Consumer Loans, Heterogeneous Interest Rates, and Inequality*

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Abstract

We examine empirically and quantitatively the impact of financial reforms on consumer welfare in Brazil. The data comprise the Brazilian credit registry combined with the matched employer-employee dataset, focusing on unsecured consumer personal loans and payroll loans, which are repaid through deductions from the borrower's paycheck. Low-income individuals consistently face higher interest rates, even after controlling for occupation, financial literacy, default probabilities, among other variables. Our model integrates life-cycle dynamics, credit types, occupations, and income shocks with endogenous default. Reforms that reduce loan interest rate spreads could significantly benefit consumers, particularly young and poor informal workers. The 2013 Loan Portability reform, aimed at enhancing banking competition in Brazil, increased welfare by 0.34% of annual consumption.

Keywords: interest rates, dispersion, consumption smoothing, inequality

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1 Introduction

Consumer credit enables households to better smooth their consumption over time, particularly in the face of idiosyncratic income and expense shocks, thereby reducing the need for precautionary saving and improving their welfare. Access to credit for individuals in developing countries, however, is limited and unequal. Even when credit is available, it is expensive, especially unsecured consumer credit. Banerjee (2003) and Banerjee and Duflo (2010) document that credit markets in developing countries exhibit high and dispersed borrowing interest rates. High and dispersed unsecured consumer loan interest rates can reflect high and heterogeneous risk profiles (e.g., Athreya, Tam and Young, 2012; Chatterjee et al., 2007; DeFusco, Tang and Yannelis, 2022; Livshits, MacGee and Tertilt, 2007). This paper uses loan-level data to show that interest rates in developing countries are higher than what it is warranted by such risk, especially for low-income borrowers. Moreover, we develop a quantitative model to examine how financial reforms aimed at reducing financing costs and enhancing competition in the banking sector impact consumption smoothing and consumer welfare.

The data comes from two linked Brazilian data sets: the Public Credit Register, a confidential loan-level dataset covering all credit operations in the country, and the matched employer-employee dataset. We use a representative sample of over one million individuals from January 2013 to December 2019. We focus on two types of loans, which account for more than 80% of all unsecured consumer loans in the country: unsecured personal loans, available to all individuals; and payroll loans, where the principal and interest payments are directly deducted from the borrower's payroll/retirement check. These payroll loans are mainly available for civil servants and retired individuals. Average interest rates are substantially higher for personal loans (146% per year) than for payroll loans (28% per year)—the average annual inflation rate in Brazil was below 5% from 2013 to 2019. Interest rates on personal loans are also much more dispersed than on payroll loans: a factor of 18 difference in standard deviation (200% versus 11%).[1] Default rates are generally low: 6% for personal loans and 2% for payroll loans.

[1]Other types of loans such as revolving credit and overdrafts have even higher and more dispersed rates than personal loans.

Interest rates for both types of loans systematically vary with individuals' characteristics. After controlling for loan characteristics (e.g., loan type, maturity, and loan size), several observable individual attributes (e.g., age, gender, occupation, location, and financial literacy), credit risk scores, and default probabilities, low-income individuals still pay substantially higher interest rates compared to high-income borrowers. We calculate an interest rate wedge by subtracting the expected cost of default, assuming a conservative zero recovering rate, from the realized interest rate. For individuals earning 1-2 minimum wages, this interest rate wedge for personal loans is approximately twice as high as the wedge for individuals earning more than 20 minimum wages: 78 percentage points (pp) versus 40pp. For payroll loans, the wedge is 18.5pp for individuals earning 1-2 minimum wages and 16pp for those earning more than 20 minimum wages. These wedges also vary by age, loan amount and whether individuals work in the formal or informal sectors, are civil servants or pensioners.

High and dispersed interest rates may arise due to several factors, such as monitoring and screening costs, reserve requirements, and lack of competition. These factors interact with each other to determine interest rate disparities. To disentangle the impact of bank competition on the credit market, we also explore a *Loan Portability* reform introduced in December 2013, which took effect in May 2014. This institutional reform established a regulatory framework to facilitate credit portability for consumer loans, allowing individuals to transfer credit to another bank at lower interest rates. Leveraging on related work by Bonomo et al. (2024), we explore cross-sectional variation in the local market (municipality) concentration of banks to estimate the impact of this resolution on loan interest rates. Many municipalities in Brazil have at most one bank branch, and some have none.[2] Therefore, we assume that this reform affected interest rates differently in municipalities with more than one bank compared to those with at most one bank. Across various specifications, interest rates for payroll (personal) loans decreased by 0.91-1.02 (10.82-11.72) percentage points, while per capita loan volume increased by approximately 3.2-4.67% (6.8-7%) in treated municipalities (with more than one bank) relative to control municipal-

[2]Financial services in municipalities without a bank are provided in public offices, such as post-offices and lottery shops, which usually intermediate services from public banks (e.g., Fonseca and Matray, 2024).

ities (with at most one bank).

We develop a model to assess the impact of such high and dispersed interest rate spreads on inequality and consumer welfare. The model features a life-cycle component, incomplete markets, two types of loans (personal and payroll), different occupations, income and expense shocks, and endogenous default. In our theoretical environment, workers can be employed in the public, formal, or informal sectors until they retire at a given age. Individuals can save and borrow with two types of loans to smooth income and expense shocks. As in the data, individuals can transit from one sector to the other and the availability of payroll loans depends on individuals' occupation. The interest rates borrowers face in each type of loan reflect the risk of default, as in most models with endogenous consumer default, plus a wedge based on individual characteristics, loan type and loan amount. The model is calibrated to reproduce the same pattern of financial deepening and default rates observed in the consumer credit market of Brazil. Moreover, the interest rate wedges in our calibration are disciplined by our loan-level data and empirical analysis.

We report results for several counterfactual exercises to understand the impact of high interest rate wedges. The first exercise (*No Wedge*) considers an economy in which loan interest rate spreads reflect only expected default costs. Although unrealistic, this is a good benchmark for assessing the possible consumer welfare gains that are in principle on the table. Debt use would increase substantially and, given that financing costs fall sharply, default rates would decrease. The average welfare gain would be approximately 3.5% of annual consumption equivalent relative to the baseline. This change would benefit largely poor individuals who face a very volatile income process in the informal sector and high wedges. For the 20 percent poorest individuals, welfare gains of eliminating interest rate wedges are above 5% of their annual consumption.

The second exercise (*Minimum Wedge*) reduces all wedges for both types of loans to the minimum observed wedge for personal and payroll loans. Loan loss provision is endogenously determined in our model, and therefore interest rate wedges represent other intermediation and operating costs, as well as financial intermediary market power. We assume that the minimum observed wedge, which corresponds to approximately 30pp for personal loans and 10pp for payroll loans, captures all these other costs that are necessary for financial intermediaries to operate. Once again, substantial decreases in default rates are

observed, along with an increase in debt usage. Consumer welfare increases by 0.8% of annual consumption equivalent to the baseline, and welfare gains for the bottom 20% of individuals are above 2% of their annual consumption.

Payroll loans are available to all civil servants and retired individuals in Brazil. They are also available to a small fraction of formal workers—8% of formal workers approximately. Banks must have agreements with firms to offer loans with repayment through automatic payroll deduction, which, in effect, turns future income into collateral. So this requires a contract of the employer with the bank in which the worker receives their wage income. We run a counterfactual (*Payroll Expansion*) in which the government facilitates access to payroll loans for all formal workers. The average welfare gain of this policy corresponds to 0.2% of annual consumption, which is relatively small when compared to the *Minimum Wedge* exercise. The main reason behind this relative small effect is that the payroll expansion affects directly only formal workers and not a large fraction of the labor force working in the informal sector, a group that faces particularly high income risk.

Finally, we use our model to evaluate the welfare impact of the pro-competition reform enacted in 2013 in Brazil. In this exercise, we simulate similar changes in interest rates to those reported in our empirical analysis, which explore how interest rate changed in municipalities with more than one bank relative to those with at most one bank. The average welfare gain of this pro-competition reform is alone 0.34% of annual consumption equivalent, with larger gains in the lower tail of the income distribution. Though large, this effect corresponds only to approximately one tenth of the gains from completely removing the interest rate wedges, suggesting potentially more gains could be achieved for consumers from pursuing further credit market reforms.

Related Literature Our contribution is both empirical and theoretical. Empirically, we document new facts about unsecured consumer loans in Brazil, a major middle-income economy, using detailed credit register data.[3] The fact that spreads are large, vary systematically with individual characteristics, and cannot be explained by default probabilities are often overlooked in the macroeconomics consumer default literature (e.g., Athreya, Tam and Young, 2012; Chat-

[3]Loan-level datasets for Brazil have been used to address different questions, such as how a financial inclusion policy affected the local economy (Fonseca and Matray, 2024).

terjee et al., 2007; Livshits, MacGee and Tertilt, 2007). Livshits, MacGee and Tertilt (2016) show that asymmetric information about borrowers' default risk and fixed costs to generate a loan can lead to dispersion in interest rates consistent with those observed in the United States.[4] In our empirical analysis we control for the size of the loan and show that, although it is negatively related to interest rates, it does not explain much of the observed variability in interest rates in Brazil.

We integrate our empirical analysis with a life-cycle model of unsecured debt and equilibrium default calibrated using our micro data and perform several experiments. Our life-cycle model has features that are consistent with economies in developing countries with a large informal sector in which agents face large income shocks. Therefore, while most papers in the macro/finance quantitative literature have studied reforms or policies in the United States, our focus is on a developing economy. Herkenhoff and Raveendranathan (2024) also integrate data into theory to measure welfare effects of a pro-competition reform in the credit card industry in the United States. Their model has a rich banking problem in which they evaluate a change in the credit market from monopoly to oligopoly consistent with the United States experience. Our model is rich in the household sector: there are two types of loans and and variable interest rates that depend on default probability and wedges. Moreover, we use a pro-competition reform implemented in 2013, which facilitated credit portability for consumer loans, to discipline loan interest rate changes in our quantitative analysis. Related to our work is the recent paper by Garber et al. (2023) which investigates how a major credit expansion program through government banks in Brazil in 2011 affected consumer credit—interest rates, volume and default at the municipality level. Their model with exogenous spreads and no default is used to rationalize the empirical findings. Our model, on the other hand, is used to quantitatively evaluate changes in consumption and consumer welfare.

Recent papers have focused their attention on heterogeneity in returns to financial and physical capital (see Bach, Calvet and Sodini, 2020; Benhabib, Bisin and Zhu, 2011; Benhabib and Bisin, 2018; Gabaix et al., 2016). Heterogeneity in

[4]Yannelis and Zhang (2023) demonstrate that market power with adverse selection and fixed costs can decrease rather than increase dispersion in interest rates. They show that their theory is consistent with the subprime market in the United States.

returns does not arise merely from differences in wealth allocation between safe and risky assets: returns are heterogeneous even within asset classes and correlate positively with wealth (Fagereng et al., 2020). We also study heterogeneity in interest rates but focus on borrowing rates instead.

A different strand of the literature focuses on dispersion in borrowing rates from the firm's perspective. Gilchrist, Sim and Zakrajšek (2013) provide evidence on dispersion in borrowing costs among publicly traded firms in the United States. Bai, Lu and Tian (2018) report similar evidence for Chinese firms whereas Banerjee (2003) and Banerjee and Duflo (2005, 2010) document that this is a pervasive characteristic of credit markets in developing countries. Cavalcanti et al. (2023) report substantial variation in financing costs for firm-level credit in Brazil and show that such variation has important effects on firm dynamics and development. We contribute to this literature on dispersion in borrowing costs by focusing on consumer loans in a credit market for a developing economy, analyzing the consumer welfare implications of this dispersion and evaluating different financial reforms.

2 Empirical Analysis

This section focuses on the empirical relations between interest rates and individual characteristics. Our primary dataset is the Brazilian Central Bank's credit registry (SCR), which provides comprehensive information on unsecured consumer loans, including interest rates, loan amounts, credit risk scores, nonperforming amounts, and maturity; as well as personal characteristics like income, occupation, gender, among others. Additionally, we supplement our analysis with data from the Brazilian matched employer-employee dataset (RAIS), which covers all formal employment contracts in the country. Further information on the data sources and on the definition of the variables used in the empirical analysis can be found in Appendix A. The empirical analysis uses a representative sample of 1.3 million individuals who are followed monthly from January 2013 to December 2019.

Our investigation concentrates on two categories of unsecured consumer loans: personal loans and payroll loans, which together represent around 80% of all unsecured consumer loans in Brazil (see Figure A1 in Appendix A.1).

Payroll loans are a specific type of loan where the borrower's repayments are automatically deducted from their paycheck. In Brazil, these loans are primarily available to civil servants and retirees. A fraction of formal employees has access to them, but informal workers do not.

Interest rates on personal loans are high. The unweighted average for the period is approximately 146% per year, while the average deposit rate when considering the maturity of such loans was 9.93%. Therefore, this leads to an average interest rate spread of approximately 136%. Table A2 in Appendix A provides summary statistics for personal loans. Personal loan interest rates are also quite dispersed. The standard deviation is approximately 200%. These loans do not exhibit very short maturity: the average maturity is longer than two years. The average default rate is 6% with a standard deviation of 24%—Default rates by income groups are displayed in Figure A2 in Appendix A.1. Most of the individuals have a credit score above a B level; about 65% individuals in our sample.[5] For formal employees, the debt-to-monthly-income ratio is 1.48 once we do not consider outliers with a debt-to-monthly-income ratio above 24, which correspond to 1% of the sample.

Interest rates on payroll loans are much lower when compared to personal loans—Table A3 in Appendix A provides summary statistics for payroll loans. These lower rates reflect the fact that, for such loans, a borrower's employment/income status are verified and payments are made directly from their paycheck. The unweighted average annual interest rate is 27.8% per year, approximately 5 times lower than the average interest rate for personal loans. The standard deviation of interest rates is approximately 11%. The average maturity of payroll loans is about 5 years. The average default rate is 2% with a standard deviation of 14%—see Panel (b) of Figure A2 in Appendix A.1. Approximately 73% of the individuals taking a payroll loan have a credit score above the B level. 65% of the individuals taking payroll loans are retired, 27% are civil servants and 8% are formal employees.[6]

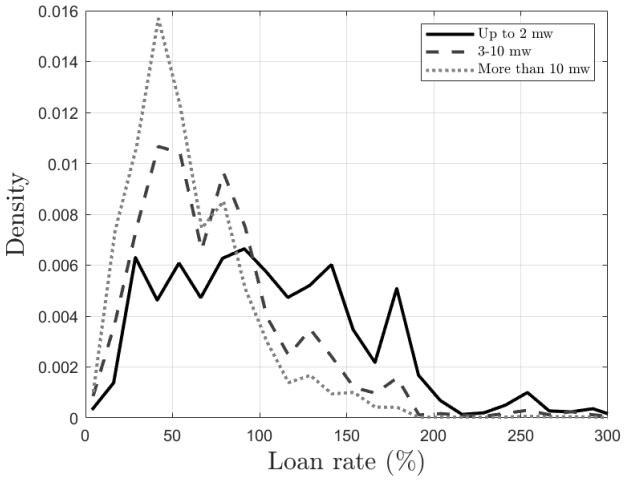
The densities of interest rates for personal and payroll loans for three dif-

[5]Credit scores vary from AA to H—there are 9 levels (AA, A, B, ..., H)—and H is the lowest credit score.

