

Die young and live large: subsidized loans and firm survival in Brazil*

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Abstract

This paper assesses whether the receipt of medium and large loans from the Brazilian Development Bank (BNDES) and its financing conditions affect firm survival. Several duration models are estimated using information on the population of Brazilian firms and direct as well as indirect loans from BNDES between 2003 and 2014. To overcome the bias through firms' self-selection into BNDES loans, the main estimates include only companies that received at least one BNDES loan at some point in time. The data show that for young, small, non-affiliated companies and for those that entered the market after 2002, loan receipt is associated with an adverse effect. For veteran companies with subsidiaries and with at least five employees, receiving a BNDES loan, along with a larger number of loans and lower interest rates, clearly reduce the risk of market exit.

keywords: BNDES, firm survival, development banks, subsidized loans

JEL classification: C41, D25, G38, L25

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1 Introduction

The Brazilian National Development Bank (BNDES) has the mission to “promote the sustainable and competitive development of the Brazilian economy, with employment generation and reduction of social and regional inequalities” (BNDES 2014: 2).¹ It has gained a larger and larger role in the economy and in public debate over the past two decades. The BNDES’ balance sheet relative to the Brazilian GDP has tripled between 2000 and 2015, reaching a new record height equivalent to 15% of GDP. Its increase was monotonous over time but accelerated significantly from 2008 onwards with the purpose of undertaking “efforts to mitigate the effects of the international crisis”, that is, the abrupt restriction of external credit supply (BNDES 2008: 10). The BNDES’ participation relative to the private financial sector is even more tremendous. Currently only 20% of national financing facilities for legal entities have a term of five years or more. About 90% of the stock of these long-term loans are assets from public banks, with 53% being only from the BNDES (Grimaldi and Madeira 2016).

Despite the BNDES’ enormous relevance in the Brazilian credit market, there are only few evaluations of how the BNDES loans affect the behavior and performance of the recipient companies. In particular, an assessment of the effects on the recipients’ probability to remain active in the market is absent thus far. This issue is extremely relevant because survival of firms – and maintaining their workers employed – is a key parameter in of the BNDES mission and and it is literally question of life or death for companies. The main purpose of this research is thus to shed more light on this neglected issue and to contribute to the discussion about the costs and benefits of subsidized loans in Brazil.

The present study applies duration analyses to verify how BNDES loans and its specific conditions, such as interest, volume, repayment and forward term affect firms’ probabilities of remaining active in the market. To this end, I combine an administrative registry of all the formal companies, the Annual Report of Social Information (RAIS) from the Ministry of Labor, with information on the large and medium-sized loans of several BNDES credit lines between 2003 and 2014.²

The present paper contributes to the literature in three ways. In the first place, the data base compiled for the purpose of this research is unique and unedited, especially because although the BNDES offers some information about the loan contracts, the effective (real and nominal) interest rates are not straightforward and involve a more complicated calculation. It turns out that, through the period 2003–2014, the average real effective interest

¹ For a review of the financial system in Brazil, the role of BNDES within it and the financial structure of BNDES itself, see De Mello and Garcia (2012).

² I chose to analyze only the effects of automatic indirect and non-automatic (direct and indirect) loans. As will be explained in greater detail in section 3.1 the term “direct” refers to whether the loans are awarded directly through the BNDES or indirectly through an accredited financial intermediary, for example, a commercial bank. These lines are not the only ones offered by BNDES, but those with the largest number of recipients and with the largest average loan volume. I refrain from considering other lines of financing also because they are target at very a specific group of companies (e.g. micro-enterprises) or because the funding is not linked to the purchase of products or inputs (e.g. in the case of exporter aid). Moreover, data access to some of these other credit lines is not public.

rate of the loans is close to zero, which should leave no doubt that BNDES loans are indeed subsidized. In addition, the BNDES also has been quite generous in terms of loans per firm, (although or just because) the volume in most credit lines has an upper bound. These findings were not necessarily common knowledge beforehand.

Second, the data reveal that there are significant differences between firms with BNDES financing and the average firm with respect to characteristics that are related to the survival probability. For example, beneficiaries have significantly more employees, more experience in the market and more affiliates, on average. One should thus expect that firms self-select into BNDES loans based on observable and unobservable idiosyncratic attributes. Given that BNDES financed firms possess a lower exit risk, in general, we expect the effects of BNDES loans on performance and survival probability to be superficially elevated in the complete sample.

In order to overcome the selection bias, the main duration analyses consider only firms that received at least one BNDES loan at some point in time. In these estimations, one observes a clear difference between small and large companies. In particular, there is a group of firms who enter the market, receive a BNDES loan and exit in the same year. The behavior of these firms distorts the estimation in a way that in the BNDES sample, receipt of a subsidized loan is associated with a negative effect on the current survival probability. Despite being young firms, they have few employees, no other affiliates and are more likely to be located in the Northern region of Brazil. For veteran companies with subsidiaries or with at least five employees, the receipt of a BNDES loan as well as a higher number of loans per year and lower interest rates decrease firms' exit risk.

A number of other studies on subsidized loans already found pronounced differences between large and small firms. Machado *et al.* (2011) analyze the use of the "BNDES Credit Card", which is another specific credit line destined mainly to micro-enterprises for the acquisition of goods and inputs. Micro-enterprises that actually made use of the credit increased their employees by about 11% while the positive effect is absent for medium and large companies. Cavalcanti and Vaz (2017) analyze a change in a loan eligibility criteria that affected only micro and small enterprises and find positive effects on investment and productivity in this target group. In contrast, Lazzarini *et al.* (2015) focus on (large) publicly traded companies and only find positive effects on the income due to the reduction of the interest burden of the benefited companies. Effects on investment and performance are absent in this sample because, according to the authors, these companies could finance their projects through other sources and the BNDES merely serves as a source of cheap capital. They also observe that the allocation of subsidized loans is not based on performance or financial risk, but rather on political motives, namely high corporate donations in political campaigns. Interestingly, Banerjee and Duflo (2014) report that both small, medium and large Indian companies subsidized loans do not replace other sources of capital because apparently even large companies suffered from credit restrictions. Consequently, an increase in the volume of directed credit from a public bank caused sales and profit growth. Despite the differences in the observation period, the institutional framework and the scale of the two development banks in India and Brazil, the fundamentally diverging results point out

that public interventions should target firms who are truly credit constrained.

Comparing the present findings with the previous literature also makes clear that it is crucial over which period the BNDES' activity is analyzed. Bonomo *et al.* (2015) state that despite the usefulness of BNDES' credit supply to contain adverse effects of the financial crisis, the continued expansion of its balance sheet did not increase social welfare because the largest recipients were large, established and less risky companies. Machado and Roitman (2015) add that there was no substitution between BNDES loans and other capital sources, at least in 2009/10. The increased need for BNDES loans in the advent of the financial crisis is in line with Byrne *et al.* (2016), who find that uncertainty about future sales, which is a typical byproduct of business cycle downturns, increase firms' exit risk significantly. The present data confirm that the effects on firms' survival became more favorable in the period after 2007. However, I also find that precisely those firms who entered the market after 2002, and especially after 2007, are responsible for the encountered adverse effect of the loan receipt. Hence, it seems that the continuous expansion and general supply of credit has attracted to lot of low-quality beneficiaries. Similarly, Bonomo and Martins (2016: 10) observed that "larger firms have privileged access to" BNDES loans and they suspect that there has been a "change on the profile of firms receiving government-driven loans towards less risky firms". Their paper also shows that monetary policy has lost its effectiveness due to the huge volume of subsidized credit between 2006 and 2012.

Naturally, the approach in the present paper builds on a large literature about the estimation of firm survival in duration models since the seminal contributions of Evans (1987), Dunne *et al.* (1989) e Audretsch and Mahmood (1995) on the effect of experience and firm size. The first results were quite contradictory but Kaniovski and Peneder (2008) unify several approaches and find that the risk rate follows a non-linear form. See also Manjón-Antolín and Arauzo-Carod (2008) for another excellent review of duration models and empirical evidence on a large number of application in industrial organization. In further contrast to the majority of previous papers who focus on firm creation and recent start-ups, I analyze the entire population of firms in Brazil. In line with my findings, the exit risk increases during the first twelve months and decreases afterwards. Other observed effects on firms' hazard rates are as expected and accord with the previous literature regarding the importance of the technological regime (Kim and Lee 2016), the interest rate of external finance (Guariglia *et al.* 2016) legal structure and the share of high qualified employees (Mata and Portugal 2002). Resende *et al.* (2016) previously confirmed that Brazilian (start-up) companies are subject to the same influences as their counterparts in developed countries.³

³ In anther interesting contribution on firm survival based on Brazilian data Muendler *et al.* (2012) create a new classification of new firms according to their origin and then show that entrepreneurs who previously gained experience by working as a manager or in other enterprises have better chances to survive.

