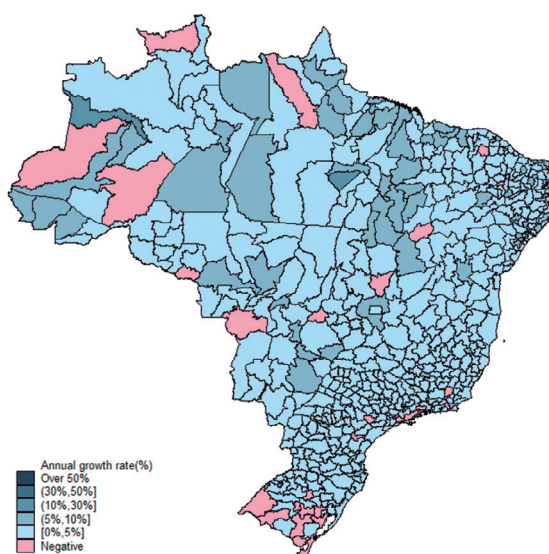
### FIGURE 5

#### Evolution of employment and establishments across micro-regions (2005-2012)

##### 5A – Employment



##### 5B – Number of establishments

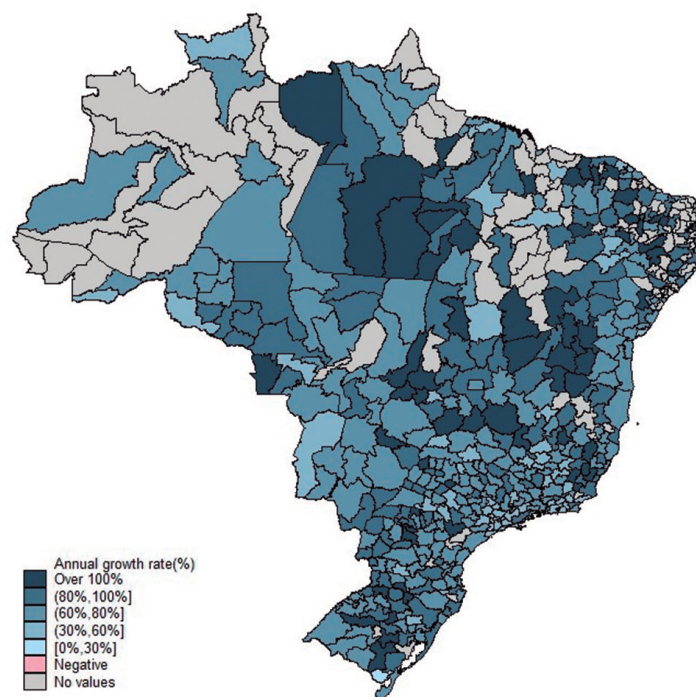


Source: Rais.

Obs.: Figure whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

The second key administrative data set comes from the BNDES. It contains detailed information at the establishment level about different aspects of the BNDES card credit line. This data set covers the universe of firms that applied to the credit line and the registered suppliers with which firms can make their purchases of inputs and capital goods. Figure 6 shows the evolution of the number of firms that used the credit card. As the map shows, there is substantial regional variation in the growth rate of credit usage (measured as number of firms).

**FIGURE 6**  
Evolution of firms that used the BNDES Card (2005-2012)



Source: BNDES.

Obs.: Figure whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

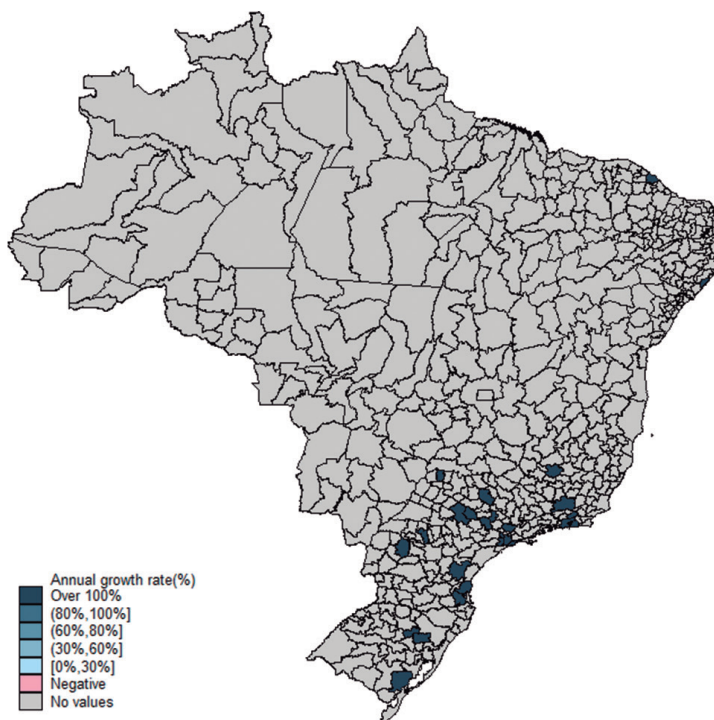
A second crucial dimension of the credit line refers to the evolution of the credit volume to each micro-region in the period of analysis. Figure 7 shows the evolution of total BNDES card credit used and separately by type of purchase financed with the card, whether it was inputs or capital goods. The maps show a striking pattern, as most of the growth in total credit volume comes from credit used to finance the purchase of capital goods, while credit use for purchasing inputs is largely concentrated in few micro-regions in the South and Southeast regions, which are the richest and developed regions in the country.