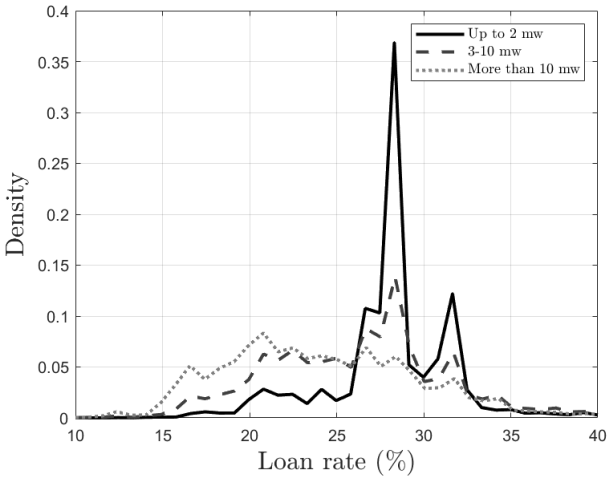
[6]In Brazil, public sector workers are granted lifetime tenure following a three-year probationary period. Due to the absence of performance evaluation mechanisms in the public sector, it is uncommon for a public employee to be denied tenure. But public employees can still face income shocks such as being promoted to have some management role or demoted— see Cavalcanti and Santos (2021).

Figure 1: Loan interest rate densities by income groups; spreads and default-adjusted spreads by income groups

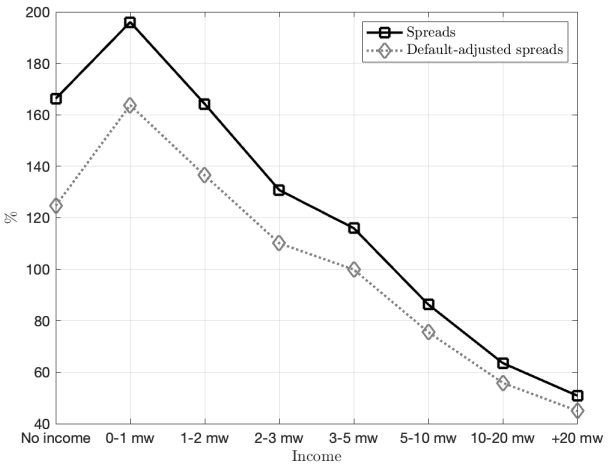
(a) Personal Loans



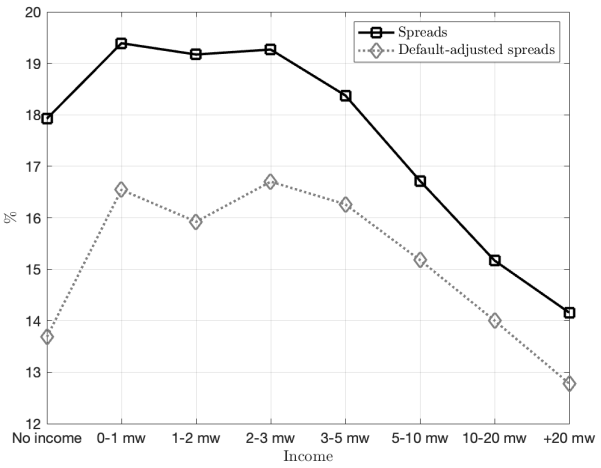
(b) Payroll Loans



(c) Personal Loans



(d) Payroll Loans



Notes: Panel (a) and Panel (b) display the density of interest rates by income levels (up to 2 minimum wages (mw), 3-10 mw and more than 10 mw) for personal loans and payroll loans, respectively. Panel (c) and Panel (d) display interest rate spreads and default-adjusted spreads versus income levels for personal loans and payroll loans, respectively. Spreads are the contracted interest rates minus the benchmark interest rate. Default-adjusted spreads are calculated by setting the interest rate to -100% for loans in default.

ferent income groups are depicted in Panels (a) and (b) of Figure 1—Figure A3 in Appendix A.1 displays the density of interest rates for personal and payroll loans without splitting the sample by income levels. There is considerable variability in interest rates for both personal and payroll loans, but this is more noticeable for personal loans. The kurtosis for personal loans is higher for low-income individuals, those earning up to twice the minimum wage, than for high-income individuals, those earning more than ten times the minimum wage. Furthermore, the distribution is positively skewed for high-income individuals and relatively symmetric for low-income individuals. Therefore, loan interest rates for high-income individuals are more concentrated on lower levels of interest rates, while the distribution of interest rates for low-income individuals is more spread out. Approximately 50% of personal loans for individuals earning up to 2 minimum wages have an interest rate higher than 100%, while only 10% of individuals earning more than 10 times the minimum wage pay an interest rate above 100% in personal loans—the cumulative distribution functions for personal loans are depicted in Figure A4 in Appendix A.1.

The density of interest rates for payroll loans exhibits a higher kurtosis among high-income individuals compared to low-income individuals. Furthermore, the distribution is positively skewed for high-income individuals and relatively symmetric for low-income individuals, similarly to the pattern observed for personal loans. More than 80% of payroll loans for individuals earning up to 2 minimum wages have an interest rate higher than 25%, while only 20% of individuals earning more than 10 times the minimum wage pay an interest rate above 25% in payroll loans—the cumulative distribution functions for personal loans are depicted in Figure A4 in Appendix A.1.

The higher interest rates paid by low-income individuals may reflect a higher risk of default among them. This is not the case. To show this, we compute two measures: interest rate spreads and default-adjusted spreads. Interest rate spreads are the contracted loan rates minus the deposit rate, which is based on the central bank (Selic) rate taking into account the cost of capital at different maturities. Default-adjusted spreads are calculated by setting the interest rate to -100% for loans in default. Such assumption implies that default occurs immediately, fully and the creditor's recovery rate is zero. Panels (c) and (d) of Figure 1 plot interest rate spreads and default-adjusted spreads against individual monthly income measured by multiples of the minimum wage. The

difference between these two measures of spreads decreases with income but the default-adjusted spreads are substantially lower for high-income individuals compared to low-income individuals.[7] For personal loans, default-adjusted spreads are above 100pp for individuals earning up to 3 times the minimum wage and about 40pp for individuals earning more than 20 times the minimum wage. Default-adjusted spreads for payroll loans are 3pp higher for individuals earning up to 3 times the minimum wage than for individuals earning more than 10 times the minimum wage.

The regressions in Table 1 investigate how personal loan interest rates vary with loan and individual characteristics. Columns (1)-(7) consider different control variables or samples. Interest rates decline with income, a result robust across the different specifications. Individuals earning more than 20 times the minimum wage pay an average annual interest rate on personal loans 28-44pp lower than those earning 1 to 2 times the minimum wage. Such negative relationship between income levels and loan interest rates also appear when we run regressions by risk level—Table A4 in Appendix A.2. The same result materializes when we control for individual fixed effects for formal workers—Table A7 in Appendix A.4.

Table 1 also shows the relationship of personal loan interest rates with other characteristics. These interest rates decrease with maturity and loan amount, which could be explained by a fixed cost for loan provision (e.g., Banerjee, 2003; Yannelis and Zhang, 2023). Controlling for all other observable characteristics, a personal loan of 1,000 Brazilian Reais is associated with an 11pp higher interest rate than a loan of 10,000 Brazilian Reais. Though large, such a gap is still small relative to the high and dispersed spreads observed in the Brazilian credit market. Column (2) controls for the credit risk scores provided by the data set (SCR). Doing so increases the overall explanation of the model by 2.7pp. The coefficients for the different income levels decrease slightly. Instead of using the SCR-provided risk scores, Columns (4) and (5) use the default probability. This is the probability predicted by observable loan and individual characteristics based on a logit regression. The coefficients are robust to such specifications.

[7]The reality lies somewhere between the raw interest rate spread and the default-adjusted spread. Even if recovery rates upon default are low for the poor and high for the rich, the relationship between income and interest rates will be strongly negative. Figure A5 in Appendix A.10 depicts the densities of time-to-default (in days) for personal and payroll loans across different income groups. Some of these densities are very similar for the different income groups.

Table 1: Interest rates and individual characteristics - Personal loans

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Maturity	-1.881***	-1.828***	-1.828***	-1.941***	-1.941***	-2.165***	-2.210***
	(0.0926)	(0.0941)	(0.0945)	(0.0961)	(0.0965)	(0.0234)	(0.0188)
Maturity Sq.	0.00748***	0.00747***	0.00743***	0.00774***	0.00770***	0.0119***	0.0124***
	(0.00109)	(0.00110)	(0.00110)	(0.00113)	(0.00113)	(0.000294)	(0.000218)
Log of loan	-4.591***	-4.518***	-4.411***	-3.590***	-3.479***	-4.060***	-3.860***
	(0.138)	(0.141)	(0.142)	(0.147)	(0.148)	(0.0611)	(0.0613)
No income	87.92***	77.38***	79.54***	84.33***	86.44***	77.59***	80.22***
	(0.725)	(0.703)	(0.722)	(0.729)	(0.753)	(1.273)	(1.381)
Up to 1 mw	61.04***	50.09***	50.98***	60.51***	61.45***	46.33***	48.22***
	(0.474)	(0.498)	(0.500)	(0.479)	(0.481)	(0.436)	(0.463)
From 1 to 2 mw	43.90***	37.61***	38.27***	43.57***	44.26***	28.18***	29.18***
	(0.379)	(0.388)	(0.390)	(0.387)	(0.389)	(0.325)	(0.340)
From 2 to 3 mw	31.54***	26.90***	27.42***	31.91***	32.46***	21.50***	22.08***
	(0.315)	(0.319)	(0.320)	(0.326)	(0.327)	(0.312)	(0.327)
From 3 to 5 mw	20.89***	17.32***	17.81***	21.69***	22.22***	13.31***	13.85***
	(0.247)	(0.243)	(0.244)	(0.257)	(0.258)	(0.306)	(0.321)
From 5 to 10 mw	9.971***	8.195***	8.564***	10.76***	11.19***	5.853***	6.226***
	(0.181)	(0.166)	(0.167)	(0.186)	(0.186)	(0.287)	(0.299)
From 10 to 20 mw	1.644***	1.004***	1.380***	2.075***	2.490***	-0.447	-0.284
	(0.122)	(0.119)	(0.119)	(0.123)	(0.121)	(0.281)	(0.292)
Retired	0.693***	1.203***	1.478***	0.404***	0.665***		
	(0.125)	(0.121)	(0.121)	(0.124)	(0.124)		
Civil Serv	-12.21***	-7.839***	-7.445***	-11.68***	-11.27***		
	(0.179)	(0.171)	(0.171)	(0.181)	(0.181)		
Informal	4.094***	3.853***	4.113***	2.895***	3.139***		
	(0.0699)	(0.0679)	(0.0665)	(0.0682)	(0.0671)		
Age	1.104***	1.113***	1.129***	1.379***	1.397***	0.187***	0.192***
	(0.0116)	(0.0113)	(0.0113)	(0.0127)	(0.0127)	(0.0280)	(0.0291)
Age Sq.	-0.0114***	-0.0108***	-0.0109***	-0.0135***	-0.0136***	6.11e-05	0.000167
	(0.000120)	(0.000114)	(0.000114)	(0.000127)	(0.000127)	(0.000356)	(0.000370)
Female	7.434***	8.267***	8.279***	8.253***	8.273***	3.920***	3.981***
	(0.0628)	(0.0609)	(0.0613)	(0.0648)	(0.0652)	(0.101)	(0.105)
Pr. default				58.19***	58.63***		
				(0.595)	(0.602)		
Fin. Literacy						-1.335***	-1.317***
						(0.0146)	(0.0141)
Constant	122.0***	185.1***	183.4***	104.9***	102.7***	187.3***	186.0***
	(0.404)	(0.659)	(0.666)	(0.490)	(0.499)	(1.114)	(1.163)
Observations	20,483,498	20,483,498	20,464,737	20,483,498	20,464,737	2,651,533	2,556,358
R-squared	0.269	0.297	0.309	0.276	0.289	0.294	0.331
Risk control	NO	YES	YES	NO	NO	YES	YES
Time FE	YES	YES	NO	YES	NO	YES	NO
Munic. FE	YES	YES	NO	YES	NO	YES	NO
Munic.xTime FE	NO	NO	YES	NO	YES	NO	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated coefficients for income dummies are relative to those earning more than 20 mw. Estimated coefficient for occupations are relative to formal workers.

Across specifications, informal employees pay about 2.8-4.1pp higher interest rate in a personal loan than formal employees, while civil servants pay roughly 7.4-12pp less than formal employees. Women pay 4-8pp more in interest rates than men. For the last two columns (6 and 7), we restrict our sample to only formal employees since we have more information for them available in the matched employer-employee data set (RAIS). For instance, we can control for the degree of financial literacy.[8] Individuals with higher financial literacy pay a lower rate but the magnitude of the difference is not substantial. One standard deviation increase in financial literacy leads to a 4pp reduction in the personal loan interest rate.[9] We control for time fixed effects to absorb macro shocks, such as changes in the central bank interest rate, and municipality fixed effects to control for location characteristics, such as local bank concentration (Columns 1, 2, 4 and 6). Columns (3), (5) and (7) also allow macro shocks to vary by location or local characteristics to vary over time, as these include municipality$\times$time fixed effects.

Table 2 presents regression results for interest rates of payroll loans. Control variables are similar to those used in regressions for personal loans, although payroll loans are not available to informal workers. So the dummy variable for this occupation is dropped in all regressions of Table 2. Similarly to the case of personal loans, interest rates are monotonically decreasing with income. The magnitude of the coefficients are, however, smaller than for the case of personal loans. Controlling for credit scores and occupation, an individual earning 1 to 2 times the minimum wage faces on average approximately 2.5-3pp higher interest rate in a payroll loan than individuals earning more than 20 times the minimum wage. Formal workers pay higher payroll interest rates than retired individuals and civil servants. A similar pattern emerges when regressions are run by risk level (Table A4 in Appendix A.2). In the case of payroll loans, one standard deviation increase in financial literacy leads to a reduction in interest rate of 0.3pp. Although most payroll loans are primarily directed at civil

[8]Financial literacy is computed by multiplying the number of years of education by a dummy variable that indicates whether the individual works in a finance-related occupation or an occupation dealing with numeracy (e.g., Garber et al., 2023). See Appendix A.1 for more details. Since occupation and education data is only available in RAIS, the number of observations is lower. Table A5 in Appendix A.3 reports all regressions run in Table 1 with only formal workers and the coefficients continue to be quite stable for the different specifications.

[9]Table A5 in Appendix A.3 shows that the introduction of financial literacy increases the R-squared by approximately 1pp.

servants and retirees, we also run all regressions for payroll loans using only the sample of formal workers who appear in the RAIS dataset. Interest rates vary negatively with income in a regression using such a sample (Table A6 in Appendix A.3). From this table, we can see that the introduction of financial literacy increases the R-squared by less than one percentage point.

In sum, interest rates for consumer credit in Brazil are high and vary greatly. Payroll loans, in which lenders can verify the borrower's employment status and payments are directly deducted from paychecks, still have average interest rates that are approximately 22 percentage points higher than the average benchmark rate. Default probabilities only account for a small fraction of the total variation in loan interest rates, and their role is even smaller in the case of payroll loans. Loan interest rates vary negatively with individual income, even after controlling for factors like credit scores, loan size, maturity, location, and other observable individual variables, such as gender, occupation, and financial literacy. These results are robust to different selected samples and specifications. Such high interest rates may arise due to a plethora of reasons. One of them might be the degree of competition in this market. The next subsection uses a pro-competition policy implemented in 2013 in Brazil to shed light on this channel.

2.1 The 2013 Loan Portability Reform

The Brazilian Central Bank introduced Resolution No. 4,292 on December 20, 2013, which became effective in May 2014. This reform established a regulatory framework to facilitate credit portability for consumer loans, enabling borrowers to settle an existing credit arrangement with a financial institution by initiating a new one with a competitor. Therefore, this loan portability allows individuals to transfer credit to another financial institution under more favorable terms. Although the original bank cannot deny this portability, it can match another institution's offer using a right to match.

