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Strategic Default and Personal Credit : The Brazilian Natural Experiment

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Abstract

Brazil provided at 2004 an interesting natural experiment concerning personal credit. The government implemented a new law that allows some financial institutions to offer a specific type of credit. This new law removes a significant share of the moral hazard problem, since the lenders of this type of credit are able to deduct the debt repayment directly from the debtors' payroll check, eliminating the choice of strategic default when debtors are able to pay their loans with their wage. Taking advantage of this fact, we estimate - using the difference-in-difference procedure - the impact of the new law on the interest rate and the volume of personal credit. We find that the first variable suffers a negative impact, while on the second one the effect was positive, as expected, improving credit market conditions. Both effects are economically and statistically significant.

Keywords: Credit Market, default, moral-hazard, difference-in-difference, law.

JEL Codes: E44, D01, C33, K00.

1 Introduction

At the end of 2003 the Brazilian Congress approved a new law that regulates payroll loans. The payroll loan is a type of personal credit with repayments directly deducted from the borrowers' payroll check, which, in practice, makes a collateral out of future income.

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Before the implementation of the new law, only workers, pensioners and retired workers from the public sector had this type of credit available. The new law comes to provide such credit to private workers associated to trade unions, pensioners and retired workers from the National Institution of Social Security (INSS)[1]. Only some financial institutions (those authorized by the government) are able to provide this loan for the INSS beneficiaries. This paper attempts to take advantage of this experiment to analyze how it affects the personal credit market.

The evolution path of the interest rate and new loans can be seen in the figures 1 and 2 respectively (line with triangles). Notice that the more pronounced effect is on the called "treatment group" (line with diamonds), composed by the financial institutions able to provide the payroll loans. The interest rate line of treatment group clearly detaches from the interest rate offered by the control group (line with circles), composed by the financial institutions that are not allowed to offer payroll loans, at the same period that the law was implemented. The same happens with the volume of new loans, where the increase was stronger for the treatment group than for the control group after the new law.

The explanation of this fact is that such loan eliminates debtors' choice of no repayment when they have enough wage to do it, vanishing a significant part of the strategic default. The reduction of default's probability increases the expected repayment for the lenders making them willing to offer more credit at better terms.

Taking advantage of this natural experiment we estimate, using the difference in-difference procedure, how it affects the personal credit market. This empirical approach has some advantages. Our estimator has less bias than a simple mean estimator once we have a control group. For example, in the period before the new law's enforcement the mean of the basic interest rate (taxa selic) was 1.63% per month while in the period after the enforcement this mean rate was 1.36%. If we estimated the new law's effect using the simple difference between the interest rate for the treatment group before and after new law's enforcement we would have a biased estimator, since part of the interest rate decrease in this period is due to the basic interest rate fall. With the difference-in-difference procedure we can have an unbiased estimator without any kind of macroeconomic control. Otherwise, if we estimated the effect using the simple mean we would have to include macroeconomic controls, which increase the number of parameters to be estimated, putting more uncertainty in our estimation and reducing the power of the test. Also, the exogenous nature of the new law is a good opportunity to study

[1]The Brazilian pension system, a pay-as-you-go scheme, is publicly managed by this governmental agency, INSS.

the informational costs of personal credit market without endogeneity problems.

The empirical results show that the volume of new loans and the total amount of personal credit increased, while interest rate decreased although at a lower rate. It indicates that in Brazil the cost provided by information failures as moral hazard is significantly high for volume of credit offered to the population but not so high for the interest rate charged for it. This could be saw as an evidence of credit rationing or market power in the bank sector.

Figure 1: Evolution of the Interest Rate

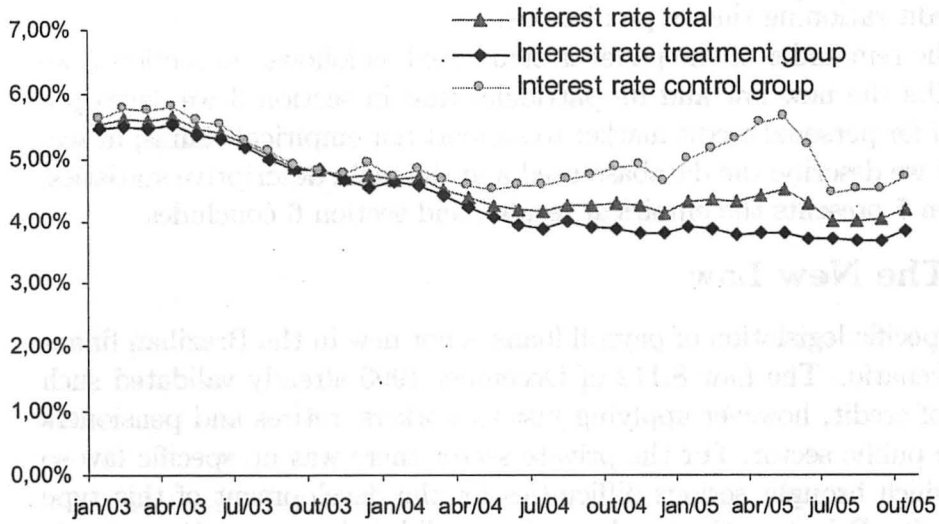
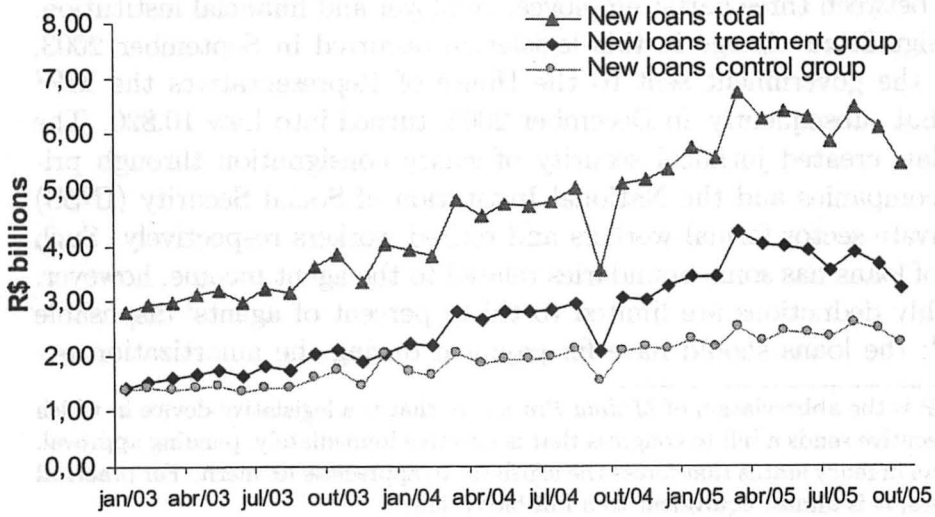