2 Estimating firm survival

The main objective of this paper is to find out if BNDES loans, and more specifically their favorable conditions in comparison with loans at usual market conditions, have some effect on the probability of remaining active in the market. This section explains the details and specifications of the applied duration models.⁴

By definition, survival (also called duration) in this context is the time lag between market entry and exit of a company. In the literature on the estimation of survival models, the duration $t > 0$ is treated as the realization of a random variable T which has a density distribution $f(t)$ and a cumulative distribution $F(t)$. Hence the function $F(t)$ equals the probability that the duration of a company is less than or equal to a specific value t . The complementary cumulative distribution $S(t) \equiv 1 - F(t) = \Pr(T > t)$ is called a survival function because it indicates the probability of remaining in the market for a period greater than t . In fact, it is not just the exit event that is of interest to researchers, but the *hazard rate*, which is defined as the probability of exit in an infinitesimal range given that the exit has not occurred before. In economics, it is natural to analyze whether the effects of a set of variables \mathbf{X} determine the survival rate. Incorporating this dependency, yields the following formal definition of the hazard rate

$$\theta(t|\mathbf{X}) = \lim_{dt \rightarrow 0} \frac{\Pr(T \in [t, t + dt) | T \geq t, \mathbf{X})}{dt} = \frac{f(t|\mathbf{X})}{1 - F(t|\mathbf{X})} = \frac{f(t|\mathbf{X})}{S(t|\mathbf{X})} \quad (1)$$

The *proportional risk* model the hazard rate is assumed to be determined by two multiplicative components.

$$\theta(t|\mathbf{X}) = pt^{p-1} \cdot \exp(\mathbf{X}\beta) \quad (2)$$

The first component is called base hazard because it is common to all firms. It defines the form of the risk function $\theta(t|\mathbf{X})$ and eq. (2) assumes that the duration follows a Weibull distribution because it is the most common and it yields coefficients with straightforward interpretations.⁵ Comparing the results of the Weibull distribution to other, more complex and flexible distributions, such as the generalized Gamma, the Gompertz or a non-parametric estimation according to Cox (1972), proves the robustness and appropriateness of eq. (2) in the present case. The other term $g(\mathbf{X})$ depends exclusively on the individual characteristics and determines the level of the hazard function, but it remains proportional to the base risk.

⁴ The formulas and definitions related to the duration analysis mainly follow the exposition in Cleves *et al.* (2004).

⁵ According to the parameter estimate of the base hazard p , the exit probability has an increasing, decreasing or constant functional form. A disadvantage of the generalized Gamma distribution is that it can not derive closed solutions for the risk rate (Kaniovski and Peneder 2008). Their coefficients only indicate whether a given variable has a positive or negative impact on firm survival. According to Manjón-Antolín and Arauzo-Carod (2008), the non-parametric Cox estimation avoids biased β coefficients caused by the imposition of an erroneous distribution assumption. However, if it is possible to approximate the true distribution well with one of the parametric choices, the semi-parametric estimation will be less efficient and therefore not automatically the best choice. Economic theory does not offer much guidance regarding the most appropriate choice for the stochastic error distribution and duration. Following previous works in this line of research, I will compare distributions cited above.

In analogy to the random effects model, it is possible to extend eq. (2) by a frailty component ν_i that captures unobservable effects for each firm i . By writing the dimensions of the variables explicitly, the frailty proportional hazard model becomes

$$\theta_i(t|\mathbf{X}_{it}, \nu_i) = pt^{p-1} \cdot \exp(\mathbf{X}_{it}\beta) \cdot \nu_i \quad (3)$$

Assuming that ν_i follows a normal gamma or inverse distribution, it is still possible to obtain closed form solutions for the likelihood function. According to Manjón-Antolín and Arauzo-Carod (2008), most articles on firm survival do not find substantially different results after the inclusion of individual effects. Nevertheless, this extension constitutes a sound robustness test for the exogeneity of the variables of interest and, therefore, will be implemented in this research.

3 Data

3.1 BNDES loans

The BNDES provides information on indirect automatic loans and on non-automatic loans that may be direct or indirect. For the purposes of this study, operations between 2003 and 2014 were used. The distinction between direct and indirect operations refers to whether the BNDES grants the loan directly to the applicant. Indirect loans, in contrast, are operated by an accredited financial agent. In this way companies can be attended directly through the widespread network of accredited agencies and, therefore, the BNDES facilitates the access to its distinct credit lines. In the latter case, the operating financial agent is responsible for examining applications and deciding on the allocation or denial of the loan. The financial agents' autonomy also comprehends the financing conditions, within certain general limits of each credit line. That is, each operator determines its own rewards for the credit but they need to assume the credit risk (BNDES 2016). Another difference between the two types of loans is that direct loans usually have a larger contract volume and more favorable financing conditions.

The BNDES credit lines have well defined contract conditions and project scopes by regulatory norms that, nevertheless, have undergone changes over time.⁶ The credit lines differ in regard to the sectoral affiliation of the firm, the type of product it wants to finance, the base interest rates and some have a legal maximum or minimum volume. All this contributes to the substantial variation between the financing conditions that will be explored in the econometric analysis below. By and large, the BNDES loans are intended to finance the expansion, recovery and modernization of fixed assets the acquisition of new national equipment and the associated working capital, that is, investments focused on the productive capacity of the company. In this sense expenditures such as the marketing

⁶ For example, the BNDES defines some groups of companies (micro, small, medium and large) according to their annual gross operating revenue and determined that due to their advantageous situation in the market, the largest companies should receive less favorable loan conditions. These definitions as well as the associated basic interest rates changed over time.

of new products and services, personnel training, research and development, or for the acquisition of software and related services, among others, can be covered by the loan.

The BNDES loan data can be matched to the firm-level data by means of a unique establishment number in the National Register of Legal Entities called CNPJ. The variables of greatest interest in this paper will be: an indicator if the company obtained a BNDES loan in the current year, how many loans the company obtained during the year, the total value of loans per firm-year, the effective real interest rate, the average amortization and forward period (being the time to the first interest payment after the loan payout).

Table 1 shows some descriptive statistics of loan conditions for all BNDES operations under consideration. It is evident that the variation between the loans is very large, especially the loan volume, having R\$ 4 billion and R\$ 2 as its extreme values. Considering that the Brazilian inflation rate (measured by the CPI from IPEAdata) during the period analyzed fluctuated between 9.3% in 2003 and 3.1% in 2006, having an average of 6.4%, an average nominal effective interest of 8.2% already makes clear that financing through the BNDES is more generous than through other loans available in the (private) financial market. According to BNDES' mission, that is, to finance long-term projects, it is also interesting to note that the duration of these loans is well above the average duration equal to 37 month in other emerging countries (Grimaldi and Madeira 2016).

Table 1: Agregate loan statistics

variável	weighted mean	mean	standard deviation	minimum	maximum
value (R\$ in 2014)		770.803	15.125.856	2,22	4.158.236.416
nominal interest (%)	8,19	7,85	3,59	0	38,7
real interest (%)	2,05	1,51	3,67	-19,9	31,8
forward (month)	17,7	5,62	5,63	0	182
amortization (month)	77,6	53,9	19,5	1	300

Notas: The table shows the main attributes of the 1,420,489 BNDES operations, covering automatic and non-automatic indirect loans between 2003 and 2014. The first column contains averages weighted by loan volumes. The following columns contain the unweighted average, standard deviation, minimum and maximum values.

3.2 Establishment data

The Brazilian Ministry of Labor obliges all formally registered businesses, with or without employees and independent of their legal form, to submit a yearly report about their activity (Ministério do Trabalho 2016).⁷ The resulting information about establishments and their employees is contained in the RAIS database. Since it is used to control the development of the formal labor market, as well as the social security records, information in the RAIS are accurate and reliable. I make use of the information between 2002 and 2015. The period is more extent than the one covered by load data because the first and

⁷ Note that, either way, informal businesses are not of interest in the present case because they are unlikely to apply for BNDES loans and hence should not be compared with other companies that have obtained BNDES loans.

last period are required to accurately define whether a firm has really entered or exited the market in 2003 and 2014. RAIS' extent has increased significantly during this period due to the federal government's efforts to formalize companies, see Monteiro and Assunção (2012). The number of workers (active on 31.12) in the RAIS gradually increased from 26.8 million in 2002 to 49.5 million in 2014, while the number of establishments grew by approximately 40%, from 5.9 million to 8.2 million units.