This institutional change provides a quasi-experimental framework to investigate the causal impact of increased bank competition on interest rates. In a recent paper, Bonomo et al. (2024) explore the spatial concentration of local banking in Brazil to investigate how this institutional change affected local credit markets. Many municipalities in the country have at most one bank

Table 2: Interest rates and individual characteristics - Payroll loans

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate
Maturity	0.00960***	0.00740***	0.00718***	0.00917***	0.00893***	0.0695***	0.0687***
	(0.000313)	(0.000307)	(0.000309)	(0.000311)	(0.000313)	(0.00134)	(0.00142)
Maturity Sq.	-3.31e-05***	-3.12e-05***	-3.09e-05***	-3.26e-05***	-3.23e-05***	-0.000978***	-0.000988***
	(2.17e-06)	(2.15e-06)	(2.17e-06)	(2.16e-06)	(2.17e-06)	(1.10e-05)	(1.18e-05)
Log of loan	-0.550***	-0.537***	-0.535***	-0.541***	-0.539***	-0.289***	-0.281***
	(0.00369)	(0.00366)	(0.00371)	(0.00367)	(0.00372)	(0.00898)	(0.00982)
No income	2.678***	2.782***	2.799***	2.658***	2.675***	3.504***	3.594***
	(0.0228)	(0.0244)	(0.0245)	(0.0228)	(0.0230)	(0.116)	(0.124)
Up to 1 mw	2.569***	2.626***	2.631***	2.566***	2.571***	3.254***	3.331***
	(0.0227)	(0.0242)	(0.0241)	(0.0227)	(0.0227)	(0.0999)	(0.106)
From 1 to 2 mw	2.481***	2.445***	2.457***	2.477***	2.489***	2.909***	2.992***
	(0.0228)	(0.0240)	(0.0240)	(0.0228)	(0.0228)	(0.0997)	(0.105)
From 2 to 3 mw	2.234***	2.206***	2.210***	2.234***	2.240***	2.630***	2.681***
	(0.0225)	(0.0237)	(0.0236)	(0.0225)	(0.0224)	(0.0974)	(0.102)
From 3 to 5 mw	1.921***	1.882***	1.893***	1.924***	1.936***	2.252***	2.305***
	(0.0221)	(0.0235)	(0.0234)	(0.0221)	(0.0220)	(0.0998)	(0.105)
From 5 to 10 mw	1.449***	1.414***	1.424***	1.453***	1.463***	1.651***	1.688***
	(0.0215)	(0.0232)	(0.0231)	(0.0215)	(0.0215)	(0.0973)	(0.102)
From 10 to 20 mw	0.475***	0.443***	0.453***	0.478***	0.488***	1.248***	1.277***
	(0.0180)	(0.0186)	(0.0186)	(0.0180)	(0.0179)	(0.0959)	(0.101)
Retired	-0.983***	-0.954***	-0.965***	-0.968***	-0.980***		
	(0.0150)	(0.0153)	(0.0155)	(0.0149)	(0.0152)		
Civil Serv	-2.535***	-2.532***	-2.547***	-2.529***	-2.544***		
	(0.0197)	(0.0201)	(0.0205)	(0.0197)	(0.0200)		
Age	-0.00212**	0.00536***	0.00511***	0.00296***	0.00286***	0.00441	0.0134***
	(0.00108)	(0.00111)	(0.00112)	(0.00107)	(0.00108)	(0.00397)	(0.00413)
Age^2	9.72e-05***	2.16e-05**	2.34e-05**	4.82e-05***	4.86e-05***	-0.000536***	-0.000652***
	(8.92e-06)	(9.27e-06)	(9.38e-06)	(8.92e-06)	(9.02e-06)	(4.65e-05)	(4.83e-05)
Female	0.00546*	0.00157	0.00230	0.0157***	0.0168***	-0.394***	-0.400***
	(0.00282)	(0.00283)	(0.00284)	(0.00276)	(0.00277)	(0.0140)	(0.0146)
Pr. default				1.494***	1.548***		
				(0.0277)	(0.0279)		
Fin. Literacy						-0.102***	-0.102***
						(0.00287)	(0.00297)
Constant	30.03***	30.21***	30.23***	29.82***	29.82***	28.78***	28.60***
	(0.0635)	(0.0693)	(0.0705)	(0.0627)	(0.0638)	(0.181)	(0.194)
Observations	20,524,507	20,524,507	20,506,221	20,524,507	20,506,221	1,310,182	1,234,327
R-squared	0.207	0.211	0.227	0.208	0.223	0.183	0.219
Risk control	NO	YES	YES	NO	NO	YES	YES
Time FE	YES	YES	NO	YES	NO	YES	NO
Munic. FE	YES	YES	NO	YES	NO	YES	NO
Munic.xTime FE	NO	NO	YES	NO	YES	NO	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated coefficients for income dummies are relative to those earning more than 20 mw. Estimated coefficient for occupations are relative to formal workers.

branch, and some have no banks (see Fonseca and Matray, 2024). In municipalities without banks, financial services are provided in public offices, such as post offices and lottery shops, which usually intermediate services from public banks. The identification assumption is the effects of the loan portability reform on interest rates in municipalities with at most one bank may be different than in municipalities with more than one bank, reflecting heterogeneity in the degree of competition. The spatial distribution of municipalities with at most one bank and with more than one bank is displayed in Figure C13 in Appendix C.4.

Payroll loans accounted for the majority of all requests for loan portability, approximately 98% of the transferred amount from one institution to another from 2014 to 2016. There was only a small fraction of personal loans that were portable. And some type of consumer loans were not clearly included in the institutional reform, such as overdrafts and revolving credit.

Panel (a) of Table 3 shows how the loan portability affected interest rate in municipalities with more than one bank relative to those with at most one bank.[10] All regressions control for municipality and time fixed effects. They also include controls for per capita income and population size by introducing two indicator variables: whether or not the municipality has an income per capita above the median and also a population above the median in Brazil. According to Column (1), payroll loan interest rates were reduced by 0.908 percentage point in treated municipalities (with more than one bank) relative to the control group (with at most one bank). In Column (2), we consider only municipalities which have at least one public bank in the treatment to control for any public policy affecting public banks besides the loan portability resolution. The estimated effect is stronger: a reduction of payroll loan interest rates in treated municipalities of about 1.02 percentage point.[11] Consistent with an increase in competition, Panel (b) of Table 3 show that the per capita volume of payroll loans increased by approximately 3.2%-4.6% in treated municipalities relative to control municipalities. Table C15 in Appendix C.4 shows that municipalities with low bank concentration are associated with lower interest rates for both payroll and personal loans.

Although personal loans composed a small fraction of portable loans from

[10]Therefore, the unit of observation here is the municipality.

[11]Bonomo et al. (2024) show that results are robust to other specifications. The authors also provide dynamic effects: the coefficients of the treated variable are negative and statistically significant at 95% confidence level for all 24 months after the introduction of the reform.

Table 3: Impact of the loan portability on loan interest rates

	Panel (a): Loan rate			
	Payroll		Personal	
	(1)	(2)	(3)	(4)
	Loan rate	Loan rate	Loan rate	Loan rate
Treat x Post$_{Dec2013}$	-0.908***	-1.016***	-10.82***	-11.72***
	(0.153)	(0.153)	(1.607)	(1.785)
Constant	28.71***	28.75***	98.92***	98.89***
	(0.0679)	(0.0730)	(0.627)	(0.848)
Observations	295,023	271,597	294,998	271,572
R-squared	0.504	0.501	0.763	0.771
Munic. FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Public Banks	NO	YES	NO	YES
	Panel (b): Log of volume per capita			
	Payroll		Personal	
	(1)	(2)	(3)	(4)
	$ln(Vol_{pc})$	$ln(Vol_{pc})$	$ln(Vol_{pc})$	$ln(Vol_{pc})$
Treat x Post$_{Dec2013}$	0.032***	0.046***	0.070***	0.068***
	(0.017)	(0.012)	(0.017)	(0.018)
Constant	4.485***	4.485***	3.252***	3.258***
	(0.003)	(0.004)	(0.005)	(0.006)
Observations	295,023	271,597	294,998	271,572
R-squared	0.953	0.955	0.906	0.911
Munic. FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Public Banks	NO	YES	NO	YES

Notes: Treated municipalities are those with a least two banks in Dec 2013. Control municipalities are those with at most one bank in Dec 2013. The vector of covariates contains time-varying indicator of the 2011 GDP per capita above the median and time-varying indicator of the 2012 population above the median. The sample with public banks correspond to the one in which there exists at least one public bank in the treatment group and the control group has at least one public bank or no bank. Standard errors are clustered at the state-month level, *** p<0.01, ** p<0.05, * p<0.1.

2014 to 2016, they were also affected by the loan portability reform due to the threat of competition or banks offering different deals to retain consumers. Columns (3) and (4) Table 3 report the effects of the reform on personal loan interest rates—Panel (a)—and the log of volume per capita—Panel (b)—when we use the same empirical strategy as in the case of payroll loans. Across specifications, personal loan interest rates fell by 10.82-11.72 percentage points, while per capita volume increase by approximately 7% in treated municipalities relative to control municipalities.

3 Model

3.1 Environment

The economy is populated by a continuum of finitely lived households. Each household lives for T periods and their lives are divided into a working phase, up until age T^R, and retirement thereafter. These individuals can work in the formal, informal or public sectors. The probability of switching from any sector s_i to sector s_j is given by p_{ij}. Workers are subject to income shocks, the process of which depends on the sector s where they work. The current period's income is denoted by y and next period's income y' fluctuates according to a Markov chain with transition matrix $\Pi(s, s')$, with elements $\pi_{ij}(s, s') = Pr(y' = y_j | y = y_i, s, s')$. In addition, with probability π_e, individuals face expenditure shocks, designed to capture life events such as health shocks, divorce, etc. These shocks are assumed to be proportional to income and are denoted by $e(y) = \psi y$. This corresponds to the fact that life events such as divorce, home repairs, etc. are more expensive for the wealthy. Individuals discount future periods with a factor $\beta \in (0, 1)$ and their intra-period utility is given by $u(c) = c^{1-\sigma}/(1-\sigma)$ with $\sigma > 0$.

3.2 Saving and Borrowing

Households can save and borrow by buying and selling one-period discount bonds intermediated by banks. We refer to these bonds as 'personal loans'. When selling bonds (borrowing), $a_B < 0$, households can default on their repayment obligations. Households can also borrow by means of 'payroll loans',

where the borrower can pledge up to a fraction $\eta \in (0,1)$ of their per-period income and agree that this payment is deducted 'at source'. That is, the bank can take payment of the loan before the borrower receives their income from their employer or from state retirement plans. These payroll loans are available to everyone in receipt of state payments (public sector workers and retirees) as well as a fraction of formal employees. Whether or not a formal employee has access to payroll loans can change over time according to a Markov chain.

In the period of default, households lose a fraction γ_i of their income, with $i \in \{B, P\}$, where B indicates one-period bonds and P indicates payroll loans. This represents the bank's ability to recover losses in the subsequent period. For payroll loans, banks are still in principle exposed to the income risk of households because, if the household's income drops, banks can only collect γ_P of this lower income in the event of default. In general, γ_P is the maximum fraction of income that could plausibly be seized by banks in the event of default. As such, we assume (i) the legal maximum seizable income in enforcement of personal loans is lower than for payroll, or $\gamma_B < \gamma_P$; (ii) for a borrower with both payroll and personal loans, personal loans are the residual claimant on this maximum seizable fraction of income γ_P. In practice, this means that for a personal loan, the recovery rate depends on whether a household is also defaulting on payroll loans and the quantity of payroll loans held ($-a_P$), since payroll loans are effectively senior. So denoting $\overline{\gamma}_B$ as the official rate and γ_B as the realized rate, the seizable income for bonds is

$$\gamma_B = \begin{cases} \overline{\gamma}_B & \text{if } a_P = 0, \\ \max\{\gamma_P + a_P/y, \overline{\gamma}_B\} & \text{if } 0 < -a_P \leq \gamma_P y, \\ 0 & \text{if } -a_P > \gamma_P y. \end{cases}$$

In the first case, there are no payroll loans so the official seizure rate on personal loans is applied. In the last case, all of the maximum seized income is diverted to servicing payroll loans. In the middle case, some income is being diverted to pay personal loans but they do not account for all of the maximum seizable income. What is left can be diverted to personal loans, up to the limit of $\overline{\gamma}_B$, i.e., the enforcement threshold for personal loans.

3.2.1 The Price of Loans

Households can buy or sell (save or borrow) bonds B and borrow via payroll loans P. The price of each asset is given by q_i, $i \in \{B, P\}$. These prices depend on the baseline interest rate r, default probabilities, recovery rates and wedges (that may reflect intermediation costs, market power, profit margins, etc.). The price of a loan given to a household will also depend on their state variables. To save notation, we denote a household's non-debt related state variables by $X = \{y, s, e, \tau\}$, where τ corresponds to the age of the household.

The price of an asset is given by:

$$q_i = \frac{\mathbb{E}[1 - D'(1 - \gamma_i \frac{y'}{a_i'})]}{1 + r + k_i(a_i', y, s, \tau)}, \quad i \in \{B, P\}. \tag{1}$$

The numerator in equation (1) is the expected payoff of the asset, reflecting the expected default probability in the next period (D') and the recovery rate ($\gamma_i y'/a_i'$). The denominator contains the baseline interest rate r and the wedge k_i associated with a loan of type i, size a_i' and the characteristics of the borrower (y, s, τ).

If the household is saving on a bond, there is no default and no wedge. Hence, $q_B = 1/(1+r)$, when $a_b \geq 0$. Since households may default on their debt obligations, the price at which banks buy assets from households will generally be lower (i.e., borrowing interest rates will be higher) in order to reflect this risk. Moreover, the wedges also decrease the price of the asset.

The wedges k_i are exogenous functions. These functions will be calibrated in Section 4 to reflect the empirical results reported in Section 2. In particular, these wedges will generally be decreasing in income, as estimated in the data. Appendix B describes a simple banking oligopoly model in which such a negative relationship arises endogenously. Most of our quantitative experiments in Section 5 will amount to changing these wedges k_i. Moreover, in our analysis of a pro-competition portability reform in Section 6, we will discipline changes in k_i with the post-reform experience in Brazil. The simple model in Appendix B also shows how interest rate spreads can be affected by the level of competition in the banking sector.

3.3 Decision Making

Defaulting on either type leads to exclusion from both debt markets in the next period. Households can regain access with constant probability θ every period. While in default households suffer utility loss Γ. Since defaulting on either loan triggers exclusion and utility loss, a household will always default on both loan types—default on one will trigger mandatory repayment of the other but the household always keeps (weakly) greater resources by defaulting on the second loan as well.

We represent each household's problem in two steps. At the beginning of the period, a household not already in default decides whether to default in this period or not:

$$V(a_B, a_P, P, D, X) = \max_{D' \in \{0,1\}} (1 - D')V^{repay}(a_B, a_P, P, D, X) + D'V^{default}(a_B, a_P, P, D, X),$$

where $P \in \{0, 1\}$ is a flag representing whether or not this household has access to payroll loans, $D \in \{0, 1\}$ is a default flag indicating whether or not a household is entering the period in the default status ($D = 1$), $-a_B$ is the amount of personal loans, and $-a_P$ is the amount of payroll loans. When a household is saving, then $a_B > 0$. The household is choosing over which default flag to bring into the next period D'.