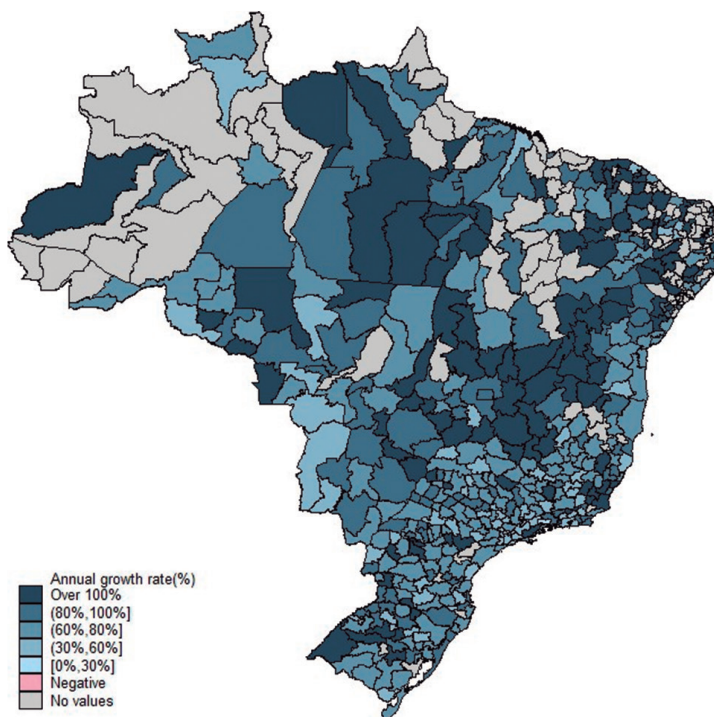
**FIGURE 7**

**Evolution of BNDES Card loans by purchase type: inputs, capital goods and total credit (2005-2012)**

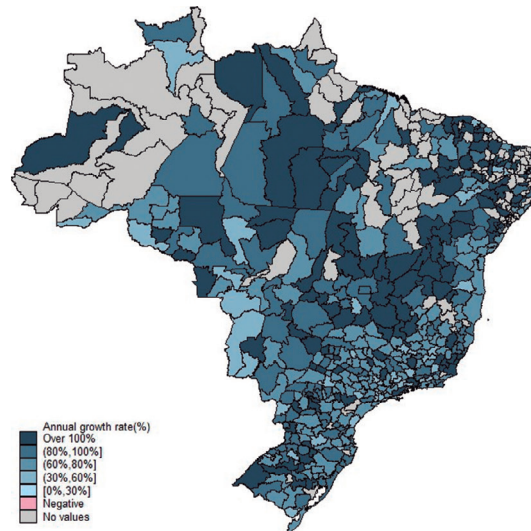
7A – Inputs purchase



7B – Capital goods purchase



7C – Total BNDES Card credit



Source: BNDES.

Obs.: Figure whose layout and texts could not be formatted and proofread due to the technical characteristics of the original files (Publisher's note).