Because the BNDES only provides information on the loans of each firm, the present analysis will take place at this level.⁸ Consequently, all variables from the RAIS are aggregated to the firm-level. One advantage of this approach is that internal re-structuring, job relocation between units of the same company or other changes leading to the closure of an establishment's activities, without necessarily indicating financial difficulties of the company as a whole, will not be falsely interpreted as death of an establishment. Moreover, the data indicate which establishment is the headquarter, and there is no death of the firm without closing the activities of the headquarter and, vice versa, there is no survival of establishments when the headquarter closes. Another advantage of the firm-level analysis is that it would be inconclusive to try to find out whether the establishment that signs the BNDES contract will actually be the only part of the firm that takes advantage of the investment made through borrowed funds. After all, the legal unit, being the company, would be free to distribute capital goods or any other resource among its establishments. Therefore, the causality between the loan payout and the effects at the establishment level could not be guaranteed.

According to the previous literature, the following information about the company and its employees are used to control for firms' intrinsic survival probabilities. At company level it is fundamental to adjust for differences between sectors, years, federal states, legal nature and whether the company opts for inclusion in the SIMPLES program. SIMPLES is a differentiated, simplified and favored tax regime for micro and small enterprises with annual gross revenues of less than R\$ 4.8 million in 2018, see Monteiro and Assunção (2012). The program exists since 1996 and leads to larger profits (Fajnzylber *et al.* 2011) and lower risk of market exit (Conceição *et al.* 2016). The size and age of the company are also obviously related to its survival rate, see for example the survey by Manjón-Antolín and Arauzo-Carod (2008). Taking advantage of employee-level data, average wages, age of employees, tenure, and the proportion of male employees are also used. According to Audretsch and Mahmood (1995), high remuneration and smaller size can be causes of elevated production costs. In the absence of more detailed information, such as the use of capital or intermediary products, the available variables serve to approximate the production function and technological level of the company (Ehrl 2018).

⁸ The difference between the two concepts is obviously that an establishment is the smallest unit of business activity, concentrated in a single address. On the other hand, the firm / company can, but does not need be, a conglomerate of establishments.

3.3 Descriptive statistics

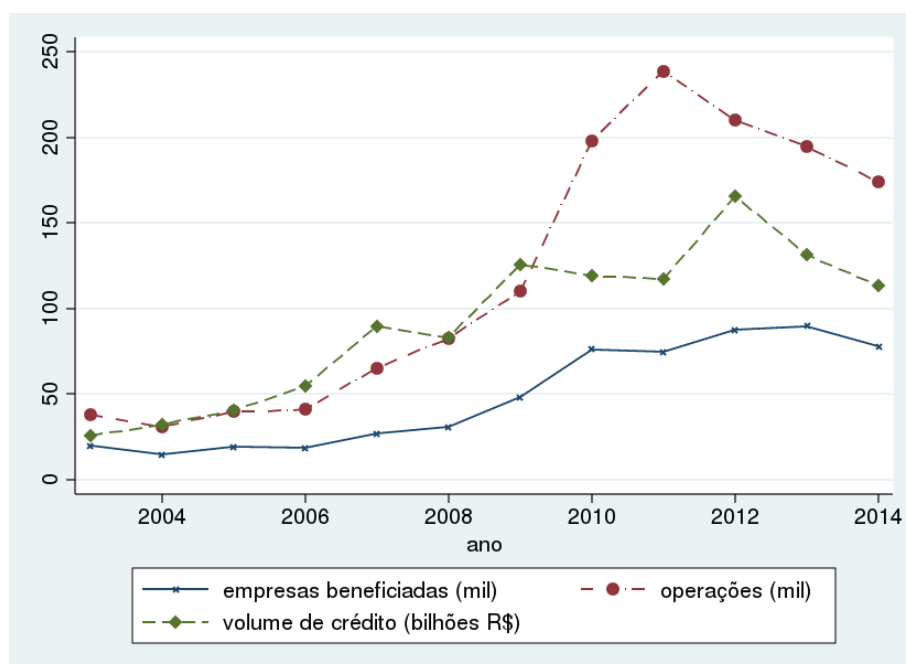
In total, the database contains 1,420,489 BNDES operations between 2003 and 2014. Figure 1 illustrates the evolution of loans and recipient firms. Before 2006, no more than 50,000 loans were awarded per year. With the onset of the subprime crisis in the US and its negative shock waves spreading throughout the world, the BNDES adjusted its strategy to the crisis scenario. To counteract the effects of the reduction of credit supply by commercial banks, the BNDES has dramatically increased its balance sheet. Bank disbursements grew by 26% in 2007 and even more (by 42%) in the following year, reaching a record high with loans granted in 2008 at a total volume of R\$ 92.2 billion. In the 2008 annual report, BNDES’s president Luciano Coutinho states that the “work of the Bank, in coordination with the Federal Government, contributed to the crisis having a much more moderate impact in Brazil than in the central countries and in a large part of the emerging nations” (BNDES 2008: 12).

Figure 1 also indicates that the strong growth in BNDES’ activities continued in the post-crisis years. Until 2009, the number of operations and the volume of loans grew practically in unison. It is interesting to observe the divergence between the growth in BNDES activities and the disproportionate increase in the number of beneficiary firms. This comparison indicates that many companies have successfully applied for several loans in a single year. Even so, the number of beneficiaries grew monotonically by a factor of six, from 14.6 thousand in 2004 to almost 89 thousand in 2013. While this year marks the highest number of applicants and loans with a total value of R\$ 70 billion, the granting of new loans has already reached its peak with 238 thousand operations in 2011. Despite the acceleration of the expansion rate of operations and the achievement of record loan volumes, the figure clearly shows that the bank’s balance sheet already quadrupled between 2003 and the beginning of the crisis in 2007.

Appendix A discusses further minor adjustments that were necessary to prepare the final matched firm-loans database. That section also contains further details about the definition of firm exit, the aggregation of variables from the establishment-level to the firm-level. It will become clear immediately that it makes sense to work with two different samples in the present research setting: the complete sample of firms and another (BNDES sample, henceforth) that only contains companies that – at some point in their history between 2003 and 2014 – received at least one BNDES loan. The idea of using two different samples is that the companies in this second sample are much more homogeneous because the process of applying for a BNDES loan is quite complicated and bureaucratic (Morais 2008). Not every company has the necessary resources to go through this process, hence the estimates in the whole sample could suffer a selection bias.

The table 2 presents descriptive statistics of the main variables for the two samples. The first and third column refer to the full sample, and the second and fourth column contain the aggregate values for those companies with at least one BNDES loan. The last columns presents the same statistics for firms that left the market before the end of the last scheduled

Figure 1: Evolution of BNDES loans and beneficiaries



Notas: The graph visualizes the number of favored companies, the number of contracts and the total volume of new BNDES loans in each year. That is, the graph shows the flows and not credit stocks.

BNDES interest rate payment. Such a company is defined as a defaulter.⁹ An important role is played by these two sub-groups of companies as will become clear subsequently.

It is evident in the first two columns of the table that firms with BNDES loans differ structurally from the average company. Firms with at least one subsidized loan are five times larger, have more experience in the market, have 0.6 more affiliates on average and among them are more limited partnerships and fewer individual entrepreneurs. A first indication on the risk differential between companies in the two samples is in the seventh row of the table. The probability of leaving the market is only 4.2% for a BNDES financed company, while it is 27% in the complete sample. It thus seems that subsidized loans have a positive impact on the duration in the market.

The third block in the table shows that, despite the scale advantage of BNDES firms, tenure and the average qualification level of employees in subsidized firms is lower. Nevertheless, their average remuneration is 15% higher, which may be due to the higher rate of male employees or higher profitability. Obviously, the BNDES sample presents higher mean values in the variables related to the loans. It is worth noting that in each fourth observation (year) in the BNDES sample, a firm obtained at least one loan while this statistic is equal to 2% in the complete sample.

⁹ Due to lack of information on loan payments it is not possible to know for sure if a company breaks the loan contract, but given that BNDES loan volumes analyzed here are considerably large (average of 770 thousand R\$), it is highly unlikely that a company without employees will have enough revenue to meet all its financial obligations. Another possibility is that the company pays the full amount before the end of the contract to get rid of debt and to be able to exit the market. Even this case can be considered a breach of agreement because it violates the intention of a development bank's subsidized loans.