If a household has access to a payroll loan, $P = 1$, and decides to repay, the value function representing their problem is:

$$V^{repay}(a_B, a_P, P = 1, D = 0, X) = \max_{c \geq 0, a'_P, a'_B} u(c) + \beta \mathbb{E}V(a'_B, a'_P, P', D' = 0, X'),$$
$$\text{subject to } c + e(y) + q_B a'_B + q_P a'_P = y + a_B + a_P,$$
$$a'_P \geq -\eta y, \ \eta \in (0, 1).$$

The price of the one-period bond is given by:

$$q_B = \begin{cases} \frac{1}{1+r} & \text{if } a'_B \geq 0, \\ \frac{\mathbb{E}[1 - D'(1 - \gamma_B \frac{y'}{a'_B})]}{1 + r + k_B(a'_B, y, s, \tau)} & \text{if } a'_B < 0. \end{cases}$$

The price of the payroll loan is given by:

$$q_P = \frac{\mathbb{E}[1 - D'(1 - \gamma_P \frac{y'}{a'_P})]}{1 + r + k_P(a'_P, y, s, \tau)},$$

where $k_B(a_B, y, s, \tau)$ and $k_P(a_P, y, s, \tau)$ correspond to the wedges for personal and payroll loans.[12]

If a household does not have access to a payroll loan and decides to repay, then the value function representing their problem reads:

$$V^{repay}(a_B, a_P, P = 0, D = 0, X) = \max_{c \geq 0, a'_B} u(c) + \beta \mathbb{E} V(a'_B, 0, P', D' = 0, X')$$
$$\text{subject to } \; c + e(y) + q_B a'_B = y + a_P + a_B.$$

The household might not have access to payroll loans in this period but may still carry over payroll loans from previous periods, which justifies the presence of a_P in the budget constraint.

Default implies assets are reset to zero. The value of default is given by:

$$V^{default}(a_B, a_P, P = 0, D, X) = \max_{c \geq 0, a'_B \geq 0} u(c) - \Gamma$$

$$+(1 - \theta)\beta \mathbb{E} V^{default}(a'_B, 0, P' = 0, D' = 1, X') + \theta \beta \mathbb{E} V(a'_B, 0, P', D' = 0, X'),$$

$$\text{subject to } \begin{cases} c + e(y) = y - \min\{\gamma_P y, -a_P - \overline{\gamma}_B y\}, & \text{if } D = 0, \\ c + e(y) + q_y a'_B = y + a_B, \; a'_B \geq 0, & \text{if } D = 1. \end{cases}$$

If a household begins the period with $D = 0$, then they enter default for the first time. In this case, their income will be garnished and they will not be able to borrow or save. After that period, they receive their full income and will be able to save.

[12] As discussed in the previous subsection, q_B and q_P depend on a household's state variables, such that $q_i(a_B, a_P, P, X)$ with $i \in \{B, P\}$. We are saving on notation and just writing q_i with $i \in \{B, P\}$.

4 Fitting the Model to the Data

In order to investigate the effects of financial reforms aiming to reduce loan interest rate spreads on consumption insurance and consumer welfare, we need to set value for model parameters. Our calibration strategy is to assign standard values for some parameters, which are commonly used in the literature; externally set others using our loan-level data and household survey data; and jointly internally calibrate the remaining parameters of the model to match key micro and macro moments of the Brazilian economy. Below we describe in detail how we discipline the model parameters.

1. **Model period:** The model period is assumed to be 1 year and households live for $T = 55$ years (ages 20 to 75, the life expectancy in Brazil in 2019). Their working-period T^r is 44 years so that the retirement age is 64.

2. **Preferences:** There are two preference parameters: the discount factor β and the coefficient of relative risk aversion σ. The coefficient of relative risk aversion is set to $\sigma = 2$, which is in line with the bulk of the literature on consumption surveyed by Attanasio (1999). This value is also consistent with the literature that estimates σ using Brazilian data, suggesting a σ in the range from 1 to 3 (see, for example, Gandelman and Hernández-Murillo, 2014; Fajardo, Ornelas and Farias, 2012). The subjective discount factor β is set internally. Heuristically, the moment identifying β is the ratio of personal credit over income. Hence, there is one preference-related parameter (β) to be internally calibrated.

3. **Deposit interest rate:** We consider a small open economy, in which banks have access to funding at real interest rate r. To determine the real interest rate, we use the monthly Over/Selic interest rate from the Brazilian Central Bank (BCB) and subtract the inflation rate measured by the IPCA (the official consumer price index) for the period, such that $r = 0.0375$.

4. **Stochastic process for labor income:** The income process is externally estimated. We use a non-parametric approach to compute the transition matrix for income shocks (De Nardi, Fella and Paz-Pardo, 2019). We use the PNAD-C household survey that has a rotating panel and divide the individuals into three groups: formal workers, informal workers and civil

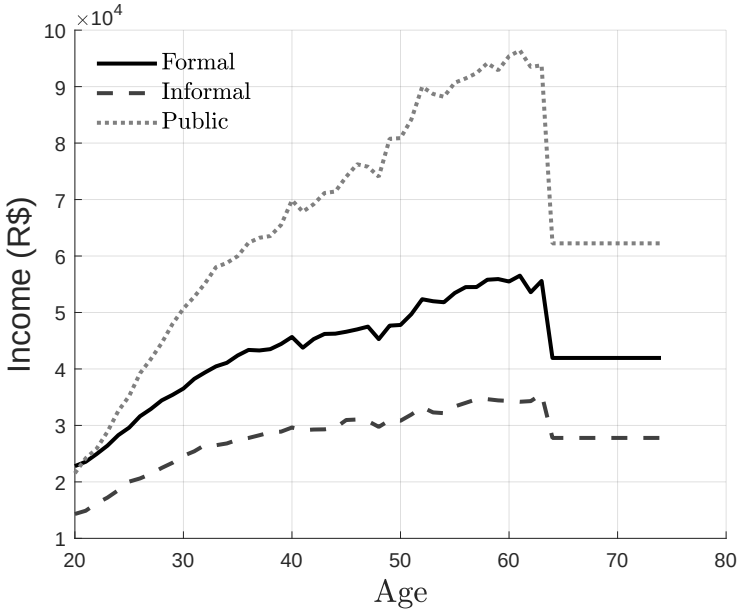


Figure 2: Income by Age and Sector

servants (see Gomes, Iachan and Santos, 2020). Within each group, we divide them into N income groups. For each income group, we calculate the average earnings. These values represent the support of the transition probabilities. Then, for each group, we construct the transition probabilities by calculating the fractions of workers who transit between group-sector pairs in one year. Figure 2 displays the average income process for public employees, formal and informal workers.

5. **Credit market variables:** First, we use the share of formal workers with access to payroll loans (which is equal to 8%) to set the probability that a formal worker has access to payroll loans. As in the data, in a payroll loan borrowers can pledge up to $\eta = 30\%$ of their per-period income.

   We also externally estimate interest rate wedges using our credit register data: $k_B(a_B, y, s, \tau)$ and $k_P(a_B, y, s, \tau)$. See Appendix A.7 for details on our estimation procedure. Here we summarize key steps. For each type of loan (personal and payroll), we proceed as follows:

   - We run a logit regression of default on loan characteristics (maturity, maturity squared, log of loan, risk), personal characteristics (income, occupation, gender, age) and fixed effects of time and municipality.

Then, we estimate the predicted probability of default of each loan.

- With the predicted probability of default ($prob\_default$) of each loan, we calculate a risk-cost-free rate for each individual that would cover the expected default: $r/(1 - prob\_default)$. We then calculate the interest wedge as the interest rate minus this risk-cost-free rate.
- We then run a regression of the wedge on observable characteristics (Appendix A.7). To extract the wedges, we consider the regression presented in column (2) of Tables A9 (personal) and A10 (payroll).

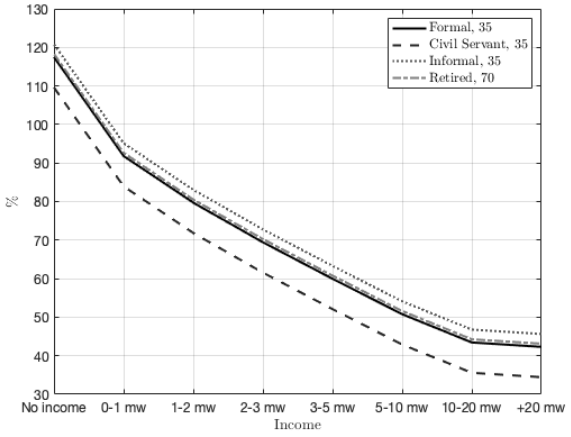
Loan-loss default is endogenous in our model and the interest rate wedges represent all other financial intermediation costs and bank market power, which are not explicitly modeled in our environment. Consequently, to construct the wedge from our regression results, we set the risk dummy at the highest credit score (i.e., AA). For personal loans, this implies a drop in the interest rate of roughly 80pp; and for a payroll loan a small rise in interest rates. Since our model period is one year, we set the maturity to 12 months. The wedge still varies by income, age, occupation and loan size, as described by the regression coefficients of Column (2) of Tables A9 and A10 in Appendix A.7.

Panels (a) and (b) of Figure 3 display interest rate wedges of a loan of R$1,000 used in our quantitative analysis for different levels of income, occupation and age groups. Therefore, for a 45 year old household, working in the formal sector and taking a personal (payroll) loan of R$1,000, the interest rate wedge will be 40pp (2pp) lower if this household earns more than 20 minimum wages than if the household earns 1-2 minimum wages.

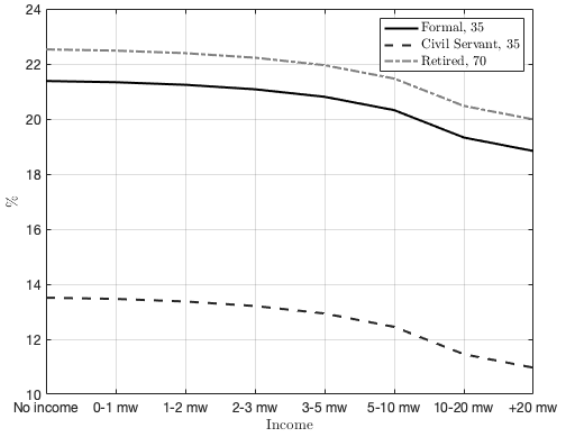
6. **Default parameters:** We set θ equal to 0.2 so that defaulting individuals have a bad credit record for, on average, 5 years. This is consistent with the law in Brazil, see Appendix A.5. The wage garnishment for payroll loans is set at the legal limit of 30%. We assume that the income loss under default for personal loans (γ_B) is zero. We set the non-pecuniary default cost (Γ), the expenditure shock $e(y) = \psi y$, with $\psi \in (0, 1)$, and the probability of facing an expenditure shock (π_e), such that the model matches default probabilities by three different levels of income and the percent of house-

Figure 3: Loan interest rate wedges by income groups and sectors

(a) Personal Loans



(b) Payroll Loans



Notes: Panel (a) and Panel (b) display the loan interest rate wedges by income levels for personal loans and payroll loans, respectively. For formal, informal and civil servant workers, they are the wedges for workers who are 45 years old. For retired individuals, they are the wedges of those who are 70 years old.

holds using debt. Hence, there are three default-related parameters to be internally calibrated: Γ, ψ, and π_e.

There are therefore 4 parameters (β, Γ, ψ, and π_e) to be internally calibrated via a minimum distance procedure. The parameters are set to match 5 moments: (i) the ratio of debt over income; (ii) the percent of households using debt; and (iii) default probabilities by three different levels of income. A change in any parameter affects all targets, but some moments are more sensitive to certain parameters. The credit-to-income ratio and the share of households using debt are useful in recovering the subjective discount factor (β); default probabilities are important to identify the probability of the expense shock (π_e); default probability at the lower tail of the income distribution helps to pin down the constant utility cost (Γ), which is relatively more important when utility is low; and default probability at the upper tail of the income distribution is important to recover the share of income loss of the expense shock (ψ).

Some selected model parameters are displayed in Table 4, including all internally calibrated parameters. Households discount the period at 9% per year, the probability that a household is hit by an expense shock is approximately

Table 4: Calibrated Parameters

Parameter	Description	Value	Source
Panel (a): Externally calibrated			
σ	CRRA	2	Standard
θ	Prob. exit default	0.2	Avg. time in bankr.
γ_P	Loss under default - Payroll	0.3	Legal
r	Real interest rate	0.0375	BCB, IBGE
γ_B	Loss under default - Personal	0	Assumed
Panel (b): Internally calibrated			
β	Disc. factor	0.91	Internal
Γ	Non-pecuniary default cost	2×10^{-4}	Internal
π_e	Prob. of expend. shock	0.13	Internal
ψ	Expend. shock, share of inc.	0.76	Internal

13% per year and, in this case, households incur a cost of approximately 75% of their annual labor income.

Table 5 displays the fit of the model with respect to the targeted and some non-targeted moments. Panel (a) of Table 5 shows that the calibration matches the credit targets (unsecured debt-to-income ratio and the percent of households using debt) fairly well. Default probabilities at the lower tail and upper tail of the income distribution are also targeted relatively well. The model displays a bit less default than in the data in the middle of the income distribution.

Regarding aggregate untargeted measures, as displayed in Panel (b) of Table 5, the model indicates lower income and wealth inequality compared to the data. Other factors influencing income and wealth inequality, such as variations in returns on assets, housing expenditures, and the tax code, are not explicitly modeled in our framework.

For formal workers, a precise measure of debt over labor income can be calculated, as presented in Tables A2 and A3 in Appendix A.1. The model underestimates the payroll debt-to-income ratio for formal employees and produces a larger debt-to-income ratio for personal loans than observed in the data.[13] In summary, the model does a relatively good job matching the values of unsecured debt and interest wedges in the economy. In our calibration, the overall intensive and extensive margins of unsecured credit use are aligning well with

[13]Figure C6 in Appendix C shows the resulting asset distribution by income and age in the model, as well as the debt use distribution by income and age. Since we do not have such counterpart distributions in the data, we do not report them here.

Table 5: Model Fit

	Model	Data	Source
Panel (a): Targeted moments			
Debt-to-Income (ex-housing) (%)	25	24	BCB
Households Using Debt (%)	8.9	9.6	CNC - PEIC
Default Rates (%)			
Up to 2 mw	9.1	7.1	SCR
2-5 mw	2.2	4.7	SCR
+5 mw	1.8	2.9	SCR
Panel (b): Untargeted moments			
Wealth share, top 10% (%)	51.2	79.6	WID
Income share, top 10% (%)	34.4	57.1	WID
Income Gini	0.44	0.49	WDI - WB
Wealth-income ratio	2.22	3.49	WID
Debt-to-Income, personal (Formal) (%)	18.7	11.3	SCR & RAIS
Debt-to-Income, payroll (Formal) (%)	16.2	26.2	SCR & RAIS

the data, and the wedges are disciplined by the data, our empirical approach, and the assumption that default is immediate and recovery rates are null.

5 The Effects of Interest Rates and Payroll Loans

We can now use the calibrated model to explore how the calibrated interest rate wedges affect debt use, default, consumption dynamics, inequality and consumer welfare. We implement a number of counterfactual exercises to assess the changes in consumer welfare and debt use under a number of alternative scenarios.