### 3 EMPIRICAL DESIGN

#### 3.1 Model specification

Our goal is to investigate how changes in credit availability impacts the evolution of different aggregate outcomes at the local economy level (i.e. micro-regions). The basic regression of interest would thus be

$$y_{rt} = \alpha + \beta Credit_{rt} + \gamma X_{rt} + \nu_r + \eta_t + \delta_{st} + u_{rt} \quad (3)$$

For  $t = 2005, \dots, 2012$  and where  $Credit_{rt}$  denotes credit availability through BNDES card in region  $r$  at year  $t$ ;  $X_{rt}$  denotes a vector of controls;  $\nu_r$  and  $\eta_t$  denote microregion and year fixed effects, respectively;  $\delta_{st}$  denotes region-year fixed effects, specific shocks at a broader regional level.<sup>11</sup>

11. In our benchmark specification we use 5 macro regions. Robustness analyses conducted using state-year fixed effects confirm the results of this specification which controls for broader regional specific shocks. On one hand, the latter specification allow us to contemplate many relevant policies which are determined at the state level, such as tax policies and transfers to municipalities. On the other hand, this specification provides a saturated model, as we have 27 states and 8 years which means the inclusion of 216 fixed effects, in addition to the 525 microregions fixed effects that are eliminated after the transformation carried on by the within group estimator. Because of that we were not able to run some tests for this later specification, as we will show in the following sections.



Finally, one must be very careful with the controls used,  $X_{rt}$ , as the addition of “bad controls” can actually worsen potential endogeneity problems and omitted variable bias. Therefore we prefer to use a parsimonious specification, bearing in mind all the afore mentioned fixed effects that already take into account idiosyncratic characteristics and shocks on regional dimensions. So, we rely on population, base line GDP interacted with a cubic trend, and base line overall credit also interacted with a cubic trend. The information from population and GDP is provided by IBGE at municipal level, and can easily be aggregated up to micro-regions. The Central Bank of Brazil shares the information on consolidated credit position in each municipality across all financial institution that could provide credit. Hence, we aim to control in a very flexible way for remaining demand shocks (base line GDP interacted with flexible time trend), supply shocks (population), and isolate C-BNDES credit line from other credit lines.

There are at least two main potential threats to identification in regression 3. The first is that typically one cannot correctly measure the *credit supply*, as the observed variable is actual credit contracted by firms, which is an equilibrium outcome that results from firms’ demand and the actual supply. Second, even if supply was correctly measured, it would suffer from endogeneity problems, as unobserved time-varying factors that can affect local economy outcomes (e.g. total employment) will also affect credit supply. This is the case for any dimension of local economic conditions that are not adequately captured in the controls and fixed effects.

Therefore we made use of  $RCS_{rt}$ , as defined in equation 2, as an instrument to achieve the correct identification of the effect of a supply driven credit shock.<sup>12</sup> This is to say we have the following model as a first stage:

$$Credit_{rt} = \alpha' + \beta' RCS_{rt} + \gamma' X_{rt} + v'_r + \eta'_t + \delta'_{st} + u'_{rt} \quad (4)$$

### 3.2 Identification

As in any IV setup, our identification relies both on the power of our instrument and on the exclusion restriction. The power of our instrument can be accessed by inspecting the results of the first stage regression. Table 2 confirm that there is a positive and significant

12. We may have a different interpretation of our parameter of interest if we assume that all targeted firms are credit constrained in Brazil. In this setting we are actually identifying the impact of relaxing credit restriction instead of the impact of credit availability. More important, the use of IV in this alternative setting does not prevent us from identifying the average treatment effect (ATT) as all treated firms would also be compliers in this case as any restricted firm would take the BNDES credit if it become available.

## DISCUSSION PAPER

correlation between our credit supply instrument and the C-BNDES loans at regional level. Moreover, we can reject the weak instrument hypothesis at conventional (and even more stringent) levels of significance according to alternative procedures (first-stage F, Anderson-Rubin, and Kleibergen-Paap test statistics).<sup>13</sup>

**TABLE 2**  
**First stage regression on BNDES loans vs credit supply controlled by regional specific shocks**

	Macro-regions shocks	States shocks
Credit supply	117,361	85,256
	(12,688)***	(17,938)***
F-joint significance	224,95	.
P-value	0,0000	.
Anderson-Rubin test	0,0000	0,0062
Observations	3809	3809
R-squared	0,735	0,754
Kleibergen-Paap rk LM statistic	47,73	7,479
P-value	0,0000	0,00624

Authors' elaboration.

Obs.: Specification using baseline population; baseline GDP interacted with cubic polynomial; baseline total credit interacted with cubic polynomial; region-year fixed effects (regional level stated in the columns). Regressions are weighted by baseline population. Standard errors are clustered adjusted by microregions. Credit supply measured as in (2) where weights are based on share of establishments and investment (capital goods) matrix.