Figure 2: Evolution of the New loans



On this subject Costa and Mello (2005) estimated the effect of ju-

dicial decision on the legality of payroll debit loans in Brazil. In June 2004, a high-level federal court upheld a regional court ruling that had declared payroll deduction illegal. Evidence indicates that it had an adverse impact on banks' risk perception, on interest rates and on the amount lent. Coelho, Garcia and Mello (2006) studied the presence of credit rationing in the Brazilian market using two different tests. First, they tested interest rate stickiness and then they do a natural experiment using the new law in order to detect credit rationing for corporate firms. In the first test they found no evidence of interest rate stickiness . In the second one, interest rate went up and new loans volume went down after a negative supply shock. Both evidences go on opposite directions to credit rationing theory predictions.

The remainder of the paper is structured as follows: in section 2 we describe the new law and its particularities; in section 3 we develop a model for personal credit market to support our empirical claims; in section 4 we describe the database used and the main descriptive statistics; section 5 presents the empirical results; and section 6 concludes.

2 The New Law

The specific legislation of payroll loans is not new in the Brazilian financial scenario. The Law 8;112 of December 1990 already validated such type of credit, however applying just to workers, retires and pensioners of the public sector. For the private sector there was no specific law so far, which brought serious difficulties for the development of this type of credit. Private retires and pensioners didn't have permission to do such operation and private workers should create a particular instrument between three parts: employee, employer and financial institution. The significant change in this legislation occurred in September 2003, when the government sent to the House of Representatives the MP[2] 130 that subsequently, in December 2003, turned into Law 10,820. The new law created juridical security of salary consignation through private companies and the National Institution of Social Security (INSS) to private sector formal workers and retired workers respectively. Such type of loans has some boundaries related to the agent income, however. Monthly deductions are limited to thirty percent of agents' disposable wage[3]; the loans should have fix payment during the amortization pe-

[2]MP is the abbreviation of *Medida Provisória* that is a legislative device in which the executive sends a bill to congress that is effective immediately, pending approval. It has an urgency status that forces the legislator to appreciate its merit. For practical purposes, it is almost equivalent to a full-blown law.

[3]Wage after the compulsory deductions like taxes, pensions, etc.

riod; and rescissory earns[4] can be consigned for the amortization of the remainder debt. Employers have several obligations relative to the values and information that are passed to the financial institutions and employees. To make competitive conditions to the employees, the participation of the trade union entities representing the employees is obligatory, but despite the agreement between the trade unions and some financial institution, the employee is free to choose any financial institution that supply this type of credit.

Despite the law be in force since September 2003, just in April 2004[5] it really took effect when the government authorized the Caixa Econômica Federal[6] to offer this type of credit to the pensioners and retired workers from INSS, supported by the new law. Subsequently, BMG (Bank of Minas Gerais) was the first private bank to assign such agreement. Today there are forty four financial institutions authorized by the government to supply this type of credit to pensioners and retired workers from INSS[7].

3 Theory

Consider a consumer who lives for two periods and maximizes utility over her consumption c.The consumer born with some amount of durable goods of value D (like a house, a car, etc) that he or she consumes in both periods, but it depreciates at rate δ. Period 1 income w_1 is observed but the second period income is uncertain, varying according to the states of nature. To the regular workers the good states means that their wage takes a higher value, while bad states means lower values, thus $w_{2s} \in [w_{21}, w_{2S}]$. Since pensioners and retired people earns a fix income, let say $\overline{w}$, we model the uncertainty assuming that an adverse event may happen, obligating them to spend an extra g_s of their income (ex: medicine), thus $(\overline{w} - g_s)^+ = w_{2s} \in [w_{21}, w_{2S}]$, where $\overline{w} = w_{2S}$. Each state occurs with probability p_s, where $p_s > 0 \ \forall s$ and $\sum_s p_s = 1$.

There is a large number of agents divided in two different groups: borrowers and lenders. Borrowers may be thought as consumers and lenders as financial institutions. Each lender is endowed with enough money to supply credit to consumers. Such lenders' endowment may be

[4]Rescissory earns comprise all rights of the employee for a contractual break.