5.1 Extreme Scenario: No Wedges

In the first experiment (*No wedges*) we consider an economy in which loan interest rate spreads reflect only the expected cost of default. This is an extreme scenario given that there are costs associated with financial intermediation activities (e.g. tax and required reserves). However, this exercise serves as a good benchmark for assessing the possible consumer welfare gains that are in principle on the table if credit markets in Brazil behaved as they are typically modeled for advanced economies like the US. The welfare gains presented here are

Table 6: Baseline vs Counterfactual Comparisons

Moments (%)	Baseline	No Wedge	Min. Wedge	Payroll Exp.
Mean Debt	25	39	28	29
Debt Use	8.9	23	11	13.2
Default Rates				
$\leq 2MW$	9.1	6.6	8.9	8.4
$2 < MW \leq 5$	2.2	1.8	2.0	1.9
$MW \geq 5$	1.8	1.8	1.9	1.8
Cons. Welfare (% CEV)	–	3.5	0.8	0.2

partial equilibrium gains. In particular, they do not take into account the possibility that the risk free rate might move in response to changes in saving and borrowing patterns as a result of changes to the wedges. In addition, we do not consider the welfare of financial intermediaries.

The second column of Table 6 reports the results for this counterfactual (No Wedge). Eliminating the interest rate wedges causes the share of individuals using debt to increase by a factor of 2.5 and overall mean debt to increase by more than 50%. Default rates are reduced substantially among poorer individuals, by approximately 28% for individuals earning less than 2 times the minimum wage. Average welfare, calculated by the average consumption equivalent of all individuals at age 20, increases by 3.5% of annual baseline consumption.[14] After a period of 20 years (i.e., when an individual is 40 years old), this welfare effect implies that individuals would need to double their consumption in the baseline to maintain the same welfare as in the counterfactual without the interest rate wedges. Therefore, although such loan interest rate wedges directly affect only a relatively small fraction of individuals (less than 10% of individuals use debt in our benchmark economy), they have a large welfare effect.

Panel (a) of Figure 4 decomposes this average welfare gain by sector and income decile. The welfare gains are largest for the poor and, particularly, the poor working in the informal sector. For the 20 percent poorest individuals welfare gains of eliminating interest rate wedges are above 5% of annual consumption equivalent to the baseline. That is, the consumption of those individuals

[14]We calculate the expected welfare of all agents at 20 in the baseline and in the counterfactual. We then compute the percentage change in annual consumption to keep individuals indifferent to the counterfactual.

should double every 14 years in the benchmark so that they would have the same welfare in the counterfactual exercise without the interest rate wedges. But even for relatively rich individuals, welfare gains of eliminating interest wedges are above 1% of annual consumption equivalent to the baseline. Some wealthy individuals might not be borrowing, but they still face a positive probability of experiencing adverse income and expense shocks. Therefore, they would still need to rely on loans for consumption smoothing.

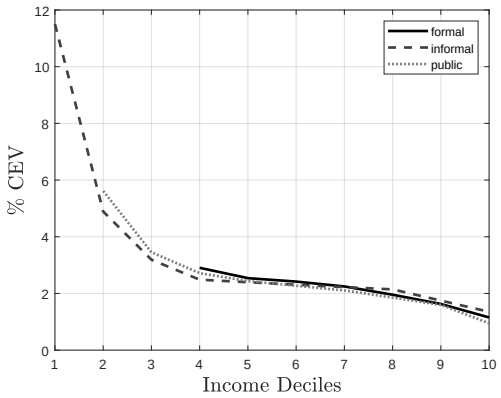
Figure 5 illustrates the change in behavior induced by the removal of wedges. The solid black line in Panel (a) shows the percentage change in average consumption by age in the counterfactual relative to the baseline. There are relatively small changes for most ages but large increases in consumption for the youngest cohorts. This is consistent with young people borrowing to finance higher consumption while young. The reduction in the cost of borrowing allows them to enjoy larger levels of consumption. There is a negative effect on consumption in middle-age as the extra debt needs to be repaid. The dashed line shows the change in the cross-sectional standard deviation of consumption by age. Among the young individuals, consumption inequality drops as young poor agents can borrow from future income. There are only moderate changes in the volatility of consumption in later periods of life. Therefore, both lines depict that the benefits of lower wedges are accrued mainly by the young cohorts of individuals.

Panel (b) of Figure 5 shows the change in mean consumption ordered by consumption percentile in the baseline. The median household in consumption terms sees virtually no change from the removal of wedges. By contrast, relatively poor individuals have large positive gains to consumption—of the order of 3-4pp. This is partially offset by small declines in consumption for the top half of the consumption distribution. Therefore, the high and dispersed loan interest rates in Brazil amplify consumption inequality, hurting mainly the poor and young individuals.

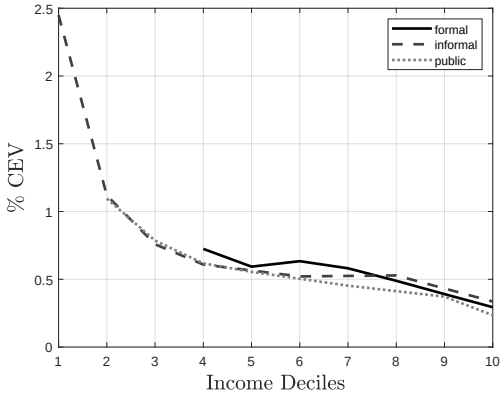
Households in the top half of the consumption distribution consume less after the removal of interest rate wedges. This can be rationalized as households borrow more when they are young and poor and repay their debt when they are older and richer. We can see this in Panel (c) of Figure 5, which shows the change in *average* lifetime consumption by a household's place in the overall distribution of average lifetime consumption. Averaging over the household's

Figure 4: Consumer Welfare by Sector and Income Decile

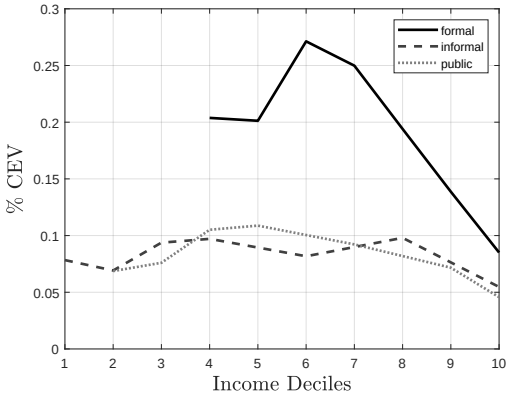
(a) No Wedge



(b) Minimum Wedge



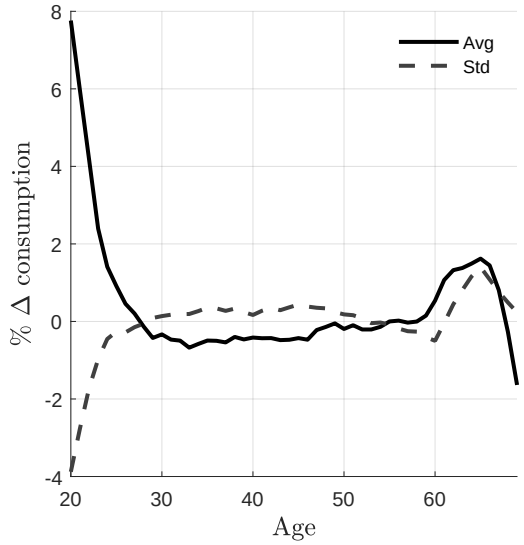
(c) Payroll Expansion



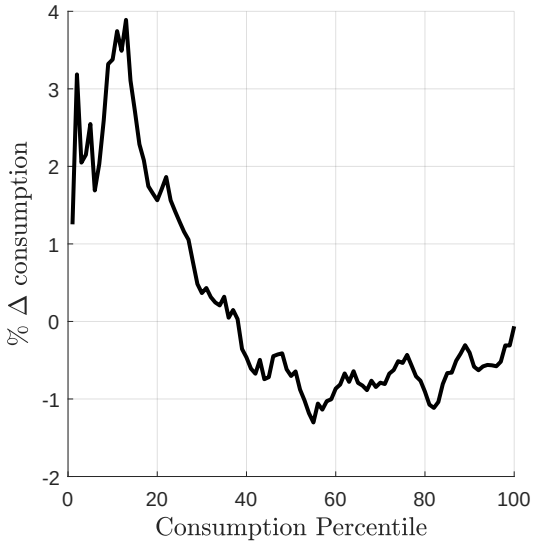
Notes: Consumption equivalent variation (as % of baseline consumption) from fully removing all wedges from both personal and payroll loans - panel (a); from considering minimum wedges for both personal and payroll loans - panel (b); from the payroll expansion to all formal workers - panel (c).

Figure 5: No Wedge: Changes in Average Consumption and in Standard Deviation of Consumption

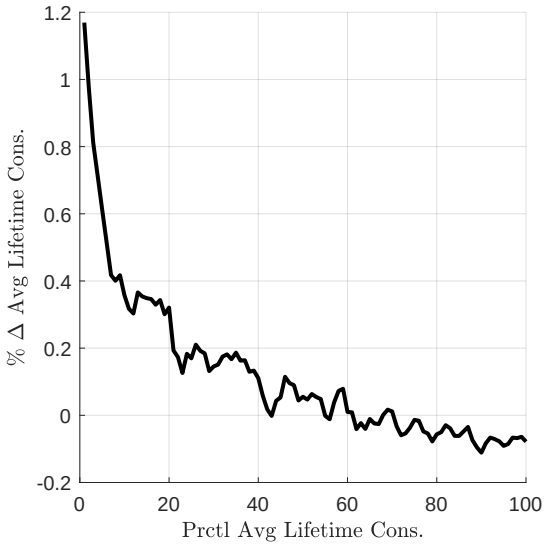
(a) By Age



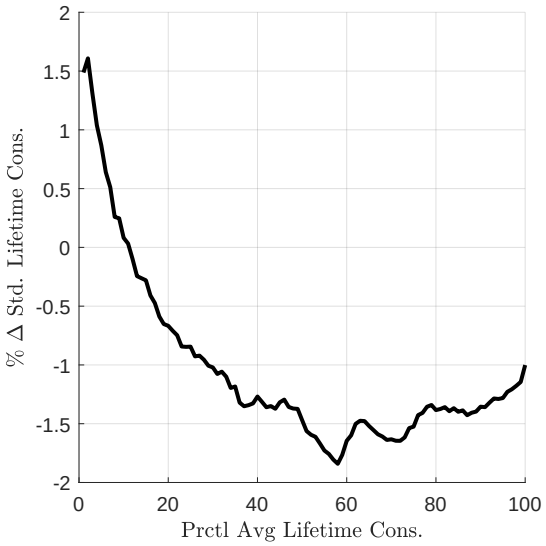
(b) By Consumption Percentile



(c) Δ Avg. Cons.



(d) Δ Std. Cons. by Avg. Cons.



Notes: Panel (a): Solid line shows % change in mean consumption by age. Dashed line shows % change in the cross-sectional standard deviation of consumption by age. Panel (b): % change in consumption according to the household's place in the consumption distribution in the baseline. Panel (c): Plots the % change in household consumption by percentile of average lifetime consumption in the baseline. Panel (d): Plots the % change from the baseline in the standard deviation of consumption over the household's lifetime for each percentile in the average lifetime consumption in the baseline.

lifetime should remove the effects of consumption shifting from old to young. The consumption gains over a full lifetime are smaller but generally positive, specially for poor individuals.[15] Panel (d) of Figure 5 reports the standard deviation of consumption over a household's life. There is a drop in volatility for almost all individuals. Figure C7 in Appendix C.2 shows that the drop in volatility is largest for those with the largest consumption volatility in the baseline. These changes to consumption patterns are reflected in the changes in the debt and asset profiles, as shown in Figure C8 in Appendix C.2.[16]

5.2 Minimum Wedge

There is a plethora of non-interest or operating expenses associated with intermediation activities, e.g., employee salaries and rental costs. These are separate from interest expenses and provisions for credit losses. Loan-loss default is endogenous in our model, and credit losses are therefore endogenously captured. Consequently, the interest rate wedges represent all other costs and bank market power, which are not explicitly modeled in our environment.

In the following exercise, the observed minimum wedges (for personal and payroll), which correspond to approximately 30pp for personal and 10pp for payroll loans, capture these other costs. Therefore, we assume that financial intermediaries make zero profit when lending to individuals facing these minimum wedges. Then, for each loan type separately, we reduce the loan interest rate wedges of all other individuals to the minimum level of wedge observed. As in the case of the previous exercise (No Wedge), wedges here fall by more for poor informal workers than for other individuals. This exercise is similar to the counterfactual without any wedge, but here the reduction in wedges are relatively smaller.

The third column of Table 6 reports the results for the Minimum Wedge counterfactual. Average debt as a share of income increases by 12% while the share of individuals using debt rises by 24%. Default rates fall, specially on the lower tail of the income distribution. Consumer welfare increases on average

[15] The richer individuals might experience a drop in consumption because, with lower wedges, there is less precautionary savings and this can affect their consumption when old.

[16] Appendix C.2 contains other figures. Figure C9 displays the typical default path in the baseline and in the counterfactual without any wedge. The typical (median) individual defaulting in the baseline does not default in the counterfactual. So the wedges are important to explain high default rates in the consumer credit market.

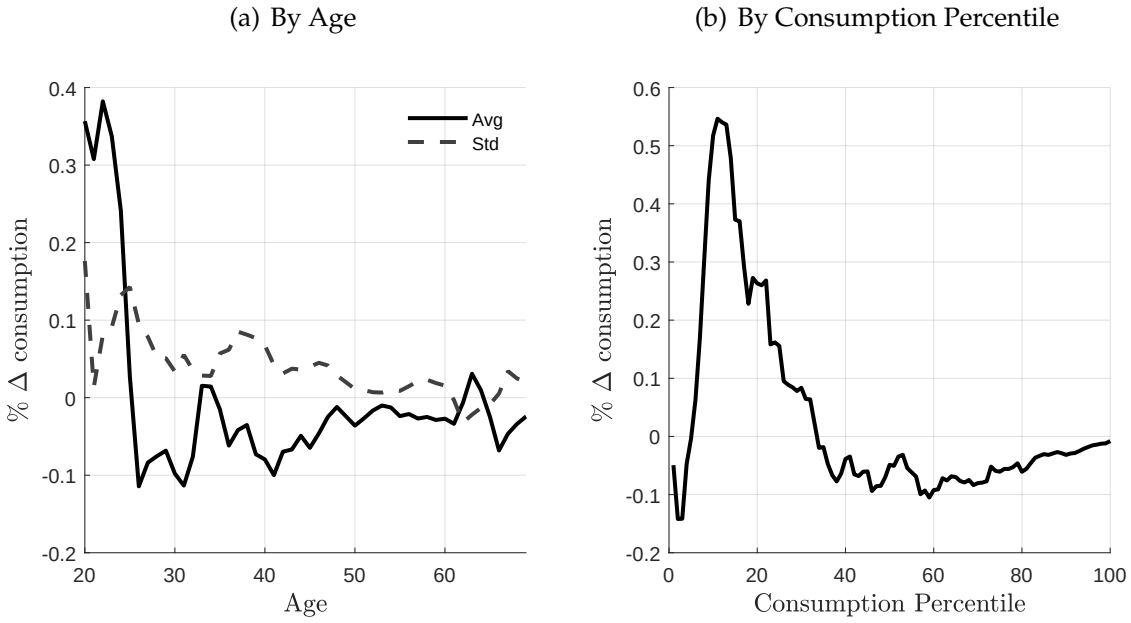
by 0.8% of annual consumption equivalent to the baseline. Once more, as Panel (b) of Figure 4 shows, most of the welfare gains are concentrated on the lower tail of the income distribution. For some poor informal individuals, the impact on welfare corresponds to more than 2% of consumption equivalent to the baseline.