Table 2: Estatísticas descritivas

sample:	complete	BNDES	exit in complete	exit in BNDES	default
size	12,61 (205,4)	62,65 (574,3)	4,994 (104,9)	31,54 (397,2)	34,01 (392,4)
affiliates	1,169 (8,722)	1,765 (17,66)	1,066 (1,788)	1,401 (5,658)	1,346 (6,363)
firm age	9,693 (9,735)	13,54 (10,19)	6,402 (8,142)	10,41 (8,530)	9,561 (8,054)
limit. soc.	0,548 (0,498)	0,774 (0,418)	0,497 (0,499)	0,737 (0,440)	0,709 (0,454)
empreend. ind.	0,313 (0,464)	0,187 (0,390)	0,388 (0,487)	0,233 (0,423)	0,262 (0,439)
SIMPLES	0,632 (0,482)	0,571 (0,495)	0,636 (0,481)	0,602 (0,489)	0,631 (0,482)
exit	0,269 (0,444)	0,042 (0,200)	0,553 (0,497)	0,262 (0,439)	0,302 (0,459)
educ. [2]	0,259 (0,343)	0,302 (0,297)	0,274 (0,374)	0,317 (0,335)	0,308 (0,344)
educ. [3]	0,571 (0,391)	0,545 (0,333)	0,566 (0,419)	0,536 (0,369)	0,554 (0,379)
educ. [4]	0,087 (0,216)	0,064 (0,141)	0,079 (0,223)	0,057 (0,155)	0,052 (0,153)
remuneration	875,9 (752,4)	1010 (665,0)	718,6 (657,7)	879,7 (631,1)	924,8 (626,6)
tenure	34,87 (38,02)	31,57 (25,54)	30,51 (36,07)	27,43 (25,91)	22,83 (21,85)
age	33,94 (8,868)	34,00 (6,490)	33,46 (9,431)	34,17 (7,608)	34,10 (7,708)
male	0,560 (0,397)	0,748 (0,279)	0,548 (0,421)	0,753 (0,307)	0,777 (0,304)
$1\{BNDES\}$	0,018 (0,135)	0,248 (0,432)	0,008 (0,089)	0,326 (0,469)	0,417 (0,493)
# loans	0,046 (1,283)	0,613 (4,660)	0,015 (0,306)	0,601 (1,872)	2,037 (3,434)
observations					
total:	28.546.567	2.130.957	13.907.646	338.896	242.842
size \neq 0:	23.097.493	2.093.389	8.458.580	301.328	205.926

Notes: A tabela mostra a média e o desvio padrão (entre parêntesis) das variáveis principais desta pesquisa para cinco amostras diferentes. A primeira coluna inclui todas as empresas na amostra. A segunda coluna inclui apenas empresas com pelo menos um empréstimo entre 2003 e 2014. A terceira e quarta coluna se referem às subamostras das empresas que saíram do mercado durante o período de observação.

Comparing the first two columns with the subgroups of companies that leave the market during the observation period, reveals the following: in line with the previous literature, failed companies are only half the size and younger. The risk of death also seems higher for individual entrepreneurs. As for the employees, one merely observes a lower remuneration and tenure, which makes sense considering the economic situation and the firms' age. Moreover, the other differences between the BNDES financed companies and the average firm remain valid even when subgroups of failed companies are compared. Finally, the

companies characterized by breach of their loan agreement, by their definition, are not very different from those leaving the market. The characteristics of defaulting companies indicate a greater risk in terms of legal nature and remuneration. That may be because the company and its employees have less experience. Regarding the finance structure, more severe differences appear. It is striking that the defaulting companies received an average of two loans per year, that is, a substantially higher number of loans than in the complete sample BNDES financed firm. One also observes similar differences regarding the average loan volumes.

4 Results

According to the empirical strategy strategy, this chapter is divided into two parts. Initially, we analyze the complete sample and compare companies that received a loan from BNDES in the period 2003-2014 with the rest of firm in the RAIS data. According to the discussion of the descriptive statistics in the previous table, the two types of companies may, for various reasons, be essentially different, possibly leading to a selection bias and premature conclusions about the determinants of firm survival. Therefore, the analysis in the second part involves only companies that received at least one BNDES loan at any moment in the observed period.

4.1 Full sample

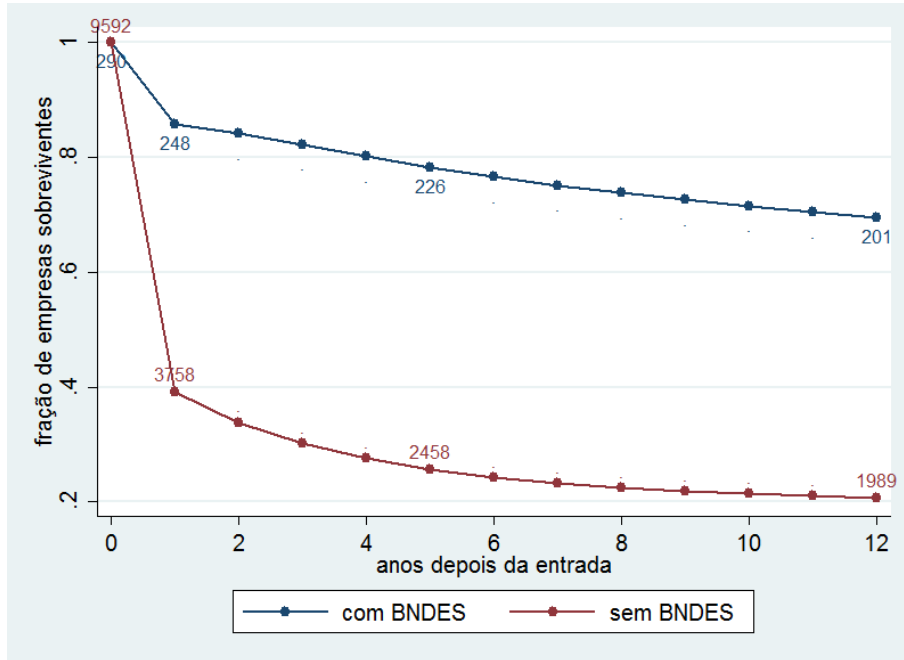
It is instructive to begin with a graphical analysis of firms' survival time before the econometric duration analysis. Figure 2 shows the survival probabilities as a function of the time at risk for all firms in the complete sample distinguishing between companies with and without subsidized loans, since this is the main variable of interest in the present study. In this case, the survival probability is calculated as the number of companies that remain active in the market after a given period of time in relation to the number of companies that were in the market.¹⁰

In total, the sample contains 9.5 million companies without subsidized loans and 290 thousand companies with at least one BNDES loan. After one year, only 3.7 million and 248 thousand companies in the respective groups are still active in the market. In other words, the evasion rate in the group of companies with BNDES loans is 15% in the first year. In the other group, an astounding fraction of 60% does not survive its first year in the market during the period 2003–2012. After the first year, the survival curves are much more similar between the two groups. One observes at closer inspection that the evasion in the BNDES group is practically linear, whereas the other curve presents a concave form due to a more accelerated exit rate in the early years. At the end of the observed twelve

¹⁰ Note that figure 2 is not equivalent to the usual representation of survival according to Kaplan and Meier (1958). Here, time in the market as measured by the horizontal axis refers to the years after entry *in the sample*, i.e., the moment it starts being at risk instead of using the number of years a firm is active in the market. Therefore, the maximum time on the horizontal axis is equal to twelve years.

years, only 20% of all companies without BNDES loan are still in the market. The 70% of surviving companies in the other group suggest a strongly positive effect of subsidized loans. Yet this is merely an accounting exercise where specific characteristics of firms are not controlled for.

Figure 2: Firm survival over time



Notes: The graph shows the fraction of firms that are still active in the market after being observed in the sample for a given period, dividing between the firms with and without a BNDES loan. The numbers close to the dots in the chart indicate the absolute number of firms (in thousand).

Table 3 shows the results of the survival models specified in equations (2) and (3). The estimations, except for the one in column (4) assume that the duration in the market follows a Weibull distribution. There are six variables related to BNDES loans, namely the indicator whether the company received a BNDES loan in the current year, the number of loans per company, the loan volume, the real effective interest rate, the amortization and the forward period of the contract (or its averages in cases where a firm received more than one loan). According to the interpretation of figure 2, the estimations in table 3 confirm that companies who benefited from BNDES loans have a greater chance of survival. Another general impression is that the number of loans and especially, the BNDES indicator itself, dominate the other dimensions of the loan contracts.

In the first estimation, where only the six BNDES related variables are included, one observes that the risk of exit in a year in which a company received a BNDES loan is only 44% of the risk that companies without BNDES financing face. Each additional loan in the same year reduces the exit risk by another 8.5%. Repeating the prior estimation with the multitude of controls for the firm specific characteristics in column two even strengthens the effect of the BNDES indicator. The regression in the third column includes firm totals instead of year-specific attributes of the BNDES loans. Hence the first coefficient indicates

that the exit probability is 76% lower for the group firms who have ever received a BNDES loan. Given that a firm has received a BNDES loan, a one percentage point reduction in the overall interest, reduces the hazard rate by 12%. The effects of the remainder BNDES related variables are similar to those in the two previous estimations.