[5]To define the exact month that a institution became able to give payroll loans we used the following criteria: when the date of the deal signature was in the first half of the month we considered the same month, otherwise we considered the next month. For example, Caixa Econômica singed the deal in 04/19/2004, so we considered May as the date that it became able.

[6]The Caixa Econômica Fedral is the biggest public bank.

[7]For more details about the date of authorization see Appendix.

used either to lend to a borrower with rate r, or to purchase a risky-free asset paying an exogenously given rate of return r_f.

If the borrowers default, the lenders can call the court to seize the borrowers' assets. In the court there is a possibility that the lenders lose the judicial process. Also, the process generates a burden to lenders and borrowers represented by the factor J_L and J_B times the amount of loans, that corresponds to the judicial cost (like lawyers, different types of fees, time, etc, $J \in (0,1)$). To follow a peculiar feature of the Brazilian judiciary, the court decides favorably to debtors if their wealth $(w_{2s} + \delta D)$ is lower than the parameter W^*[8]. This parameter represents the pro-debtors bias, since the higher is W^* the bigger is the possibility of loss in court for creditors. It also represents a pro-poor bias, which means that if debtors are richer the chances of creditors win in court is bigger.

Definition 1 *Strategic default*[9]*: It occurs when the borrower has enough money to pay his debts* $(w_{2s} + \delta D - (1+r)B \geq 0)$ *but he chooses not to do it.*

Definition 2 *Default by bad fortune: It occurs when the realization of states of nature is bad in such way that* $(w_{2s} + \delta D - (1+r)B < 0)$*, unabling the borrowers to fulfill their payment promises.*

The consumption of the first period defines the level of debt B at the beginning of period 2:

$$B = (c_1 - D - w_1)$$

which means that the agents consume more than the sum of their wages and durable goods.

A loan contract between the borrower and the lender consists of a pair $(1+r, B)$, where B is the loan volume and $(1+r)$ the loan rate, subject to the courts' costs and its decision that applies to the situation in which the borrower does not repay the debt $(1+r)B$.

If at least some debt will be held, so that $B > 0$, we can divide the borrowers actions in four distinct choices:

C1 does not file for default if: $w_{2s} + \delta D \geq (1+r)B$ and $w_{2s} + \delta D \geq W^*$

[8]Castelar (2003) presented a careful study about the Brazilian judiciary. The author, interviewing Brazilian magistrates, asked how they would rule in the case of a conflict between compliance with contracts and the interests of less privileged social segments: only 19.7 percent answered that they would follow contracts.

[9]Moral hazard is present because borrowers have a choice not to pay their debts.

C2 strategic default if: $w_{2s} + \delta D \geq (1+r)B$ and $w_{2s} + \delta D < W^*$

C3 bad fortune default (losing in the court) if: $w_{2s} + \delta D < (1+r)B$ and $w_{2s} + \delta D \geq W^*$

C4 bad fortune default (wining in the court) if: $w_{2s} + \delta D < (1+r)B$ and $w_{2s} + \delta D < W^*$

Notice that C2 and C3 are mutually exclusive.

The wealth in each situation for the borrowers is given as follows:

$$W_2 = \begin{cases} w_{2s} + \delta D - (1+r)B & \text{if C1} \\ w_{2s} + \delta D - J_B B & \text{if C2} \\ 0 & \text{if C3} \\ [w_{2s} + \delta D - J_B B]^+ & \text{if C4} \end{cases}$$

Thus the lender can receive zero in case of default – if the court does not seize the borrowers' income – or a payment between $w_{2s} + \delta D$ and $(1+r)B$ otherwise.

Analyzing the consumer choice for default, it is optimal if and only if their gains with default are bigger than their gains when they choose not to default. That is, the consumers will default whenever their wealth does not exceed the parameter W^*, since they will win in the court ($w_{2s} + \delta D - J_B B > w_{2s} + \delta D - (1+r)B$). This way, we can view the probability of no default as $(1 - p_{default}) = \sum_s p_s \iota_s \iota_j = p(C1)$, and the probability of default as $p_{default} = \sum_s p_s \left[\iota_s(1-\iota_j) + (1-\iota_s)\iota_j + (1-\iota_s)(1-\iota_j)\right] = p(C2) + p(C3) + p(C4)$, where $\iota_s = 1$ if $w_{2s} + \delta D \geq (1+r)B$ and $\iota_j = 1$ if $w_{2s} + \delta D \geq W^*$.

Notice that before the new law of payroll loans to be in effect, the default was chosen if $W^* > w_{2s} + \delta D$, even if the borrowers are totally capable of repaying their debts, i.e. $w_{2s} + \delta D \geq (1+r)B$. With the new law in effect, this type of default is partially ruled out, since their debts are automatically discounted from their income. Now, the default occurs only if $w_{2s} < (1+r)B$ for workers, and never for retired workers and pensioners if $\overline{w} > (1+r)B$[10].