5.3 Payroll Expansion

In this section, we consider a reform of a different type. What if payroll loans were more broadly available? As discussed above, these payroll loans are a form of debt primarily available only to public sector workers, the retired, and a small fraction of formal workers. This limited availability transpires because these loans require an agreement between banks and firms to garnish the worker's wages to ensure repayment. Such a contract between banks and employers is naturally easier to achieve when the employer is the state or visible large private employers. Here we run a counterfactual in which the government facilitates the expansion of payroll loans to all formal workers. This gives a large segment of the population access to a debt instrument with two important features. First, the interest rate wedge is much smaller. So, even absent of default considerations, the cost of borrowing is lower. Second, the fact that wages can be garnished after a default allows the household to choose to expose itself to greater recourse and, consequently, greater costs of default. These should, in turn, lead to lower interest rates.

The fourth column of Table 6 reports the results for this counterfactual. Relative to the baseline, this payroll expansion increases average debt as a fraction of income by 21% and the fraction of people using debt by 48%. The average consumer welfare gain amounts to 0.2% of annual consumption equivalent to the baseline. This effect is relatively small, specially when compared to the minimum wedge exercise. All formal workers now have access to payroll loans with significantly lower interest rates compared to those of personal loans. In the minimum wedge counterfactual, formal workers still face higher wedges than in this payroll-expansion exercise if they decide to take a personal loan. The payroll expansion, however, directly affects formal workers only. The individuals standing to benefit the most from lower interest rates are the young working in the informal sector and they are unable to directly take advantage of

Figure 6: Payroll Expansion: Changes in Average Consumption and in Standard Deviation of Consumption



Notes: Left panel: Solid line shows % change in mean consumption by age. Dashed line shows % change in the cross-sectional standard deviation of consumption by age. Right panel: % change in consumption according to the household's place in the consumption distribution in the baseline.

this payroll expansion. These individuals still face a positive probability to transit to the formal sector. Figure 6 corroborates this by showing that the increase in consumption for the young is limited. The cross-sectional standard-deviation of consumption is higher with the payroll expansion because the benefits of the policy accrue to the sector with relatively higher income. Therefore, the reform increases consumption inequality.[17]

The disaggregated consumer welfare gains are depicted in Panel (c) of Figure 4. Among formal workers, those directly impacted by this policy, the gains are higher. For certain formal workers, these gains correspond to up to 0.25% of annual consumption equivalent to the baseline. Informal workers and civil servants also reap benefits from this policy, despite not being directly affected by its implementation. This happens because these workers encounter a positive

[17]Figure C10 in Appendix C.3 shows changes in lifetime consumption and in standard deviation of consumption over the lifetime. The changes in these variables are small in this counterfactual relative to the baseline.

probability of working in the formal sector in the future. However, the welfare gains for these agents is relatively small.

Despite the small changes in consumption, there is a moderate decrease in default rates among formal workers. The overall default rate for formal workers drops from 2.1% to 1.5%. Among the formal workers earning less than twice the minimum wage, the default rate drops from 2.6% to 1.6%. Default is avoided because formal workers in this counterfactual can access extra credit in the form of payroll loans with lower interest rates. Hence, the interests costs are less burdensome. Moreover, defaulting on a payroll loan is more costly due to the wage garnishment.

Lower interest-rate wedges and higher recovery rates for banks in the event of default combine to make payroll loans attractive for formal workers with low default probabilities. Are payroll loans preferred in this counterfactual because personal loans have a much larger wedge? Or would households prefer payroll loans even if personal loans were just as cheap? We run a counterfactual such that personal loans have the same lower wedge as payroll loans. The only remaining difference between the two types of loans is the rate of wage garnishing for payroll loans in the event of default. Otherwise, the loans would be identical and the portfolio choice between them would be indeterminate. Figure C12 in Appendix C.3 shows that, with wedges equalized across the two types of loans, payroll loans are the household's first choice for entering into debt. However, as the interest burden and probability of default increase, households choose to also use personal loans, insuring against higher default probabilities.

6 The Importance of Competition: Analyzing the 2013 Loan Portability Reform

The results from the previous section indicate that changes in interest rate spreads can have significant quantitative effects on consumer behavior and welfare. These results were obtained by altering the interest rate wedges, represented as k_i, in the model. However, these wedges may encompass various aspects of financial intermediation, such as screening and monitoring costs, taxes, reserve requirements, and profit margins. These factors can interact with each other shaping the wedges in a non-trivial manner. Competition, or its absence,

Table 7: Welfare: Loan Portability Reform

	Mean	Debt	Default Rates			Cons. Welf.
	Debt	Use	$\leq 2MW$	$2 < MW \leq 5$	$MW \geq 5$	CEV, %
Baseline	25	8.9	9.1	2.2	1.8	–
Portability	27	10.3	9.4	2.1	1.9	0.3

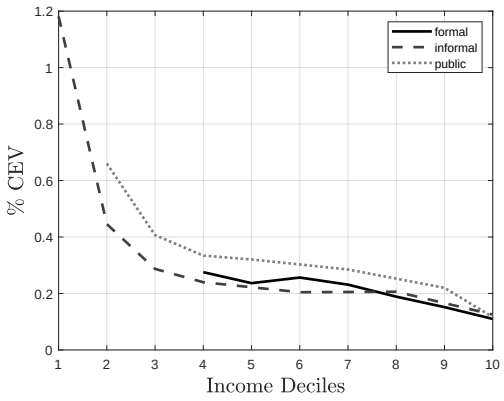
could be a crucial factor influencing these wedges. To evaluate this, we explore the results of the 2013 loan portability reform on interest rates, reported in Table 3 of Subsection 2.1.

The reduction in interest rates reported in Table 3 are relative (treated versus control municipalities) and we cannot estimate the overall effects of loan portability on interest rates. With this caveat in mind, we use the estimated effects of the portability reform on interest rates of payroll loans (1.02pp) and personal loans (11.72pp) to evaluate how the introduction of loan portability affected consumer welfare. We assume that the interest rate wedges drop by these amounts for all borrowers.

The model shows an average welfare gain from the reform of 0.34% of annual consumption equivalent to the baseline, see Table 7. This gain is quite large, specially considering a policy with negligible fiscal costs to the government and just the introduction of an institutional reform allowing consumers to sell their debt to other banks. Though large, this effect corresponds only to approximately one tenth of the gains from completely removing the interest rate wedges, suggesting potentially more gains could be achieved for consumers from pursuing further credit market reforms. The relative effect of the portability compared to the no-wedge counterfactual holds roughly true for the disaggregated results shown in Figure 7. The results from this graph are similar to the counterparts in Panel (a) of Figure 4 but scaled down to approximately 10%. Despite the micro-level kinks and non-linearities inherent in the household problem, the resulting macro picture from portability is almost a linear transformation of the more extreme no-wedge benchmark.

In common with the no-wedge counterfactual, the lower interest rates from increased portability increase consumption through lower levels of precautionary saving, particularly for the young and poor. These lower rates also allow for an expansion of debt use. Mean debt increases by 2pp and debt use by 1.4pp.

Figure 7: Consumer Welfare by Sector and Income Decile



Notes: Consumption equivalent variation (as % of baseline consumption) from the effects of loan portability on interest rates for payroll and personal loans.

For the portability case, the default rate among poor individuals rises. This is consistent with a change in the composition of borrowers since default rates are explained by both the amount of interest expenses and the risk profile of borrowers. This is consistent with findings from Garber et al. (2023) who show that the risk profile of borrowers changes with a financial inclusion policy implemented in Brazil.

7 Conclusion

Consumer credit plays a key role in enabling households to smooth their consumption, especially in the face of unpredictable income and expense shocks. However, access to credit in developing countries remains limited, with high costs associated, particularly for unsecured consumer credit. This paper documents systematic features of the Brazilian consumer credit market, and assesses the implications of financial reforms aimed at reducing financing costs and fostering competition within the banking sector on consumption, savings, inequality and consumer welfare.

The empirical analysis draws from the Brazilian administrative credit registry data. By focusing on personal loans and payroll loans, which constitute a substantial portion of the consumer credit market, we find large differentials

in interest rates, with personal loans bearing substantially higher costs compared to payroll loans. Default rates explain a relatively small fraction of loan interest rate spreads and loan interest rate wedges—the spread that cannot be explained by default probabilities—are negatively correlated with income. Poor individuals pay systematically higher loan interest rates even after controlling for several features of the loans (e.g, size, maturity and location) and individual characteristics (e.g. occupation, age and gender).

We then conduct several counterfactual exercises using a quantitative model calibrated to data from the Brazilian consumer credit market. Eliminating interest rate wedges could lead to significant improvements in consumer welfare, particularly for poorer individuals and those grappling with volatile incomes in the informal sector.

Additionally, our analysis of the impact of a portability reform in Brazil on loan interest rates stresses the role of regulatory interventions aimed at increasing competition and thereby mitigating high borrowing costs. The observed reductions in interest rates following the implementation of loan portability regulations led to average welfare gains of 0.34% of consumption equivalent, with larger gains in the lower tail of the income distribution. Though large, this effect corresponds only to approximately one tenth of the gains from completely removing the interest rate wedges, suggesting potentially more gains could be achieved for consumers from pursuing further credit market reforms.

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Appendix

A Data Appendix

A.1 Description of Data Sets and Summary Statistics

Data on loans in Brazil are from the Brazilian Public Credit Registry (SCR - *Sistema de Informações de Crédito*).[18] This is a confidential loan-level database managed by the Central Bank of Brazil. For any loan, we identify the lender, borrower, size of the loan, the interest rate on loan, the loan maturity, default rates, and credit scores. We also have some information on borrowers' characteristics such as age, gender, income, location, and occupation. An individual can have multiple loans in a period. We have a representative sample of 1,362 million individuals, and they are followed from January 2013 to December 2019.[19]

We also use RAIS (*Relação Anual de Informações Sociais*), a matched employer-employee administrative dataset covering all formal employment in Brazil. This is a mandatory annual survey maintained by the Ministry of Economy. RAIS provides information on the borrower's income and detailed occupation. Following Garber et al. (2023), we use this dataset to construct a measure of financial literacy. We follow 403,530 individuals and build an individual financial literacy index using two-individual-level characteristics that are observable in the RAIS dataset: years of education and occupation. To measure financial literacy, we rely on the occupation descriptions provided by the Brazilian Ministry of Labor. Specifically, we identify occupations that require a strong foundation in numeracy, such as economics, finance, math, statistics, accounting, engineering, and banking services. We consider individuals in these occupations to have a higher likelihood of being familiar with financial concepts. Our financial literacy index is computed by multiplying the number of years of education by a dummy variable that indicates whether the individual works in a finance-related occupation or work with numeracy (e.g. engineers). Unfortunately, the

[18] SCR detailed records on credit relationships between individuals, firms and Brazilian banks (covers all credit relationships above a threshold). The reporting threshold has changed over time: R$ 5,000 from January 2003 to December 2011, R$ 1,000 from January 2012 and May 2016, and R$ 200 starting in June 2016.

[19] In the SCR database, we use code 0202 for payroll loans and code 0203 for personal loans.

RAIS database only contains data on formal employees, which prevent us to measure financial literacy for informal employees.

Figure A1: Percentage of different loan types

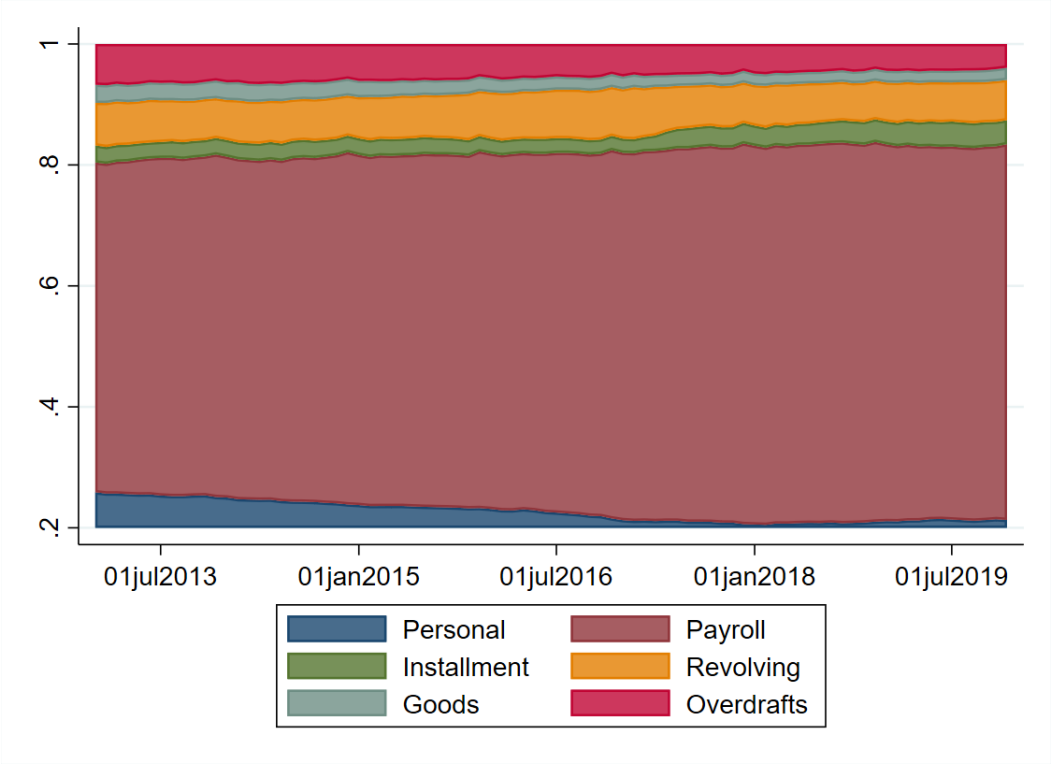


Figure A1 shows the percentage of different loan types based on their values, excluding housing and earmarked credit. This data is collected monthly by the BCB starting from March 2007 (source: BCB-DSTAT). For our analysis, we focus on data from January 2013 to December 2019. As observed in Figure A1, the majority of loans fall into three categories: payroll (59%), auto (27%), and personal (23%).

In table A1, we consolidate the data into loan types taking a weighted average of the variables - the weights are given by the loan size. In this study, we specifically consider payroll and personal loans as the most significant examples of non-collateralized loans. Table A1 provides descriptive statistics for all loan types. Notably, auto (23.06%, on average) and payroll (26.10%) have the lowest interest rates among all loan categories due to their collateralized nature. Conversely, "revolving" credit lines carry the highest interest rates for

consumers, with revolving credit cards at 347%, overdraft at 224%, and installment credit cards at 141%.