Our exclusion restriction is that the shares of sectorial employment in the initial period ( $\lambda_{rs}$ ) do not have power to predict innovations in C-BNDES loans at regional level. A formal test of such exclusion restriction is a challenge.

This can be put in a broader context if we note from our instrument definition that it can be classified as a Bartik type instrument, sometimes also referred as shif-share instrument (Jaeger, Ruist and Stuhler, 2018). The assessment of the exclusion restriction in this context has been guided by intuitive considerations. Influential papers such as (Blanchard and Katz, 1992; Autor, Dorn and Hanson, 2013)

13. We were not able to run the F test for the more saturated model, but the very high value for the F statistic for the other specification and the robustness of other relevant tests statistics is reassuring.

check violations for the exclusion restriction by inspecting the data in order to see if few sectors are heavily concentrated in few regions. Recent work by (Goldsmith-Pinkham, Sorkin and Swift, 2018) developed this intuition further and derived a measure of the partial contribution of each sector to a potential bias due to endogenous Bartik instrument. These are the Rotemberg weights, which they claim should have their values reported. Knowing at least the sectors with the highest Rotemberg weights will elucidate where identification is coming from and hence where the assessment of the exclusion restriction should matter most.

Table 3 below report both Rotemberg weights and employment share for the five sectors with highest Rotemberg weights. They are responsible for more than 80% of the overall contribution to potential misspecification. The top three sectors are responsible for 79% of the Rothemberg weights. A good feature of these top three sectors is that they are widespread across the country. So there is no risk of having a highly concentrated sector compromising our identification.

As a complimentary information, we report the share of establishments by these sectors in the second column of table 3. As one can see, the share of establishments among the top three sectors amounts to almost 60%. Therefore identification is driven by sectors with lots of establishment which should help to get regional variation, and hence a strong instrument.

**TABLE 3**  
**Sectors' contribution to identification**

Sectors	Rothembergweights	Establishment share (%)
Trade	0.46	44.9
Transport, storing and mail services	0.23	4.2
miscellaneous services	0.10	10.5
Finance and security services	0.09	1.8
Wood craft (except furniture)	0.04	0.8

Authors' elaboration.

Obs.: Rothemberg weights generated according to the decomposition proposed by Goldsmith-Pinkham, Sorkin and Swift (2018). Weights were originally computed by each combination of year and sector. Weights above in the table sum weights of each sector across years. Regressions are weighted by baseline population. Standard errors are clustered adjusted by micro-regions. Credit supply measured as in (2) where weights are based on share of establishments and investment (capital goods) matrix. Model specification using baseline population; baseline GDP interacted with cubic polynomial; baseline total credit interacted with cubic polynomial; macro-region year fixed effects. The decomposition could not be performed using the more saturated specification that uses year x state fixed effects.

## 4 RESULTS

In this section we report the results of estimating regression 3 using the regional credit supply shock  $RCS_{rt}$  as an instrument for the total volume of credit from Cartão BNDES in each micro-region  $r$  in year  $t$ . We use as the basic instrument the  $RCS(K)_{rt}$ , which uses the coefficients from the capital goods investment matrix as technical linkages between sectors ( $\omega_{sj}$ ). The other component of the instrument ( $\lambda_{rs}$ ) is based on sector “s” establishment shares in micro-region “r” at baseline. All regressions are in the log-log specification, so the estimated coefficients can be interpreted as elasticities of the outcome in question to the credit availability.

We start by analyzing the effects on (formal) employment in the first column of table 4. Results point to a positive and significant elasticity. Our point estimate suggests that formal employment tend to increase by 6.7% when BNDES credit availability increases by 1%. Such increase in regional employment could be driven either at the extensive or intensive margins. In order to inspect such components of employment variation we report the elasticities for each of these two components in the next two columns (second and third) of table 4. They are both positive, attesting that both margins contribute to employment positive response to credit availability. These contributions are not homogeneous, however. Our estimates suggests that a 1% increase in BNDES card credit availability is associated with 4% increase in average firm size (intensive margin) and a 2.6% increase in the number of establishment (extensive margin).

**TABLE 4**

**IV Estimation of credit availability impacts on various outcomes**

Variables	year x macroregion fixed effects			year x state fixed effects		
	ln(emp)	ln(#estab)	ln(avgsiz)	ln(emp)	ln(#estab)	ln(avgsiz)
Log(Total Credit)	0.067 (0.013)***	0.026 (0.006)***	0.040 (0.012)***	0.103 (0.033)***	0.011 (0.013)	0.092 (0.028)***
Observations	3,809	3,809	3,809	3,809	3,809	3,809
# of_microregions	545	545	545	545	545	545

Authors' elaboration.