For the lenders, the expected return on lending must be no less than the risk-free return. Therefore, the lender's participation constraint is:

$$(1+r_f)B \leq p(C1)(1+r)B + \sum_s p_s(1-\iota_s)\iota_j[w_{2s} + \delta D - J_B B]^+ + \\ +[p(C2) + p(C4)]0 - [p(C2) + p(C3) + p(C4)]J_L B; \quad (1)$$

[10]Notice that we model w_{2s} as $\overline{w} - g_s$,thus the repayment is deducted directly from $\overline{w}$. Also, since the new law determines that deductions are limited to thirty percent of agents' disposable wage, this class of debtors will ever pay their debts.

where $p(C1)$ is the probability of no default, with the borrower paying its debts in full, $p(C3) = \sum_s p_s(1-\iota_s)\iota_j$ is the probability of bad fortune default with the lender wining in the court, $p(C2)$ and $p(C4)$ is the probability strategic default and bad fortune default respectively, with lenders loosing in court. The extra interest rate paid $r - r_f$ is exactly the one needed to offset the loss the financial institution makes when the consumer defaults: it is the same as an insurance premium.

Observe that the lenders' expected return, given by the equation (1) determines the supply of credit in the economy. The supply of credit depends directly from the judicial costs (J) and courts pro-debtor bias (W^*). Intuitively, if the cost of default is high and the pro-debtor bias is low the borrowers have more incentive in avoid the strategic default. As the judicial costs reduces and the pro-debtor bias increases, the borrowers' incentive to file for strategic default raises. Since the court's decision depends on borrowers' wealth, the supply of credit may affect borrowers in different ways. For those with higher wealth, the probability of loss in court is higher, inhibiting the strategic default. On the other hand those with lower wealth have higher probability of success in court, motivating the strategic default and increasing the credit constraint.

Proposition 1 *A pro-debtor judiciary (bigger W^*) tends to produce higher interest rates. For an extremely high level of bias ($\overline{W}$) the supply of credit disappears.*

Proof. For an arbitrary level of W^*, the lender recovery all its debt (if $w_{2s} + \delta D \geq (1+r)B$) or at least part of it (if $w_{2s} + \delta D < (1+r)B$) if $s \geq s^*$ such that $w_{2s} + \delta D = W^*$. In this case, the probability of payment is $\sum_{s=s^*}^{S} p_s$. Let us consider a judiciary with a higher pro-debtors bias, i.e. $W^{**} > W^*$. Now, just for the states $s > s^{**}$ there will be a payment of the debt, reducing the probability of recovery for $\sum_{s=s^{**}}^{S} p_s < \sum_{s=s^*}^{S} p_s = \sum_{s=s^{**}}^{S} p_s + \sum_{s=s^*}^{s^{**}} p_s$. Such increase in W reduces $p(C1)$ and $p(C3)$, and raises $p(C2)$ and $p(C4)$. To keep the equality in the equation (1) r increases.

Increasing even more the pro-debtor bias up to the level $\overline{W}$ that makes the debtor default in all states of nature, the supply of credit disappears since $(1+r_f)B = [p(C2) + p(C4)]0 - [p(C2) + p(C3) + p(C4)]J_L B \Rightarrow B = 0$. Thus, for all $W \geq \overline{W}$, $B = 0$. ■

Since the people with less wealth are the most benefited with the judiciary bias, they have an incentive to default in more states than the

wealthier people, reducing the expected return of the creditors for this type of agents. When the expected return is lower than the risk-free asset this public have their credit denied.

Corollary 1 *For a specific level of pro-debtor bias the poorer people will have the supply of credit denied.*

Proof. Let $\bar{\bar{W}}$ the level of wealth that makes the court decide in favor of the lenders. For the people with goods (D) and income (w_{2s}) sufficiently low such that $w_{2s} + \delta D < \bar{\bar{W}} \quad \forall s$, the participation constraint (1) will be $(1 + r_f)B = [p(C2) + p(C4)]0 - [p(C2) + p(C3) + p(C4)]J_L B$ and therefore $B = 0$. ■

The new law of payroll loans provide a kind of protection for the lenders. This law allows creditors to receive their repayment for loans when the debtors income overcome their debt payment, i.e., when $w_{2s} \geq (1+r)B$. This vanish the possibility of strategic default for all states of nature that makes this inequality true.

Proposition 2 *The new law of payroll loans reduces the interest rates and the credit constraint.*

Proof. Suppose that $W^* > (1 + r)B$, allowing for the possibility of strategic default. Let $[s^*, s^{**}]$ the set of states of nature which the agent chooses strategic default, i.e. $w_{2s} + \delta D \geq (1+r)B$ and $w_{2s} + \delta D < W^*$, making the probability of strategic default equal to $\sum_{s=s^*}^{s^{**}} p_s$. With the new law the possibility of strategic default when $w_{2s} \geq (1+r)B$ for all $s > s'$ is completely eliminated. In this case, the probability of strategic default will be $\sum_{s=s^*}^{s'} p_s < \sum_{s=s^*}^{s'} p_s + \sum_{s=s'}^{s^{**}} p_s$. Now, the probability of no default increases by $\sum_{s=s^*}^{s'} p_s$, and $p(C2)$ reduces in the same magnitude. The new law increases the lenders' expected return and to hold the equality in the participation constraint (1) r decreases. The poorest individuals which had their credit denied due to the excessive protection of the court, in all states of nature that $w_{2s} \geq (1+r)B$ will also pay the debt, increasing the expected return and making $(1 + r_f)B = p(C2/w_{2s} \geq (1 + r)B)(1 + r)B - [p(C2/w_{2s} < (1 + r)B)) + p(C3) + p(C4)]J_L B \Rightarrow$

$(1 + r) = \frac{(1+r_f)+J_B[p(C2/w_{2s}<(1+r)B))+p(C3)+p(C4)]}{p(C2/w_{2s}\geq(1+r)B)}, B > 0.$ ■

The new law has important effects on the credit market, it reduces the interest rates for all people that uses the mechanism of payroll loans, and spread the credit market to the people that had their credit denied

due to the lenience of the local judiciary. The most benefited with the new law were the poorer and retired people that were excluded from the credit market before the enforcement of law 10,820. With the new law in effect they started to have access to credit at a low interest rate.