Table A1: Summary Statistics - Consumer Loans (ex-housing and earmarked credit)

	N	Mean	SD	Min	Max
Loan (Cars)	84	0.27	0.04	0.23	0.36
Loan (Personal)	84	0.23	0.02	0.20	0.26
Loan (Payroll)	84	0.59	0.03	0.55	0.63
Loan (CC Installment)	84	0.03	0.01	0.02	0.04
Loan (CC Revolving)	84	0.07	0.01	0.06	0.09
Loan (Goods)	84	0.02	0.00	0.02	0.03
Loan (Overdraft)	84	0.04	0.00	0.03	0.05
Rate (Cars), % p.a.	84	23.06	2.19	19.15	27.56
Rate (Personal), % p.a.	84	112.32	19.28	67.84	141.86
Rate (Payroll), % p.a.	84	26.10	2.30	20.54	29.97
Rate (CC Installment), % p.a.	84	140.99	28.06	100.13	178.46
Rate (CC Revolving), % p.a.	84	346.77	76.42	250.18	497.73
Rate (Goods), % p.a.	84	81.50	9.14	66.20	96.66
Rate (Overdraft), % p.a.	84	224.22	60.02	121.13	285.17
Maturity (Cars), mos	84	42.34	0.94	40.83	44.90
Maturity (Personal), mos	84	38.37	2.39	31.31	46.46
Maturity (Payroll), mos	84	69.15	5.21	59.55	80.03
Maturity (CC Installment), mos	84	9.00	0.86	7.97	10.83
Maturity (Goods), mos	84	16.04	2.28	12.35	21.21

Table A2 provides descriptive statistics for the main variables used in our empirical analysis for personal loans. For the deposit rate we consider the maturity of the loan and the term structure of interest rates in order to take into account the cost of capital for longer maturity. As we can observe, there are more than 20 million observations, and statistics for the following variables are provided: annual interest rate, maturity, default rate, loan amount and credit risk score (from AA - lowest risk score or lowest default probability to H - highest

risk score), occupation (formal, retired, civil servant and informal),[20] as well as borrower's age, gender, race, monthly income[21] and loan amount as a share of the formal monthly income. For annualised share of debt to income, we can divide the Loan/wage (personal) (RAIS) by 13 since there are 13 wages in Brazil. We also have the municipality of the loan origination, which is not reported in Table A2.

[20]Formal employees are well identified since they must appear at RAIS. For informal employees, we cannot assess whether they are informal workers or self-employed. We also do our empirical analysis restricting informal employees as those who do not appear at RAIS and earn up to 10 minimum wages in monthly income and all results are.

[21]Those reported as multiple of minimum wages are borrower's reported income by the bank to the SCR. The wage from RAIS is also reported but only for formal employees.

Table A2: Summary Statistics - Personal Loans

	N	Mean	SD	p10	p50	p90
Deposit rate (personal)	2.54e+07	9.93	3.11	6.36	10.17	14.10
Rate (personal)	2.16e+07	146.39	200.29	31.07	89.26	254.41
Maturity	2.16e+07	26.89	21.11	5.97	24.07	58.13
Default (personal)	2.16e+07	0.06	0.24	0.00	0.00	0.00
Loan (personal)	2.16e+07	4393.85	54132.88	267.63	1460.56	8012.17
Risk: AA	2.16e+07	0.04	0.20	0.00	0.00	0.00
Risk: A	2.16e+07	0.50	0.50	0.00	1.00	1.00
Risk: B	2.16e+07	0.11	0.31	0.00	0.00	1.00
Risk: C	2.16e+07	0.16	0.36	0.00	0.00	1.00
Risk: D	2.16e+07	0.10	0.30	0.00	0.00	1.00
Risk: E	2.16e+07	0.05	0.22	0.00	0.00	0.00
Risk: F	2.16e+07	0.01	0.12	0.00	0.00	0.00
Risk: G	2.16e+07	0.01	0.09	0.00	0.00	0.00
Risk: H	2.16e+07	0.02	0.13	0.00	0.00	0.00
Retired (personal)	2.16e+07	0.20	0.40	0.00	0.00	1.00
Civil Serv (personal)	2.16e+07	0.12	0.33	0.00	0.00	1.00
Informal (personal)	2.16e+07	0.56	0.50	0.00	1.00	1.00
Formal (personal)	2.16e+07	0.12	0.33	0.00	0.00	1.00
Age	2.16e+07	47.34	15.65	27.00	46.00	69.00
Female	2.16e+07	0.49	0.50	0.00	0.00	1.00
White	2.16e+07	0.06	0.24	0.00	0.00	0.00
No income	2.16e+07	0.01	0.11	0.00	0.00	0.00
Up to 1 mw	2.16e+07	0.16	0.37	0.00	0.00	1.00
From 1 to 2 mw	2.16e+07	0.27	0.45	0.00	0.00	1.00
From 2 to 3 mw	2.16e+07	0.17	0.38	0.00	0.00	1.00
From 3 to 5 mw	2.16e+07	0.16	0.37	0.00	0.00	1.00
From 5 to 10 mw	2.16e+07	0.14	0.35	0.00	0.00	1.00
From 10 to 20 mw	2.16e+07	0.06	0.23	0.00	0.00	0.00
+20 mw	2.16e+07	0.03	0.16	0.00	0.00	0.00
Wage (RAIS)	3035985	2564.57	3334.20	888.50	1644.44	4904.19
Loan/wage (personal) (RAIS)	3035985	1.48	2.43	0.13	0.79	3.23
Fin. Literacy	3035985	0.74	3.25	0.00	0.00	0.00
Yield curve (personal)	2.16e+07	9.97	3.19	6.36	10.63	14.11

Table A3 contains similar statistics for the variables of Table A2 but for payroll loans. The deposit interest rates are different because loan maturity for payroll and personal loans are different and we consider the term structure of inter-

est rates to define the deposit rate. There are more than 20 million observations. Some individuals can appear at RAIS, i.e. be a formal worker, but be also a civil servant. Since a job in the public sector is safer and, in general, there is a wage premium to work in the public sector, we denote those individuals as civil servants since they would have easy access to payroll loans. Similarly, a worker can have a formal job and receive a pension. We denote such individuals as retired. One of the reasons to follow this approach is that civil servants and retired individuals have easier access to payroll loans than formal workers and our model would not allow individuals to have more than one occupation.

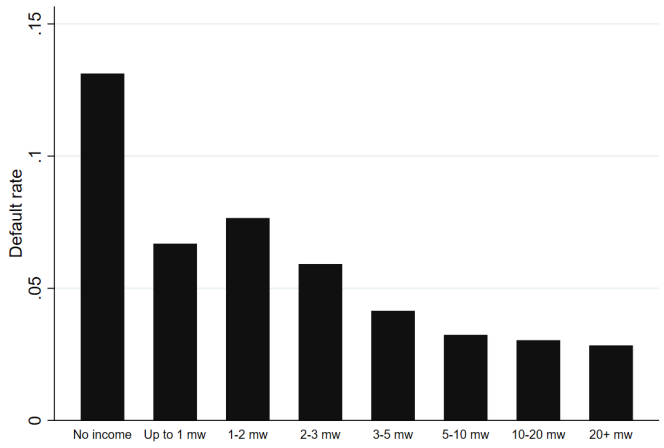
Table A3: Summary Statistics - Payroll Loans

	N	Mean	SD	p10	p50	p90
Deposit rate (payroll)	2.12e+07	9.97	3.31	6.32	10.81	14.15
Rate (payroll)	2.11e+07	27.80	10.87	20.98	28.18	31.99
Maturity	2.11e+07	62.44	21.24	33.07	61.67	86.07
Default (payroll)	2.11e+07	0.02	0.14	0.00	0.00	0.00
Loan (payroll)	2.11e+07	8100.90	15915.24	643.72	3616.71	18358.28
Risk: AA	2.11e+07	0.05	0.21	0.00	0.00	0.00
Risk: A	2.11e+07	0.47	0.50	0.00	0.00	1.00
Risk: B	2.11e+07	0.21	0.41	0.00	0.00	1.00
Risk: C	2.11e+07	0.16	0.37	0.00	0.00	1.00
Risk: D	2.11e+07	0.05	0.21	0.00	0.00	0.00
Risk: E	2.11e+07	0.02	0.14	0.00	0.00	0.00
Risk: F	2.11e+07	0.02	0.14	0.00	0.00	0.00
Risk: G	2.11e+07	0.01	0.11	0.00	0.00	0.00
Risk: H	2.11e+07	0.01	0.12	0.00	0.00	0.00
Retired (payroll)	2.11e+07	0.65	0.48	0.00	1.00	1.00
Civil Serv (payroll)	2.11e+07	0.27	0.44	0.00	0.00	1.00
Formal (payroll)	2.11e+07	0.08	0.27	0.00	0.00	0.00
Age	2.11e+07	60.94	15.35	36.00	66.00	77.00
Female	2.11e+07	0.59	0.49	0.00	1.00	1.00
White	2.11e+07	0.04	0.20	0.00	0.00	0.00
No income	2.11e+07	0.03	0.17	0.00	0.00	0.00
Up to 1 mw	2.11e+07	0.25	0.43	0.00	0.00	1.00
From 1 to 2 mw	2.11e+07	0.26	0.44	0.00	0.00	1.00
From 2 to 3 mw	2.11e+07	0.12	0.33	0.00	0.00	1.00
From 3 to 5 mw	2.11e+07	0.15	0.36	0.00	0.00	1.00
From 5 to 10 mw	2.11e+07	0.12	0.32	0.00	0.00	1.00
From 10 to 20 mw	2.11e+07	0.04	0.20	0.00	0.00	0.00
+20 mw	2.11e+07	0.01	0.12	0.00	0.00	0.00
Wage (RAIS)	2266268	2952.29	3309.93	942.45	1919.41	5921.05
Loan/wage (payroll) (RAIS)	2266268	3.41	3.96	0.42	2.14	7.65
Fin. Literacy	2266268	0.59	2.95	0.00	0.00	0.00
Yield curve (payroll)	2.11e+07	9.98	3.30	6.32	10.81	14.15

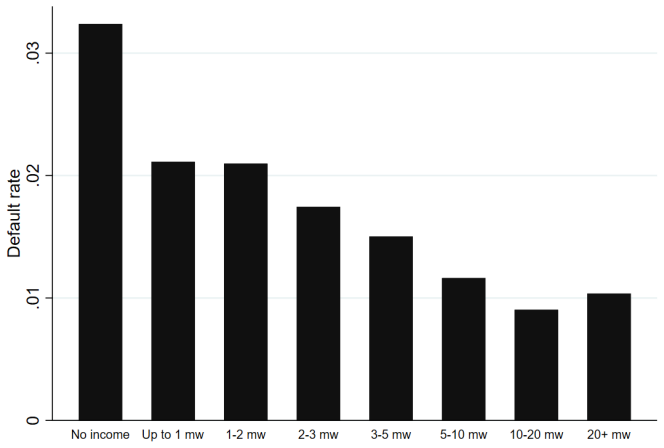
Figure A2 reports default rates by income groups for personal (Panel (a)) and payroll (Panel (b)) loans. Although the average default rate is high for individuals without any income, their share in our sample is quite low (1% and 3% for personal and payroll loans, respectively). Default rates are negatively

Figure A2: Default rates by income groups

(a) Personal Loans



(b) Payroll Loans



Notes: Panel (a) and Panel (b) display default rates by income levels for personal loans and payroll loans, respectively.

correlated with income.

Figure A3 displays the density of interest rates for personal (Panel (a)) and payroll (Panel (b)) loans. As can be seen, the variability in interest rates is larger for personal loans than for payroll loans. Additionally, Figure A4 plot the cumulative distribution function for all personal loans (Panel (a)) and all payroll (Panel (b)) loans. It also depict the cumulative distribution function by income brackets for personal (Panel (c)) and payroll (Panel (d)) loans.

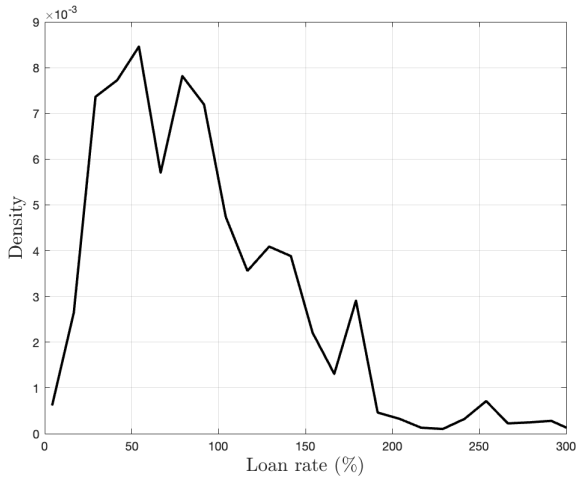
A.2 Interest Rates and Individual Characteristics by Risk

The Central Bank of Brazil Resolution 2682, issued on December 21, 1999, mandates that financial institutions categorize credit operations based on ascending risk levels, ranging from AA to H. The institution responsible for the credit must carry out this risk classification using consistent and verifiable criteria. Furthermore, the institution is required to review this classification at least on a monthly basis, taking into account any delays in paying the principal installment. Here is the risk classification based on the delay period:

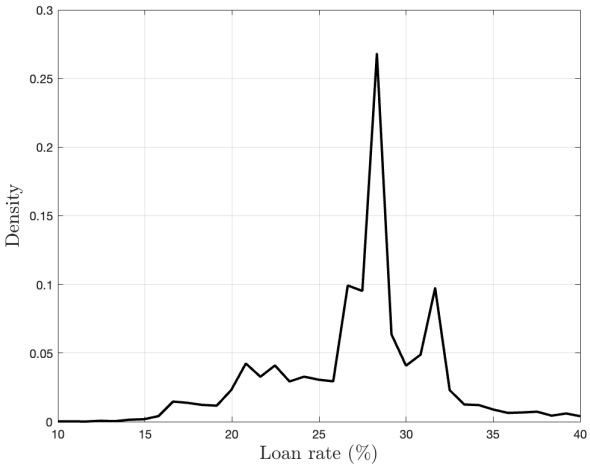
- Delays between 15 and 30 days: risk level B, at least.

Figure A3: Loan interest rate density

(a) Personal Loans



(b) Payroll Loans



Notes: Panel (a) and Panel (b) display the density of interest rates for personal loans and payroll loans, respectively.

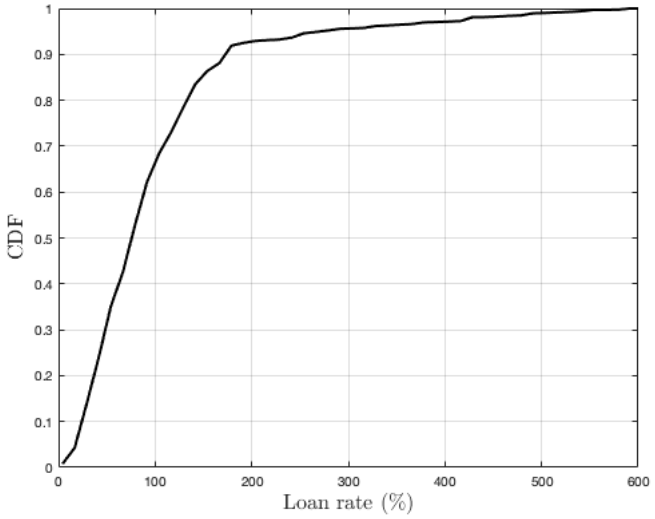
- Delays between 31 and 60 days: risk level C, at least.
- Delays between 61 and 90 days: risk level D, at least.
- Delays between 91 and 120 days: risk level E, at least.
- Delays between 121 and 150 days: risk level F, at least.
- Delays between 151 and 180 days: risk level G, at least.
- Delays greater than 180 days: risk level H.

In summary, Resolution 2682 outlines the process and criteria for credit risk classification, with specific risk levels assigned based on the duration of delays in paying the principal installment.

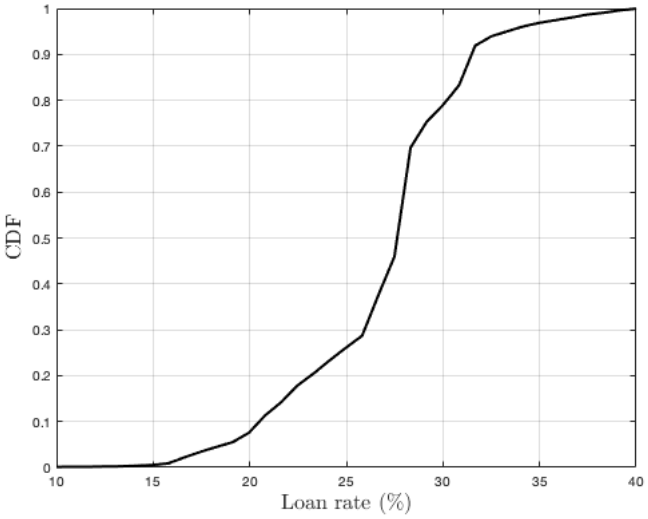
Table A4 contains regression results similar to those presented in the Empirical Section of the paper (Section 2), but by level of risk scores for both personal loans - Columns (1)-(3) - and payroll loans - Columns (4)-(6).