In general, it is suspicious that the specific terms of the current loans very little or no separate effect on firm survival. The dominance of the extensive margin of BNDES loans, that is “whether and how many” loans a firm receives, could point to a self-selection, because according to the present results, it does not matter how much capital a firm obtained and at what price but only if it is part of the “beneficiary club”. For various reasons, such as higher efficiency, better juridical advisors, managers’ networking skills, etc., the application for BNDES funds may be correlated with the propensity to survive, which would give rise to biased estimates.

The last two columns of the table 3 report two extensions that aim to test the suitability of the basic specification with the Weibull distribution. Column (4) repeats the estimation in column (2) but uses a more flexible distribution to approximate the duration. Because the generalized gamma distribution can only be integrated into the accelerated failure specification eq. (??), the interpretation of the coefficients is reversed, in the sense that values above one indicate a higher chance of survival and vice versa. Consequently our previous interpretations remain valid.¹¹ Finally, in the last column, the basic specification is extended by an individual component of each firm according to the equation eq. (3). The convergence of such estimates is more difficult caused particularly by the large sample size. Convergence is obtained assuming an inverse normal distribution of the individual components, however, compared to the prior estimation without individual effects in column (2), the differences are minimal. The conclusion is thus that the basic specification already captures the principal effects on the hazard rate of Brazilian companies and other unobservable idiosyncratic effects do not distort these baseline results.

4.2 BNDES sample

In order to avoid a selection bias in the estimated determinants of market exit risk, the sample is reduced in all subsequent estimates to those firms that received at least one BNDES loan during the period under observation (2003–2014). Table 4 contains six estimates spanning the same specifications as the previous table.

The first coefficient in the table shows that the greatest influence on the hazard rate stems from the BNDES indicator itself, that is, whether the company was benefited through a subsidized loan or not. The coefficient in the first column suggests that among all recipients of BNDES funds, receiving a BNDES loan currently leads to a 80% *higher* exit probability. Note that the specification in column contains only the basic fixed effects for sector, year, region, legal nature and SIMPLES participation. Without any control

¹¹ Hypothesis tests for the coefficients of the generalized gamma distribution reject the proportionality of the basic risk rate. Yet, the concise interpretation of the BNDES related variables’ effect is more important than the functional form of the baseline hazard.

Table 3: Duration analysis – complete sample

	(1)	(2)	(3)	(4)	(5)
controls:	without	lagged	lagged	lagged	lagged + frailty
distribution:	Weibull	Weibull	Weibull	gen. Gamma	Weibull
values:	annual	annual	total	annual	annual
BNDES	0.302*** (0.004)	0.232*** (0.008)	0.143*** (0.002)	2.678*** (0.059)	0.233*** (0.007)
# loans	0.919*** (0.004)	0.962*** (0.008)	0.898*** (0.003)	1.022*** (0.005)	0.961*** (0.005)
volume	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.001)
interest rate	1.012*** (0.001)	1.017*** (0.003)	1.166*** (0.001)	0.987*** (0.002)	1.018*** (0.003)
amortization	1.006*** (0.000)	1.004*** (0.000)	1.050*** (0.001)	0.997*** (0.000)	1.004*** (0.001)
forward time	1.005*** (0.001)	1.014*** (0.002)	1.001 (0.004)	0.990*** (0.001)	1.015*** (0.002)
p	0.610*** (0.000)	1.479*** (0.002)	1.498*** (0.002)		1.528*** (0.002)
$\ln(\sigma)$				-0.331*** (0.002)	
κ				0.673*** (0.007)	
Observations	28,546,559	18,663,899	18,663,899	18,663,899	18,663,899
LL	-1.530e+07	-2.252e+06	-2.195e+06	-2.251e+06	-2.252e+06
AIC	3.070e+07	4.505e+06	4.390e+06	4.502e+06	4.504e+06

Notes: The estimation in the first column does not include any further control variables, as indicated in the first line. The other estimations add fixed effects for sectors, states, years, legal nature and participation in the SIMPLES program, as well as lagged values of: firm age, # employees, # affiliates, the share of male employees, shares of different education levels, average remuneration, tenure and age of employees. The second line indicates the assumed duration distribution. In the last column, eq. (3) is fitted with a inverse Gaussian frailty distribution. The third line indicates whether the values of the variables related to the subsidized loans refer to the current period or the whole period.

variables, the adverse effect of BNDES loans is even larger. The reduction of the negative effect indicates that the subsidized loans were distributed in sectors, regions and years with greater risk of bankruptcy. Each additional loan reduces this risk by 11%, but nevertheless an adverse effect of BNDES loans is likely to remain. The interest rate has the expected sign and suggests that a one percent annual interest rate reduction decreases the hazard rate by almost 10%. In comparison with these effects, the magnitudes of other loan related variables, such as the volume, the forward and amortization period, are either insignificant, of minor importance, or both.

How could this surprising result be explained? First, it is necessary to test if it is still valid in other specifications. The next columns of table 4 add the complete set of control variables from the previous table. The second specification shows again that the hazard risk is substantially reduced by controlling for more firm-specific attributes, such as its size or technological level. Hence characteristics that indicate higher propensity of exit are positively correlated with the receipt of subsidized loans, a result that is certainly in line with the mission of a development bank. Even so, the hazard rate is still 6 % higher for

companies with BNDES loans. In the same way, the impacts of the interest rate and the number of loans per year are also smaller but still favorable and significant.

The control variables' categories are too numerous to be displayed in the table but a number of aspects deserve to be commented. Sectors that stand out by the highest exit risk are agriculture, communication and transportation, construction and wholesale trade. On the contrary, firms are most likely to survive in medical services, housing services, the metallurgical industry and the mineral products industry. As for geography, companies in the North (with the exception of Roraima) and in the Midwest are generally at greater risk, while newly opened in the Northeast (with the exception of Pernambuco and Alagoas) have a greater chance of surviving. According to the general perception of the Brazilian business cycle, the data indicate that the risk increased gradually such that the average hazard rate in 2014 is about 4 times higher than in 2003. Firm size is also captured by various categorical dummy variables that indicate a highly significant and inverse U-shaped effect. As expected, small enterprises face the highest hazard rate, by far. In particular, the hazard rate of firms with fewer than ten employees is at least two times higher than in companies with similar characteristics but more employees. The estimates then suggest a reduction of the hazard rate, such that the risk is lowest for firm with between 50 and 500 employees, followed by a slight but gradual increase for even larger firms. This effect can be explained by the disadvantage in the cost of production that small firms suffer vis-à-vis competitors who operate at a larger scale (Audretsch and Mahmood 1995). Agency, monitoring, or regulatory issues may be responsible for the increased risk of the largest companies.

What can be seen in the table is that individual entrepreneurs and all other possible legal forms involve a higher risk than the one faced by the representative limited company (the omitted category).¹² The coefficients of the SIMPLES indicator and the age of the company confirm with previous literature. Using a Propensity Score Matching Conceição *et al.* (2016) find that opting for the SIMPLES program reduces their chance of mortality by 30% compared to non-opting firms. While the present data indicate a 19% reduction in column (2), the effect on the following estimates rises to the same magnitude. Every additional year of experience in the market also has a strong and positive effect. This positive experience effect is stronger than, for example, the one found by Kaniovski and Peneder (2008), remembering that the present estimate is obtained only from companies with BNDES financing, while most other research on this subject focuses on startups and new entrants. According to Thompson (2005: 26) the dependence of the hazard rate on firm age is one of the most prominent empirical regularities in industrial organization literature, and in line with his findings, it is robust to controlling for firm size. Since age, size, and specific effects in each year are captured separately, the basic risk rate parameter p , (see eq: PH-Weibull), is less significant and difficult to interpret.¹³ The coefficients in column

¹² Because there are a multitude of possible categories of legal nature in the data and several of them have a small number of observations, it is advisable to group them into a residual category called "others".

¹³ Values of p above two indicate that the longer a company stays in the market, the greater its hazard rate. However, these observations are still likely to be the result of the worsening business environment in Brazil.