Corollary 2 *The retired people that earn a fix income from INSS will have access to credit at the lowest rate, even the poorest ones.*

Proof. Let $\bar{w}$ be the income received by the retired people. Now, they will automatically fulfill the payment of their promises in all states of nature since their income is fix and the uncertainty (g_s) occurs after the payment. Thus, for

$\bar{w} > (1+r)B$ we have $(1+r_f)B = (1+r)B$. ■

Remark 1 *Notice that we are not considering the probability of death of the retired people. In the real world the interest rates despite smaller, is not equal to the risk-free interest rate, probably because of the risk of death.*

Remark 2 *The other reason of why the interest rate is closer to the risk-free rate is because we are assuming perfect competition between lenders. This might not be the case in the Brazilian credit market.*

4 Description of the data and Descriptive Statistics

The database comes from Central Bank of Brazil according to *circular* 2.957 of 12/30/1999 and *comunicado* 7.569 of 05/20/2000.

The database contains daily information about new loans, total amount of credit and interest rates. All information is displayed by financial institution, type of loan indexation (prefixed, interest rate indexation, exchange rate indexation and price indexation) and kind of borrower (household or firm).

The present paper uses information about personal loans, i.e., credit to households, without collateral but with considerable screening by financial institutions. The loan is not linked with the purchase of a specific good, so the borrower can buy any kind of good or even repay other debts with the loans' proceeds. We use only the prefixed loans, since it is the most usual type of personal credit[11].

[11] The personal loans are composed basically of two kinds of personal credit: direct credit to consumer (CDC) and payroll loans (Crédito consignado). The basic difference between them is that payroll loans allow the direct discount of the debt payment on the payroll check while direct credit to consumer doesn't.

The sample consists in a group of 112 financial institutions, which contains a subsample of 40 financial institutions that are able to give personal loan according to the new law.

We run our empirical tests using monthly data generated through the daily data. The new loans variable is constructed by summing of daily values over the whole month. The total amount of credit is defined as the monthly average of the daily data for the stock of loans. Finally, for the interest rates variable, we use the monthly average, weighting up by respective new loan volume. The sample period is from January 2003 to October 2005, so our sample consists of 34 months and 112 cross sections units (3,808 observations).

Now we present some descriptive statistics concerning personal loans for treatment and control groups before and after the new law of payroll loans take effect. Figure 3 illustrates a strong increase of the new loans volume for the treatment group in the post-treatment period. The monthly average of new loans increased from R$57 millions to R$127 millions, i.e., a rise of R$70 millions. The coefficient of variation (standard deviation/mean) decreased from de 2.7 to 1.9, meaning a fall of the new loans dispersion for the treatment group in the post treatment period. The same cannot be told about the control group (see table 1). Comparing with the treatment group, the increase in the mean of new loans for the control group was not so high, raising from R$25 millions to R$35 millions, i.e. a rise of R$10 millions. Also, the coefficient of variation practically did not change.

Figure 3: Mean of new loans before and after the new law

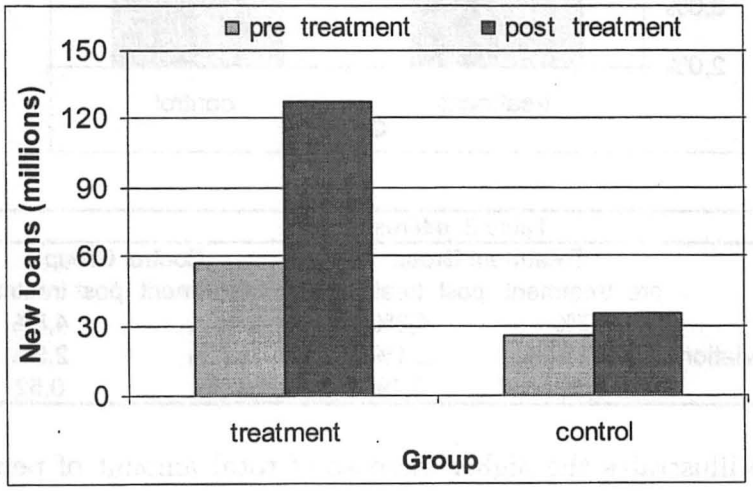


Table 1: New Loans				
	Treatment Group		Control Group	
	pre treatment	post treatment	pre treatment	post treatment
mean	57	127	25	35
standard deviation	152	235	70	96
std/mean	2,7	1,9	2,8	2,7

The monthly average interest rate (% per month) for the treatment group decreased from 5.7% before treatment to 4.3% in the post treatment period, i.e., a reduction of 1.4% per month, which annualized means a fall of 18% per year. The variation coefficient decreased from 0.56 to 0.49, meaning that the interest rate standard deviation also decreases (see table 2). For the group of control, the monthly average interest rate decreased from 5.5 % to 4.8%, which means that the fall for the treatment group was two times bigger than the fall for the control group, 1.4% against 0.7% (see figure 4). Even though there were timing factors that decreased the interest rates for both control and treatment groups, the reduction for the treatment group was much higher. The variation coefficient for the control group remained stable.