Obs.: specification using baseline population; baseline GDP interacted with cubic polynomial; baseline total credit interacted with cubic polynomial; region-year fixed effects (regional level stated in the columns). Regressions are weighted by baseline population. Standard errors are clustered adjusted by micro-regions. Credit supply measured as in (2) where weights are based on share of establishments and investment (capital goods) matrix.

Results from these three first columns of table 4 were based on a regression specification that includes year x macro-regions fixed effects. The last three columns of table 4 report analogous results estimated using a regression specification including year x states fixed effects. Although this specification relies on a much more saturated model, we still get a positive and significant impact of BNDES Card credit availability on regional (formal) employment. Our point estimate suggests that formal employment tend to increase by 10.3% when BNDES credit availability increases by 1%. This impact on employment is higher than the one reported in the first column (6.7%) for the previous specification using year x micro-region fixed effects. The same pattern can be observed for the impact on the intensive margin of employment. Our estimate reported in the fifth column of table 4 suggests that a 1% increase in BNDES card credit availability is associated with 9.2% increase in average firm size when using the model specification with year x state fixed effects. For the extensive margin, this last specification deliver an elasticity of 1.1% but not statistically significant at conventional levels.

As a complementary information we report in table 5 other estimated responses to BNDES Card credit availability. Once again we have each impact estimated with the two previous mentioned regression specifications, which differs only with respect to fixed effects aimed to capture regional shocks. The first two columns show that the increase in the number of establishments previously detected in the third column of table 4 is driven solely by the entrance of new establishments when credit availability increases. A 1% increase in BNDES card credit availability is associated with a 9.6% increase in the number of entrant establishments, and a null reaction on firm survival. This later result is a relevant one as it suggests that such type of credit does not help zombie (low productivity) firms.

In the third column we see that average establishment size increases significantly among entrant firms, where a 1% increase in credit availability is associated with an increase of 7.5%. This is a higher elasticity than the one reported in the third column of table 4 for the average size of all establishments. Finally, we attest in the fourth column that the higher BNDES card credit availability is associated with increase in productivity measured as the ration between GDP and (formal) employment.

These are relevant results as they suggest that the type of credit provided by BNDES card foster the dynamics of local labor markets, increasing the entrance of new firms, which are pointed as the group most affected by credit constrains. Moreover we have no evidence that such credit availability will avoid the exit of low productivity firms, nor that it will harm productivity.

**TABLE 5**  
**IV Estimation of credit availability impacts on various outcomes**

Variables	year x macroregion fixed effects			year x state fixed effects				
	ln(entrants)	ln(surv)	ln(size_ent)	productivity	ln(entrants)	ln(surv)	ln(size_ent)	productivity
Log(Total Credit)	0.096 (0.015)***	0.001 (0.002)	0.075 (0.029)***	0.033 (0.010)***	0.092 (0.021)***	0.001 (0.005)	0.170 (0.069)**	0.023 (0.021)
Observations	3,809	3,809	3,792	3,809	3,809	3,809	3,792	3,809
Number of regions	545	545	544	545	545	545	544	545

Authors' elaboration.

Obs.: specification using baseline population; baseline GDP interacted with cubic polynomial; baseline total credit interacted with cubic polynomial; region-year fixed effects (regional level stated in the columns). Regressions are weighted by baseline population. Standard errors are clustered adjusted by microregions. Credit supply measured as in (2) where weights are based on share of establishments and investment (capital goods) matrix.

## 5 CONCLUSION

This paper assesses the aggregate impacts of the credit credit line Cartão BNDES, a credit line of the BNDES in Brazil targeted at small and medium enterprises. In doing so, this report aims to contribute to the general topic of financial constraints and development. This link is explored in a vast literature spanning from theoretical to empirical contributions.

Our main result is that a 1% increase in BNDES Card loans will foster average local formal employment, which will increase between 6.7% and 10.3%. This increase in employment is driven by the increase in the average size of firms, specially by average size of new entrant firms. These are relevant results as they suggest that the type of credit provided by BNDES card foster the dynamics of local labor markets, increasing the entrance of new firms which are pointed as the group most affected by credit constrains. Moreover we have no evidence that such credit availability will avoid the exit of low productivity firms, nor that it will harm productivity.

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