Table 4: Duration analysis – BNDES sample

	(1)	(2)	(3)	(4)	(5)
controls:	basic	current	lagged	lagged	lagged + frailty
distribution:	Weibull	Weibull	Weibull	gen. Gamma	Weibull
BNDES	1.805*** (0.028)	1.060*** (0.018)	0.606*** (0.021)	1.276*** (0.022)	0.606*** (0.021)
# loans	0.887*** (0.005)	0.967*** (0.004)	0.937*** (0.009)	1.033*** (0.005)	0.937*** (0.009)
volume	1.000 (0.000)	1.000 (0.000)	0.999 (0.001)	1.000 (0.000)	0.999 (0.001)
interest rate	1.096*** (0.001)	1.085*** (0.002)	1.102*** (0.003)	0.955*** (0.002)	1.102*** (0.003)
amortization	1.006*** (0.000)	1.002*** (0.000)	1.006*** (0.000)	0.997*** (0.000)	1.006*** (0.000)
forward	1.003*** (0.001)	0.999 (0.001)	1.003 (0.002)	0.999 (0.001)	1.003 (0.002)
indiv. entr.	1.331*** (0.010)	1.020** (0.008)	1.099*** (0.013)	0.957*** (0.006)	1.099*** (0.013)
legal nat. [others]	1.093*** (0.018)	1.173*** (0.022)	1.215*** (0.034)	0.912*** (0.012)	1.215*** (0.034)
SIMPLES	0.982** (0.007)	0.815*** (0.006)	0.701*** (0.007)	1.189*** (0.007)	0.701*** (0.007)
age		0.810*** (0.001)	0.904*** (0.002)	1.054*** (0.001)	0.904*** (0.002)
educ. [2]		0.997 (0.029)	0.964 (0.029)	1.019 (0.015)	0.964 (0.029)
educ. [3]		1.157*** (0.031)	0.993 (0.028)	1.004 (0.014)	0.993 (0.028)
educ. [4]		1.280*** (0.052)	1.085* (0.048)	0.960* (0.021)	1.085* (0.048)
p	0.990*** (0.002)	2.488*** (0.013)	1.953*** (0.018)		1.953*** (0.018)
ln(σ)				0.449*** (0.015)	
κ				3.400*** (0.169)	
observations	2,130,957	2,130,957	1,840,900	1,840,900	1,840,900
LL	-182,932	-131,494	-96,021	-96,000	-96,021
AIC	366,007	263,157	192,207	192,167	192,209

Notes: The estimation in the first column does not include any further control variables, as indicated in the first line. The other estimations add the full set of controls as specified in table 3. The second line indicates the assumed duration distribution. In the last column, eq. (3) is fitted with a inverse Gaussian frailty distribution.

(2) still suggest that a higher the rate of highly qualified employees increases the firm's exit risk. This result can be explained by considering the positive relation between use of technology and human capital. Audretsch and Mahmood (1995), among others, have already established that innovative companies have greater exposure to risk, especially shortly after entry into the market.

In contrast to the previous table, column (2) represents an intermediate step that illustrates two distinct effects on the BNDES variables. On the one hand, introducing more control variables, i.e., comparing firms that are observationally equivalent in an multitude of characteristics, reduces the adverse effect of BNDES loans on firm survival. On the other hand, the use of lagged values eliminates the first observation of each firm and thus reduces the sample from 2.1 million observations to 1.8 million. In particular, the new sample no longer

contains the 41,000 companies that only remain in the market for one year (compare figure 2). Recalling that by the definition of the sample in this section, all companies received at least one BNDES loan, it becomes clear that these are 41 thousand cases in which a firm entered the market, received subsidized financing and closed the activities within the same year. This adjustment causes another impressive reduction of the BNDES indicator coefficient. The effect of receiving a subsidized loan on the relative hazard rate changes from +6 % to -39 % and hence no longer indicates that upon receipt of the loan the risk of exit is higher.¹⁴ It is also interesting to note that the other coefficients are very similar in estimations (2) and (3) and, therefore, the previous interpretations remain intact. In fact the result in column (3) is still representative for the great majority of companies because those who enter and leave in the same year are more specific cases, but even so, they exert a strong distortion in the estimation. Although the first year in the market seems to be the most critical from the firm's point of view, one would not necessarily expect to find a large number of firms with a loan from a development bank to enter and exit the market after less than one year. Nevertheless, one should remember that the essential condition to obtain a positive effect of BNDES loans is the survival beyond the first year in the market.

The estimation in column (4) builds on the specification in column (3) but assumes a generalized gamma distribution instead of a Weibull. This more flexible distribution does not significantly improve the econometric adjustment and the coefficient estimates in the two specifications confirm the previous interpretations. Like previously in the complete sample, the Weibull distribution and its coefficients appear sufficiently accurate. As in the complete sample, the last column of the table B.1 demonstrates that the inclusion of an individual component for each company does not significantly change the results. In other words, the basic specification can already capture the most important effects.

Building in the results in table 4, the appendix table B.1 contains some more extensions of the basic specification in the BNDES sample. Changing the Weibull duration distribution to a Gompertz distribution or even to the non-parametrical estimation according to Cox (1972) confirm the accuracy of the previous estimates. The concern here is that, according to the discussion in section ??, imposing an erroneous distribution distorts the entire estimation. Since the parameter estimates only differ in the second or third decimal place, that does not seem to be the case. In a next extension, similar to the one column (3) in table 3, the use of total instead of annual loan variables also does not significantly alter the results. In the same spirit, lagged values of the loan variables also show a high significance for the firm survival rate. Both extended models even improve the statistical adjustment and are encouraging for the Brazilian Development Bank because the effect of its loans on firm survival is not limited to the current period but rather extends itself to the near future. Table B.1 also shows that conditional on being active for at least four years, the estimated BNDES indicator coefficient becomes even lower and indicates that among firm with at least a medium duration, subsidized credits increase the chance of survival

¹⁴ The decrease in the relative hazard rate (coefficient decrease) is also visible in the complete sample when going from column (1) to (2) but because the dropout rate of startups in the first period is even more pronounced for those without a BNDES loan, the BNDES indicator points to a positive effect throughout all specifications.

in the current year by 51%. Throughout these extensions the loans' volume, the forward and amortization period still do not show any significant and independent effect on firms' hazard rate.

4.3 Further consolidations

One of the main results of this research is that the direction of the effect of having received at least one BNDES loan crucially depends on whether all firms are included in the estimation or whether companies with a survival of less than two years are excluded. To obtain a more in-depth understanding of why the divergence occurs, several subgroups of the BNDES sample are analyzed in the following, without using lagged controls. Therefore, the reference estimates are those in the second column of the table 4.

The first extension in the table 5 is based only on companies that entered the market after the beginning of the observation period in 2003, that is, veteran, well-established companies are not taken into account. As a result, all dimensions of subsidized loans appear less favorable. The most striking change is the increase in the risk increase of beneficiary companies in the current year from 6% to 25%. Considering only companies with market entry in 2008 or later results in even greater increase. The sudden change in risk clearly demonstrates that the risk of exit is higher in companies who benefited from the cheap BNDES funds if the companies were created during the period of the bank's expansion period. One possible interpretation is that the increased supply of subsidized loans has attracted lower-quality entrepreneurs to the market, or because it has become easier for higher-risk firms to obtain a subsidized loan. At least we know that national- or state-level business cycle effects are already eliminated by the econometric specification and, therefore, are not responsible for the observed result.

The estimation in the second column of the table 5 is conditional on being active in the market in first observation period, i.e., all companies that entered the market after 2003 are excluded. In this case, the BNDES indicator is clearly below one, indicating a greater probability of survival in the year of the loan. Consequently, in the subgroup of veteran companies, BNDES loans have the desired effect. This finding reinforces the previous interpretation that the more risky or poorly qualified enterprises can be found among the beneficiaries during the expansion of the BNDES' balance sheet.

The estimates in columns (3) and (4) divide the sample into the period before and after the beginning of the financial crisis. One observed that the hazard rate is much higher for companies who benefited in the period prior to 2008. In the subsequent phase only the number of loans and lower interest rates contribute to a slight reduction of the company's exit risk. Apparently, the receipt of loans itself is not associated with a negative effect but still the data do not reveal the positive impact one would expect from a subsidized loan in a financial emergency. In any case, the second extension suggests that, even before the expected credit crunch, the BNDES was already (too) generous to low-quality entrepreneurs. This observation is in line with the significant increase in the total volume

Table 5: Extensions with subgroups of the BNDES sample

	(1) entry after 2002	(2) active since 2003	(3) pre-2008	(4) post-2007	(5) without affiliates	(6) with affiliates
BNDES	1.253*** (0.027)	0.487*** (0.028)	1.832*** (0.148)	0.981 (0.016)	1.173*** (0.020)	0.540*** (0.029)
# loans	0.975*** (0.005)	0.956*** (0.009)	0.953*** (0.010)	0.976*** (0.003)	0.966*** (0.004)	0.985*** (0.005)
interest rate	1.059*** (0.002)	1.156*** (0.005)	1.106*** (0.007)	1.049*** (0.002)	1.081*** (0.002)	1.125*** (0.007)
observations	636,037	1,233,682	669,185	1,461,772	1,556,289	574,668
LL	-51,692	-34,736	-19,303	-101,674	-112,213	-18,030
AIC	103,551	69,640	38,760	203,506	224,592	36,229

Notes: The table shows estimates of the proportional hazard model with Weibull distribution and the full number of controls, as specified in table 4, however, all controls refer to current values. Other loan related variables with a minor impact are included but omitted for brevity. The first line indicates which sub-group of the BNDES was used for each of the estimations.

of BNDES' loans between 2003 and 2007 detected in figure 1 and with the increased risk in beneficiaries since 2003, according to column (1) of table 5.