Figure 4: Mean of interest rate before and after the new law

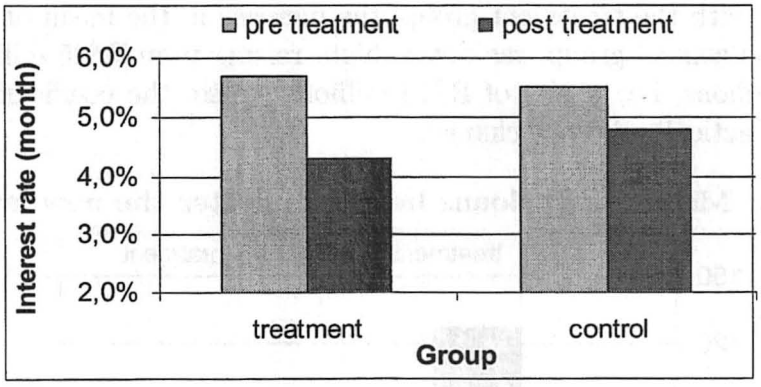


Table 2: Interest Rate				
	Treatment Group		Control Group	
	pre treatment	post treatment	pre treatment	post treatment
mean	5,7%	4,3%	5,5%	4,8%
standard deviation	3,2%	2,1%	3,0%	2,5%
std/mean	0,56	0,49	0,54	0,52

Figure 5 illustrates the higher increase of total amount of personal credit for the treatment group when compared with the control group. However, such difference is not as larger as before, which can be explained by the duration of the contracts. Usually, such contracts have duration varying between 1 to 3 years, which means that a significant

part of the total amount is prior to the new law. Thus, since the new law is recent, is natural to expect that the effect on total amount of credit be smaller than the effect on new loans. The monthly average of total amount of credit increased from R$475 millions to R$993 millions. The coefficient of variation (standard deviation/mean) decreases from de 2.8 to 2.2, reducing the dispersion of the amount of credit for the treatment group in the post treatment period (see table 3). For the control group, the total amount of credit increases from R$187 millions to R$342 millions. There was no change in the coefficient of variation.

Figure 5: Mean of the total amount of credit before and after the new law

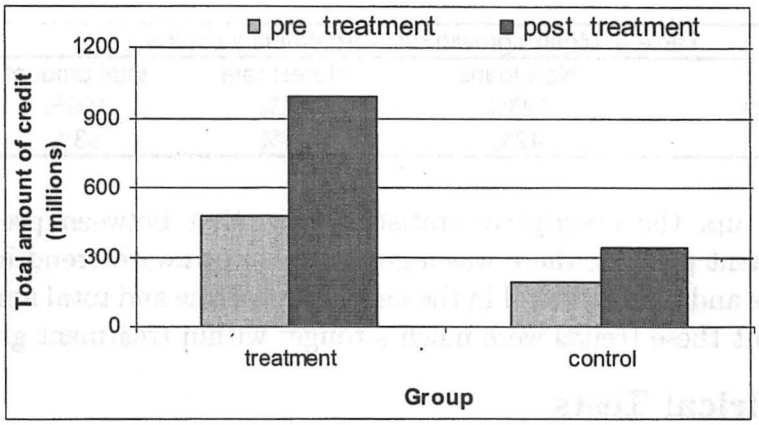


Table 3: Total Amount of Credit				
	Treatment Group		Control Group	
	pre treatment	post treatment	pre treatment	post treatment
mean	475	993	187	342
standard deviation	1338	2154	518	953
std/mean	2,8	2,2	2,8	2,8

Analyzing the above information as growth rate, we notice that the new law affects strongly the treatment group in all considered variables (see figure 6 and table 4). First, the new loans variable suffered a much higher increase in the treatment group than in the control group, 123% against 42%. Second, despite the law be recent, the total amount of credit for the treatment group also suffers a significant impact after the new law be in force, 109% against 83%. Finally, the reduction of the interest rate was much bigger for treatment group too, 23% against 13%.

Figure 6: Means' Growth rate - Treatment x Control

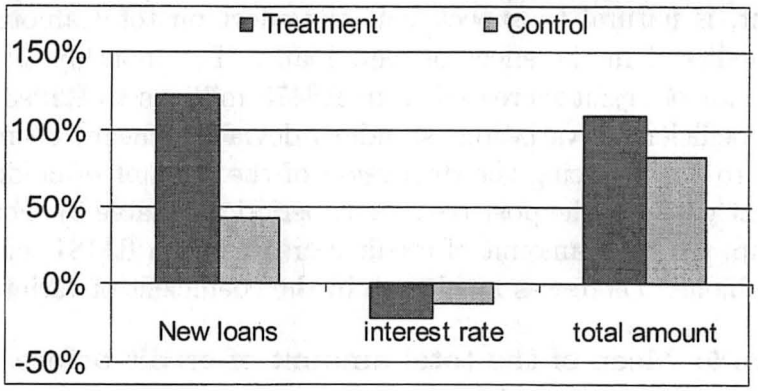


Table 4: Mean's growth rate - treatment x control			
	New loans	interest rate	total amount
Treatment	123%	-23%	109%
Control	42%	-13%	83%

To sum up, the descriptive statistics show that between pre and post treatment periods, there was a generalized downward trend in the interest rate and upward trend in the new loans volume and total amount of credit, but these trends were much stronger within treatment group.

5 Empirical Tests

We measure the impact of the new law of payroll loans on personal credit market (new loans, interest rate and total amount of credit) using a difference-in-difference estimator[12] with bank-level panel data. The difference-indifference specification compares the change (before and after the government implements the new law) in personal loans in treatment banks (those authorized by the government to supply such type of loan) with the corresponding change in control banks (those without permission to offer such loan).