Finally, columns (5) and (6) distinguish between companies with and without other subsidiaries during the observed period. According to the differences in means observed in table 2, companies who leave the market are smaller, younger and have less affiliates. The present estimates show a corresponding significant increase in the probability of surviving for firms with multiple subsidiaries. On the contrary, single establishments are more likely to disappear from the market and are mainly responsible for the adverse effect of BNDES loan receipt.

Two more extensions reveal some more details about the enterprises who are mainly responsible for the surprising decrease of the survival probability after having received a BNDES loan. Table B.2 presents the baseline estimation for firms of different size categories and table B.3 shows separate results for the five great regions in Brazil. For the sake of space, the two tables are relegated to the appendix B. In both of them, it is once again the coefficient of the BNDES indicator that varies most between the estimations and attracts our interest. First of all, one observes that the associated exit risk of a BNDES loan receipt is almost monotonically decreasing in the size of firms. Only for firms with 5 or more employees do the BNDES loans lead to an unambiguous hazard rate reduction. In contrast, it becomes clear that enterprises who never had more than 5 employees, and especially those with less than two employees, are responsible for the adverse effect that was detected in this research. The main insight from table B.3 is that, despite the small absolute number of firms in the North, the beneficiaries in that region are 50% more likely to exit the market than other BNDES beneficiaries who did not receive a loan in the current year. It is well known that businesses in the North suffer from a comparative disadvantage due to the lack of infrastructure and elevated trade costs. According to ?, the federal states in that region, despite the recent convergence process, still lag behind

the Brazilian average in their economic performance as well as in social aspects, such as education or health. A further analysis at the firm-level about why exactly businesses in the North have higher hazard rates than in the rest of the country seems to be a fruitful research question.

5 Conclusion

Initially, the present study sketched the evolution of the direct and indirect loans of the BNDES between 2003 and 2014. The Brazilian development bank has steadily increased its scale in terms of operations, customers and loan volume since 2003. The expansion gained even more pace with the beginning of the global financial crisis, reaching record heights in 2011/2012. We observed a large dispersion in financial details of the contracts over the whole period in the compiled database, for there are several different credit lines and the idiosyncratic risk of each enterprise also affects the financial conditions of each loan contract. The general impression of BNDES loans is that amortization is well above the common (short or medium run) loans in the private financial market and the average effective interest rate is slightly above zero.

Next, I examined the effect of receiving the subsidized BNDES loans on firms' probabilities of remaining active in the market applying duration analysis. I also exploited the variation in the contracts' details to examine the effect of interest rates, forward and amortization time. An analysis between the activity of the BNDES and firm survival was – thus far – absent in the literature, although the topic is directly related to the mission of the BNDES and especially to the increase of its activities due to the financial crisis.

A general difficulty in this kind of research is that the estimation of the effect of subsidized loans involves a counterfactual. It remains unobservable to the researcher why some firms apply for BNDES loans and others did not receive this kind of financing. It is also unknown whether beneficiaries had other possible means of financing themselves, and what their destiny would have been in the absence of the BNDES loans. If firms' self-selection into BNDES loans is based on attributes that are correlated with the loan receipt or with some of the contracts' characteristics, the coefficients of interest are biased. Using the population of Brazilian firms, one observes that the extensive margin of loans (i.e. if and how many loans are received) seems to be extremely positive for firms' survival probability, but neither the value, the interest rate, nor other details of the contract are significant. At the same time the distribution of various characteristics between BNDES beneficiaries and non-beneficiaries is highly skewed. Companies with BNDES loans are five times bigger, have more experience in the market, more subsidiaries, are less likely to be individual entrepreneurs and, apparently, their probability to survive the first year in the market is substantially higher. These results certainly reinforce the self-selection suspicion of firms with an intrinsically higher survival probability into attractive subsidized financing.

In order to overcome the selection bias, I exploited the rich within-firm variation in the timing of BNDES loan receipt and the variation across their financing conditions. Using

a sample where all firms received at least one BNDES loan during the sampled period, we initially observed that the immediate effect of the loan increases the risk of leaving the market. The reason for this unexpected result is the high number of companies who enter the market, get a loan and leave within the same year. In total, 40,000 of the 290,000 beneficiaries show this behavior, that is, each seventh company. Companies of this type are small, more likely to come from the Northern region and it seems that the expansion of the BNDES' credit supply particularly attracted such low-quality firms.

Once enterprises with a duration of less than one year are excluded from the estimation, receiving a subsidized loan reduces the instantaneous risk by around 40%. In addition, lower interest rates and higher number of loans per year also positively affect survival in the current period, as well as in the near future. Therefore, for most companies with an established economic activity and common duration, receiving a subsidized loan brings positive effects to the chance of surviving. Consequently, the main conclusion of this research is that receiving a subsidized loan in young, one or two man enterprises is associated with the default of the contract and the abandonment of the economic activity. The situation is more encouraging for large and veteran companies because, on average, receiving a BNDES loan reduces their hazard rate. Finally, the number of subsidized loans and a lower interest burden also reduce the firm's exit risk in the near future.

Another important insight from the present research is that even before the highly praised and at the same time criticized expansion of BNDES' balance sheet through the Investment Sustainability Program (PSI), many companies took great advantage of the financing provided by BNDES. Although the issue of alternative financing options has not been addressed here, many economists doubt that large companies, except in the exceptionally moments of a credit crisis, are not able to finance themselves through the market and operate profitably. One can only hope that the Brazilian financial market will become deeper, more efficient and more stable, so that the BNDES' role does not become a permanent solution, because, as previous contributions have shown, public credit subsidies are costly for taxpayers, counteract the attempts to reduce the budget deficit and impede the efficient exercise of monetary policy by the Central Bank. In light of the literature it is evident that stimuli to the adjudication of loans are more effective when the companies suffer severe financial restrictions. Consequentially, and the results of this research corroborate this point, loans do not need to be granted at below market interest rates; it is their overall availability that really matters.

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Appendices

A Additional details about the data and sample preparation

Other specificity choices of the specification in survival analysis are largely imposed by the data structure. Therefore, it is worth clarifying in what format and degree of detail the information is found in the database described preliminarily in chapter ref sec: Data. Some subjects have already been mentioned previously, such as the dependency of \mathbf{X} . Since the database in this research is a panel, it is of course allowed that the values of the explanatory variables in \mathbf{X}_t vary over time. Other adjustments and choices refer to time measurement, censorship and truncation of periods, as well as the possibility of multiple failures.

Given the general theoretical considerations, before one can estimate survival models of companies in this specific case, it is necessary to define what exactly means "death" or exit the company from the market. Manjón-Antolín and Arauzo-Carod (2008: 2) conclude that there is no compliance on the subject in the literature, but the definition largely depends on the information available. In our context it is common to declare a company dead if it is not active in a given year according to RAIS information. Recalling that the declaration for RAIS is mandatory and that late declarations are still included in the database subsequently, it is indeed known that the company had neither official nor market activity. It is important to note that most RAIS information is only valid for the last day of the year. Consequently, the number of employees for a company that terminated its activities at some point during the year, its size observed on December 31 is zero. This implies that the size of the firm becomes an explanatory variable with (artificially) high explanatory power. To avoid bias in the estimates, it is assumed that the companies closed the activities on December 31 of the previous year, where a positive number of employees is still observed. This procedure is applied to all companies that are observed for two years or more. In many cases, a new company enters and leaves the market in the same year. In these cases it is not possible to prevent the company from having zero size in the data, but at least other information such as sector, municipality and receipt of BNDES credits are still valid. Some tests will be implemented to determine the effect of this subgroup of companies on the coefficients estimated in the complete sample.

There is a variable contained in RAIS that in some cases, but not all, specifies the date the company terminated its activities. For the purpose of this work, the reason for the market exit, whether due to bankruptcy, owners own will, etc. does not matter. Other changes of, for example, address, legal nature do not lead to a new CNPJ and therefore will not be confused with exit from the market. In the same way there is also a variable that indicates the date of creation of the company but unfortunately this information is not known for all companies. In cases with no creation date, it is assumed that the company entered the market on June 30 of the year in which it was observed at RAIS for the first time.