Unlike the usual difference-in-difference procedures, the pre and post treatment period will be different for each institution because they became able to provide payroll loan according to the new law in different periods. For the control group we assumed May 2004[13] as the cut for pre and post periods.

[12]See Meyer (1995).

[13]This was the date that the first institution became able to give payroll loan according to the new law. To test the robustness of our results we ran our models using April 2005 – the date which more than 50% of the treatment group was able to give payroll loans – as the cut for pre and post period for the control group. The results did not change in terms of coefficient magnitudes and significance.

The estimation was made using several empirical models to access the new law's effect on new loans volume, interest rate and total amount of credit. For all three dependent variables we estimate: a diff-in-diff model without fixed effects; a diff-in-diff model with fixed effects by cross section unit; and a diff-in-diff model with cross section unit and time fixed effects. Since the variable new loans is censored in zero, in this case we also estimated a Tobit model.

The empirical model OLS1 can be specified in regression form as:

$$y_{it} = c + \theta \cdot dum_treatment_i + \delta \cdot dum_period_{it} + \\ + \beta \cdot dum_treatment_i \cdot dum_period_{it} + \varepsilon_{it}.$$

The right-hand-side of OLS1 includes dum_treatment$_i$ to control for specific factors of treatment group fixed over time, the dum_period$_{it}$ to control for factors that vary from the period pre to post treatment but are common across all banks, and the interaction of both dummies that is the diff-in-diff variable that captures the impact of new law of payroll loans.

The empirical model OLS2 can be specified in regression form as:

$$y_{it} = c_i + \delta \cdot dum_period_{it} + \beta \cdot dum_treatment_i \cdot dum_period_{it} + \varepsilon_{it}.$$

The right-hand-side of OLS2 includes the bank fixed effects to control for bank-specific factors that are fixed over time, the dum_period$_{it}$ to control for factors that vary from the period pre to post treatment but are common across all banks and the interaction of both dummies that is the difference-in-difference variable that measures of the impact of new law of payroll loans.

The empirical model OLS3 can be specified in regression form as:

$$y_{it} = c_i + \varphi_t + \beta \cdot dum_treatment_i \cdot dum_period_{it} + \varepsilon_{it}.$$

For the dependent variable new loans the empirical form used to specify the Tobit model was:

$$NL^*_{it} = c_i + \varphi_t + \beta \cdot dum_treatment_i \cdot dum_period_{it} + \varepsilon_{it}$$
$$NL_{it} = NL^*_{it} \text{ if } NL^*_{it} > 0; \; NL_{it} = 0 \text{ otherwise.}$$

Finally, the right-hand side of OLS3 and Tobit include bank-fixed effects to control for bank-specific factors that are fixed over time, the month fixed effects to control for factors that vary over time but are common across all banks, and the coefficient β that is the difference-in-difference estimator of the impact of new law of payroll loans.

We define the dummies variables as follows:

dum_treatment$_i$ – is a dummy variable that assumes 1 when the cross section unit i belongs to the treatment group (the institutions able to give payroll loans according to the new law) and 0 otherwise.

dum_period$_{it}$ – is a dummy variable that assumes 1 if the observed period for cross section unit i is after its inclusion in the payroll loans concession according to the new law and 0 otherwise. For the institutions that are not able to give payroll loans this dummy variable assumes 0 before May of 2004 and 1 otherwise. May of 2004 is the date that the first institution became able to give payroll loans according to the new law.

5.1 New Loans

In this subsection we estimate the effect of the new law of payroll loans on new loans. The coefficients estimated from the four different models are presented at table 5. The key variable is the interaction of an indicator of whether the bank is able to offer such loan with indicator of whether the month was in the post treatment period. In other words, the main interest of the estimation is to access the economic and statistical significance of the interaction between dum_treatment$_i$ and dum_period$_{it}$. It provides the real effect of treatment (the new law) on the variable of interest.

The estimated effect of the new law on new loans is statistically significant at 1% level in all specifications and its magnitude varies between R$41.8 millions and R$56.7 millions. As we showed previously, the average of new loans for the treatment group before the new law was R$57 millions with an increase of R$70 millions after the new law. Thus, the effect caused by the new law on the new loans varies between 73% and 100% (between 60% and 81% of the total increase).

Table 5: new loans (R$ millions)*				
	OLS1	OLS2	OLS3	Tobit
constant	24.9	37.1	37.6	-3.9
	(<0.01)	(<0.01)	(<0.01)	(0.59)
dum_treatment	32.1	-	-	-
	(<0.01)			
dum_period	10.4	10.2	-	-
	(0.04)	(<0.01)		
dum_treatment x dum_period	56.7	41.8	42.4	44.8
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
time fixed effects	No	No	Yes	Yes
cross-section fixed effects	No	Yes	Yes	Yes
R^2	0,05	0,91	0,91	0,09
Number of cross-sections	112	112	112	112
Number of obs	3678	3678	3678	3678
* p-value in parentheses				
Robust standard errors (except the Tobit model)				

These results show the potential improvements in social welfare that this law may produce. Such law helps to complete the contingent markets once it brings the possibility of people making contracts of future payments conditioned to future cash flow. It reduces the number of states of nature in which banks would lost their money in a pro debtor judicial decision, stimulating the supply of credit (see proposition 2) mainly to people who did not have enough personal goods to use as collateral for borrowing from bank sector. All this factors make the volume of new loans increase, specially for the retired workers from the INSS (see corollary 2), which were the biggest share of population affected by the new law.