These considerations already make it clear that RAIS provides survival information with

daily accuracy. By the principle of efficiency, we choose to specify models with continuous time instead of aggregating the events at the annual level.¹⁵ In the present 12-year database, there are 4384 potential dates (days) at which events may occur and it seems reasonable to assume that the time is continuous. By definition of death of the company, it is possible that a company ends its activities in one year, but resumes its activities some other year later. It would technically be feasible to include companies with multiple deaths in the analysis. However, from the economic point of view, the first exit is not equivalent to another later exit because the failure would already be part of the history of the enterprise. Consequently, one of these companies would be fundamentally different from the others with no history of failure, with obvious consequences for the concession and credit conditions. In other words, it would be unlikely that a firm that just closed its doors and would like to re-start its activities, could obtain credit, still from a public agency like BNDES. Moreover, the first failure already has all the negative consequences for society, such as falling GDP, rising unemployment, etc. For these reasons and in order to obtain clean effects, it was decided to consider the history of companies only up to the first exit of the market at the most.¹⁶

First it is necessary to aggregate the information at the level of establishment to the level of the company respecting that the hours worked may vary between the employees. In this sense, the size of the company was calculated by the sum of all hours worked per month divided by 40 in order to obtain an indicator of size in terms of full-time workers (40 hours). Consequently, the variables extracted from the worker level (age, remuneration, length of employment and fraction of male employees) are weighted averages by the number of hours worked in the company. The other company information (sector, municipality, etc.) refers to the company's matrix, in case it is formed by more than one establishment. As mentioned earlier, one advantage of aggregation is that openings and closures of branches or production sites will not be confused with the death of the company. For there could be restructurings involving the closing of a factory, etc. in exchange for increased activities elsewhere.

The following adjustments were also made, based on the RAIS to obtain an appropriate sample, to estimate the survival of companies according to the econometric models. Companies with ill-defined values are excluded from one of the key variables (for example if there is a lack of the CNPJ or the indication of which branch is the parent company), public entities and companies in the public administration. Of caution, we also excluded some rare cases in which the pairing between the observations of the RAIS and the BNDES base were made but the company name in the two bases was significantly different. As the survival time of a company is calculated by the difference between the date of opening and the time of death or the last year observed in the data, it is also necessary to discard

¹⁵ Note that discrete-time data require other distributions of duration and therefore other models rather than those exposed in this chapter, see Cleves *et al.* (2004), for example.

¹⁶ Despite arguments about the stigma of the market exit, there are cases where inactive companies return to the market and get a subsidized loan in some subsequent year. In order to maximize the number of observations with subsidized loans in the sample, do not consider previous deaths of these companies but the period of market activity with the loan until the next market exit, if any.

companies whose survival time shows negative values. These irrational values ??obviously result from an error in the declaration of one of these two dates.

The cost of BNDES loans has three components: (1) The basic financial cost of BNDES, which is defined by regulatory standards, specific to each financing line. There are several types of cost and depends on the type of company (micro, small, medium or large) and the line that applies in the project. One important modality is the TJLP (long-term financing rate), it is regulated by Law 9,365 of December 16, 1996 and is defined quarterly by the Central Bank of Brazil. This fee compensates the resources of the FAT (Worker's Support Fund) transferred to the BNDES, that is, it corresponds to BNDES's own financing cost (Morais 2008). The TJLP varies according to the inflation target of the Central Bank and is a component that reflects the economic risk in the current situation in the market. Other types of financing costs are the SELIC rate, TJ-462, which corresponds to TJLP plus 1 % per annum, TJ-453 which adds 2.5 % pa. on the TJLP and a fixed rate fixed by the BNDES. This last cost of financing is usually the lowest. (2) The basic remuneration of BNDES is added on this cost basis. (3) In addition there is a financial intermediary fee. This renumbering depends on the evaluation of the risk of default, the characteristics of each project financed and the credit rating of the company. In the data, we observe only the effective interest rate that is composed of these components and, therefore, it varies substantially from project to project.¹⁷

¹⁷ In the data on the loans that the BNDES provides only the type of interest rate and the aggregate of other financing costs. Knowing if the interest rate is post- or pre-fixed and what are the values in each year, makes it possible to recover the effective interest rate on average over the amortization period, ie the total cost of each loan.

B Complementary tables

Table B.1: Extensions – BNDES sample

	(1)	(2)	(3)	(4)	(5)
estimation:	basic	Cox	basic	life>3 y.	basic
distribution:	Gompertz	non-param.	Weibull	Weibull	Weibull
variables:	annual	annual	total	annual	annual + lagged
BNDES	0.609*** (0.024)	0.609*** (0.026)		0.487*** (0.022)	0.645*** (0.023)
# loans	0.944*** (0.010)	0.940*** (0.010)	0.947*** (0.003)	0.953*** (0.011)	0.940*** (0.010)
volume	1.000 (0.000)	0.999 (0.001)	1.000* (0.000)	0.999 (0.001)	0.999 (0.001)
interest rate	1.103*** (0.003)	1.100*** (0.003)	1.158*** (0.002)	1.087*** (0.004)	1.089*** (0.003)
amortization	1.005*** (0.001)	1.005*** (0.001)	1.003*** (0.000)	1.003*** (0.001)	1.004*** (0.000)
forward	1.002 (0.002)	1.002 (0.002)	0.994*** (0.002)	1.005** (0.002)	1.004** (0.002)
BNDES _{t-1}					0.902*** (0.026)
# loans _{t-1}					0.984*** (0.005)
volume _{t-1}					0.999 (0.001)
interest rate _{t-1}					1.121*** (0.003)
amortization _{t-1}					1.004*** (0.000)
forward _{t-1}					0.999 (0.002)
p			1.857*** (0.018)	2.777*** (0.027)	2.007*** (0.018)
γ	1.001*** (0.000)				
observações	1,840,900	1,840,900	1,840,900	1,799,004	1,840,900
LL	-93,796	-504,622	-87,951	-71,222	-92,637
AIC	187,756	1.009e+06	176,064	142,614	185,459

Notes: All estimates include the full number of controls specified in table 4. The second line indicates which distribution for the duration was assumed. The results in the second line stem from a semi-parametric estimation according to Cox (1972). The third line specifies whether the loan rerelevant variables contain values from the current period, the previous period or aggregate values for the entire observation period. In the fourth column, the BNDES sample was reduced to companies with a duration of 4 years or more.

Table B.2: Results for different firm size groups

	(1)	(2)	(3)	(4)	(5)	(6)
size:	0-2	2-5	5-10	10-19	19-50	50+
BNDES	1.920*** (0.044)	1.106 (0.085)	0.757*** (0.054)	0.627*** (0.051)	0.770** (0.082)	0.429*** (0.036)
# loans	0.992*** (0.002)	0.974 (0.018)	1.011*** (0.001)	1.014 (0.014)	0.969** (0.015)	0.984** (0.007)
interest rate	1.027*** (0.002)	1.100*** (0.006)	1.119*** (0.006)	1.121*** (0.007)	1.122*** (0.009)	1.122*** (0.009)
observations	130,715	179,083	346,590	485,970	393,886	594,713
LL	-34,250	-14,857	-19,269	-19,798	-12,527	-14,557
AIC	68,663	29,874	38,699	39,757	25,216	29,280

Notes: The table shows estimates of the proportional hazard model with Weibull distribution and the full number of loan related variables and controls, as specified in table 4, however, all controls refer to current values. The first line indicates which sub-group of the BNDES was used for each of the estimations where firm size refers to the highest number of workers the firm has ever employed in a single period.

Table B.3: Results for different regions

	(1)	(2)	(3)	(4)	(5)
region:	North	Northeast	Southeast	South	Central-West
BNDES	1.493*** (0.106)	1.006 (0.040)	1.037 (0.027)	1.123*** (0.034)	1.010 (0.064)
# loans	0.980* (0.011)	0.976*** (0.007)	0.968*** (0.005)	0.944*** (0.007)	0.990 (0.009)
interest rate	1.064*** (0.006)	1.045*** (0.003)	1.102*** (0.004)	1.098*** (0.004)	1.115*** (0.008)
observations	96,838	304,274	919,434	662,673	147,738
LL	-6191	-18332	-54274	-42115	-10500
AIC	12509	36797	108670	84351	21122

Notes: The table shows estimates of the proportional hazard model with Weibull distribution and the full number of loan related variables and controls, as specified in table 4, however, all controls refer to current values. The first line indicates which sub-group of the BNDES was used for each of the estimations.