Using the diff-in-diff methodology we are able to take out the bias of a "pure estimator". We showed in other section that the new loans' volume increased for both treatment and control group between pre and post treatment periods. So it is important to control for this generalized trend of growth in the credit market through the use of diff-in-diff estimator. The results show that even controlling for common temporal trends and for cross section heterogeneity (the time and cross section fixed effects) the new law's effect on new loans is economically and statistically significant. It means the new loans' growth between pre and post treatment periods was much bigger for treatment group than for control group even when we control for these factors.

5.2 Interest Rate

Table 6 presents the main results for the dependent variable interest rate. The difference-in-difference coefficient is negative and statistical significant at 5% in all estimations. This result indicates that the new law

caused a reduction in the interest rate on personal loans. The estimated decrease varies between 0.24% per month to 0.61% per month, which means a decrease varying between 2.9% and 7.6% per year. Comparing to the levels of interest rate for the treatment group before treatment period we can say that the rate decreased between 4% and 11% (between 17% and 44% of the total fall).

Table 6: interest rate (percent)*			
	OLS1	OLS2	OLS3
constant	5.5	5.5	5
	(<0.01)	(<0.01)	(<0.01)
dum_treatment	0.17	-	-
	(0.16)		
dum_period	-0.71	-0.57	-
	(<0.01)	(<0.01)	
dum_treatment x dum_period	-0.61	-0.24	-0.31
	(<0.01)	(0.02)	(<0.01)
time fixed effects	No	No	Yes
cross-section fixed effects	No	Yes	Yes
R^2	0,02	0,87	0,89
Number of cross-sections	112	112	112
Number of obs	3538	3538	3538
* p-value in parentheses Robust standard errors			

The model of the previous section rationalizes this effect by the supply side of credit market. With the new law the expected value recovered by the bank is bigger since it will be repaid in more states of nature, once the new law vanishes a significant part of the default, which occurs only when the debtor loose his job or dies. So, the desired interest rate for the bank that equalizes the expected return of the credit and the risk free interest rate reduces (see proposition 2).

We note that while the new loans volume raised between 73% and 100% the interest rate dropped only between 4% and 11%. Why didn't the interest rate drop more deeply? One possible explanation is that after the new law the demand for personal loans increased putting upward pressure on interest rate. Another possible explanation is that probably most of potential borrowers of payroll loans were rationed before the new law. When there is rationing in credit markets, due to non-monotonic supply function of credit, the quantity moves while interest rate remains fixed after a supply shock[14]. Finally, it would be a lack of concurrence in the banking sector.

[14]See Stiglitz and Weiss (1981), corollary 1 pp.398.

5.3 Total Amount of Credit

In table 7 the variables are defined the same way as before. The estimated effect of the new law on total amount of credit was positive and statistical significant at 1%. The effect was estimated between R$239.3 millions and R$363.7 millions. Comparing to the volume of credit for the treatment group before the treatment period where the amount of credit was R$445 millions, we can say that the estimated growth of the total amount of credit varies between 50% and 76%. Also, since the increase was R$518 millions, the effect of the new law corresponds to 46% to 70% of the total increase. Thus, the new law's effect was not only statistical but also economic significant. This finding confirms the previously reported results for new loans.

Table 7: Total amount of credit (R$ millions)*

	OLS1	OLS2	OLS3
constant	187.5	295.7	490.4
	(<0.01)	(<0.01)	(<0.01)
dum_treatment	287.2	-	-
	(0.16)		
dum_period	154.8	152.9	-
	(<0.01)	(<0.01)	
dum_treatment x dum_period	363.7	239.6	239.3
	(0.01)	(<0.01)	(<0.01)
time fixed effects	No	No	Yes
cross-section fixed effects	No	Yes	Yes
R^2	0,04	0,91	0,91
Number of cross-sections	112	112	112
Number of obs	3678	3678	3678

* p-value in parentheses
Robust standard errors

6 Conclusion

The new Brazilian law of payroll loans, launched in September 2003, provides a natural experiment on personal credit, since it was an exogenous change that affected only a fraction of financial institutions.

Differently from the past where only workers, pensioners and retires from the public sector had access to payroll loans, the new legislation regulates such loan to private workers associated to trade unions, pensioners and retired workers from INSS. This type of credit allows financial institutions to deduct the monthly repayment of debt compulsorily, eliminating a significant part of the strategic default. Theoretically, banks will be more willing to offer better terms of credit since the expected value of the loan's repayment increases due to the lower probability of default.

The empirical methodology applied to estimate the effect of the new law was the difference-in-difference procedure, using the institutions authorized by the government to offer payroll loans as the treatment group. The results – that are totally aligned with our theoretical claims – point to an increase in the new loans and in the total amount of credit, and to a fall in the interest rate. In quantitative terms, our estimation indicates an increase in the new loans varying between 73% and 100% and in the total amount of credit varying between 50% and 76%. For the interest rate there was found a decrease that varies between 4% and 11%. All results are highly significant and robust to the empirical model.

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A Appendix

Table A1 - Number of institutions signing the deal with INSS by month	
May of 2004	1
September of 2004	1
November of 2004	4
December of 2004	6
January of 2005	3
March of 2005	2
April of 2005	5
May of 2005	5
June of 2005	5
August of 2005	8

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