Figure A4: Loan interest rate cumulative distribution function (CDF)

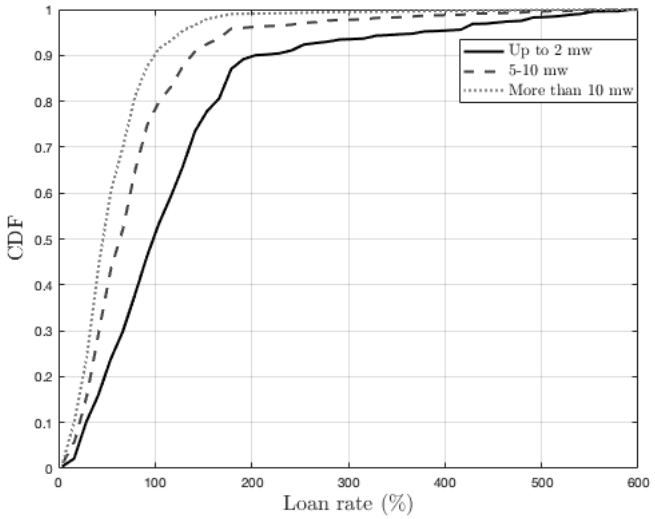
(a) Personal Loans: All loans



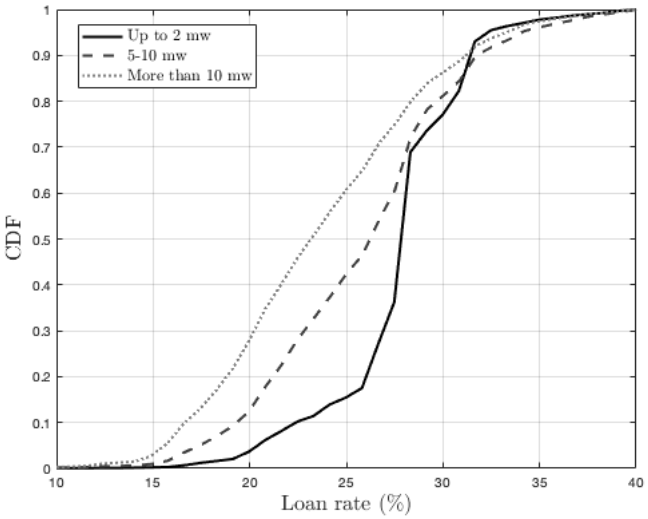
(b) Payroll Loans: All loans



(c) Personal Loans: By income



(d) Payroll Loans: By income



Notes: Panel (a) and Panel (b) display the cumulative distribution function (CDF) for personal loans and payroll loans, respectively. Panel (c) and Panel (d) display the cumulative distribution function (CDF) for personal loans and payroll loans by income brackets, respectively.

Table A4: Interest Rates and Individual Characteristics by Risk Scores - Personal and Payroll loans

	Personal			Payroll		
	(1)	(2)	(3)	(4)	(5)	(6)
	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate
Variables	AA/A	B/C/D	E/F/G	AA/A	B/C/D	E/F/G
Maturity	-2.289***	-0.891***	-2.865***	0.0241***	-0.00525***	-0.0115***
	(0.0681)	(0.00885)	(0.0451)	(0.00104)	(0.000250)	(0.000596)
Maturity^2	0.00506***	0.00340***	0.0146***	-7.84e-05***	-1.19e-05***	-2.51e-06
	(0.000918)	(6.39e-05)	(0.000426)	(8.84e-06)	(1.46e-06)	(1.56e-06)
Log of loan	-2.486***	-3.111***	-1.590***	-0.585***	-0.468***	-0.454***
	(0.120)	(0.0383)	(0.0814)	(0.00455)	(0.00394)	(0.00503)
No income	111.5***	49.13***	24.01***	2.253***	4.285***	2.235***
	(0.948)	(0.736)	(0.777)	(0.0323)	(0.0324)	(0.0770)
Up to 1 mw	66.81***	45.25***	70.48***	2.250***	3.205***	2.129***
	(0.456)	(0.368)	(0.826)	(0.0314)	(0.0229)	(0.0653)
From 1 to 2 mw	53.62***	35.78***	38.58***	1.910***	3.335***	2.378***
	(0.384)	(0.222)	(0.557)	(0.0311)	(0.0224)	(0.0624)
From 2 to 3 mw	42.50***	23.04***	30.00***	1.701***	3.067***	2.163***
	(0.352)	(0.212)	(0.533)	(0.0309)	(0.0226)	(0.0635)
From 3 to 5 mw	29.50***	15.19***	24.57***	1.387***	2.731***	1.934***
	(0.331)	(0.196)	(0.517)	(0.0311)	(0.0223)	(0.0631)
From 5 to 10 mw	15.40***	8.525***	16.65***	1.084***	1.968***	1.431***
	(0.284)	(0.167)	(0.464)	(0.0313)	(0.0219)	(0.0619)
From 10 to 20 mw	4.838***	1.818***	6.904***	0.158***	0.917***	0.578***
	(0.194)	(0.127)	(0.437)	(0.0260)	(0.0197)	(0.0646)
Retired	1.201***	0.623***	1.103**	-0.852***	-1.595***	-2.014***
	(0.171)	(0.134)	(0.473)	(0.0150)	(0.0222)	(0.0345)
Civil Serv	-11.96***	-9.046***	-6.925***	-2.563***	-2.989***	-3.460***
	(0.237)	(0.138)	(0.318)	(0.0192)	(0.0284)	(0.0423)
Informal	5.556***	1.635***	2.272***			
	(0.0916)	(0.0873)	(0.205)			
Age	1.223***	0.669***	1.622***	0.00334***	-0.0118***	-0.0668***
	(0.0158)	(0.0115)	(0.0355)	(0.00111)	(0.00149)	(0.00286)
Age^2	-0.0110***	-0.00821***	-0.0151***	0.000116***	0.000105***	0.000504***
	(0.000165)	(0.000122)	(0.000404)	(9.19e-06)	(1.25e-05)	(2.51e-05)
Female	10.05***	3.489***	6.850***	-0.00607*	0.00115	-0.0135
	(0.0844)	(0.0520)	(0.165)	(0.00332)	(0.00386)	(0.00974)
Constant	105.0***	98.38***	116.1***	29.38***	30.74***	34.48***
	(0.651)	(0.399)	(1.073)	(0.0704)	(0.0851)	(0.122)
Observations	11,000,832	7,679,462	1,326,288	10,554,285	8,575,777	921,572
R-squared	0.333	0.212	0.351	0.270	0.249	0.257
Munic.xTime FE	YES	YES	YES	YES	YES	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated coefficients for income dummies are relative to those earning more than 20 mw. Estimated coefficient for occupations are relative to formal workers.

A.3 Interest rates and individual characteristics for formal employees

In this subsection in order to check how attrition affects our results presented in Section 2 of the paper, we consider only the regression results with the sample of individuals who appear in the RAIS dataset - the sample is similar to the one used in regressions (6) and (7) of Tables 1 and 2. Results are presented in Table A5 for personal loans and Table A6 for payroll loans. We can observe that the patterns of how income and interest rates vary are similar when we consider the whole sample or only individuals who are formal workers.

Table A5: Interest rates and individual characteristics - Personal loans (subsample: formal workers)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate
Maturity	-2.153***	-2.133***	-2.175***	-2.242***	-2.278***	-2.165***	-2.210***
	(0.0205)	(0.0215)	(0.0176)	(0.0219)	(0.0175)	(0.0234)	(0.0188)
Maturity^2	0.0112***	0.0112***	0.0116***	0.0118***	0.0122***	0.0119***	0.0124***
	(0.000255)	(0.000264)	(0.000196)	(0.000274)	(0.000200)	(0.000294)	(0.000218)
Log of loan	-4.291***	-4.216***	-4.019***	-3.309***	-3.133***	-4.060***	-3.860***
	(0.0580)	(0.0593)	(0.0602)	(0.0603)	(0.0615)	(0.0611)	(0.0613)
No income	88.16***	81.72***	84.35***	85.38***	87.64***	77.59***	80.22***
	(1.306)	(1.272)	(1.380)	(1.300)	(1.407)	(1.273)	(1.381)
Up to 1 mw	58.02***	50.93***	52.83***	57.42***	59.02***	46.33***	48.22***
	(0.441)	(0.445)	(0.472)	(0.437)	(0.462)	(0.436)	(0.463)
From 1 to 2 mw	37.68***	32.76***	33.76***	37.49***	38.29***	28.18***	29.18***
	(0.332)	(0.334)	(0.349)	(0.332)	(0.345)	(0.325)	(0.340)
From 2 to 3 mw	28.90***	25.66***	26.23***	29.23***	29.69***	21.50***	22.08***
	(0.324)	(0.322)	(0.337)	(0.326)	(0.341)	(0.312)	(0.327)
From 3 to 5 mw	19.39***	16.75***	17.28***	20.04***	20.49***	13.31***	13.85***
	(0.315)	(0.314)	(0.329)	(0.318)	(0.332)	(0.306)	(0.321)
From 5 to 10 mw	9.863***	8.152***	8.532***	10.50***	10.86***	5.853***	6.226***
	(0.294)	(0.293)	(0.305)	(0.295)	(0.308)	(0.287)	(0.299)
From 10 to 20 mw	0.202	-0.222	-0.0210	0.436	0.687**	-0.447	-0.284
	(0.278)	(0.276)	(0.287)	(0.278)	(0.289)	(0.281)	(0.292)
Age	0.274***	0.153***	0.158***	0.450***	0.458***	0.187***	0.192***
	(0.0283)	(0.0280)	(0.0291)	(0.0284)	(0.0296)	(0.0280)	(0.0291)
Age^2	-0.00124***	0.000703**	0.000818**	-0.00261***	-0.00249***	6.11e-05	0.000167
	(0.000360)	(0.000355)	(0.000369)	(0.000359)	(0.000373)	(0.000356)	(0.000370)
Female	2.956***	3.610***	3.669***	3.644***	3.760***	3.920***	3.981***
	(0.102)	(0.102)	(0.105)	(0.102)	(0.106)	(0.101)	(0.105)
Pr. default (personal)				41.96***	43.26***		
				(0.646)	(0.681)		
Fin. Literacy						-1.335***	-1.317***
						(0.0146)	(0.0141)
Constant	135.5***	184.1***	182.8***	122.5***	120.4***	187.3***	186.0***
	(0.705)	(1.114)	(1.163)	(0.738)	(0.789)	(1.114)	(1.163)
Observations	2,651,533	2,651,533	2,556,358	2,651,533	2,556,358	2,651,533	2,556,358
R-squared	0.275	0.291	0.328	0.280	0.318	0.294	0.331
Risk dummies	NO	YES	YES	NO	NO	YES	YES
Time FE	YES	YES	NO	YES	NO	YES	NO
Munic. FE	YES	YES	NO	YES	NO	YES	NO
Munic.xTime FE	NO	NO	YES	NO	YES	NO	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Estimated coefficients for income dummies are relative to those earning more than 20 mw.

Table A6: Interest rates and individual characteristics - Payroll loans (subsample: formal employees)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate
Maturity	0.0825***	0.0698***	0.0691***	0.0771***	0.0765***	0.0695***	0.0687***
	(0.00138)	(0.00133)	(0.00140)	(0.00140)	(0.00149)	(0.00134)	(0.00142)
Maturity^2	-0.00102***	-0.000983***	-0.000995***	-0.000992***	-0.00100***	-0.000978***	-0.000988***
	(1.14e-05)	(1.09e-05)	(1.16e-05)	(1.14e-05)	(1.22e-05)	(1.10e-05)	(1.18e-05)
Log of loan	-0.392***	-0.300***	-0.293***	-0.333***	-0.327***	-0.289***	-0.281***
	(0.00952)	(0.00909)	(0.00993)	(0.00944)	(0.0103)	(0.00898)	(0.00982)
No income	2.969***	3.798***	3.888***	2.867***	2.879***	3.504***	3.594***
	(0.119)	(0.112)	(0.120)	(0.119)	(0.127)	(0.116)	(0.124)
Up to 1 mw	3.021***	3.567***	3.645***	2.983***	2.994***	3.254***	3.331***
	(0.104)	(0.0946)	(0.0999)	(0.103)	(0.109)	(0.0999)	(0.106)
From 1 to 2 mw	2.960***	3.230***	3.316***	2.947***	2.995***	2.909***	2.992***
	(0.103)	(0.0944)	(0.0995)	(0.102)	(0.108)	(0.0997)	(0.105)
From 2 to 3 mw	2.729***	2.923***	2.977***	2.747***	2.769***	2.630***	2.681***
	(0.100)	(0.0923)	(0.0971)	(0.0994)	(0.105)	(0.0974)	(0.102)
From 3 to 5 mw	2.362***	2.461***	2.514***	2.403***	2.435***	2.252***	2.305***
	(0.103)	(0.0954)	(0.101)	(0.102)	(0.107)	(0.0998)	(0.105)
From 5 to 10 mw	1.863***	1.833***	1.871***	1.897***	1.930***	1.651***	1.688***
	(0.0996)	(0.0932)	(0.0980)	(0.0989)	(0.104)	(0.0973)	(0.102)
From 10 to 20 mw	1.372***	1.274***	1.303***	1.394***	1.419***	1.248***	1.277***
	(0.101)	(0.0939)	(0.0986)	(0.100)	(0.105)	(0.0959)	(0.101)
Age	-0.00122	0.00933**	0.0181***	0.0232***	0.0308***	0.00441	0.0134***
	(0.00405)	(0.00399)	(0.00415)	(0.00415)	(0.00431)	(0.00397)	(0.00413)
Age^2	-0.000473***	-0.000566***	-0.000679***	-0.000683***	-0.000781***	-0.000536***	-0.000652***
	(4.74e-05)	(4.65e-05)	(4.83e-05)	(4.81e-05)	(5.00e-05)	(4.65e-05)	(4.83e-05)
Female	-0.367***	-0.426***	-0.433***	-0.304***	-0.303***	-0.394***	-0.400***
	(0.0149)	(0.0142)	(0.0149)	(0.0144)	(0.0151)	(0.0140)	(0.0146)
Pr. default (payroll)				7.674***	8.133***		
				(0.126)	(0.133)		
Fin. Literacy						-0.102***	-0.102***
						(0.00287)	(0.00297)
Constant	28.37***	28.40***	28.23***	27.25***	27.08***	28.78***	28.60***
	(0.177)	(0.174)	(0.186)	(0.175)	(0.187)	(0.181)	(0.194)
Observations	1,310,182	1,310,182	1,234,327	1,310,182	1,234,327	1,310,182	1,234,327
R-squared	0.144	0.180	0.216	0.148	0.183	0.183	0.219
Risk dummies	NO	YES	YES	NO	NO	YES	YES
Time FE	YES	YES	NO	YES	NO	YES	NO
Munic. FE	YES	YES	NO	YES	NO	YES	NO
Munic.xTime FE	NO	NO	YES	NO	YES	NO	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated coefficients for income dummies are relative to those earning more than 20 mw. Estimated coefficient for occupations are relative to formal workers.

A.4 Individual Fixed Effects

For formal workers we can also control for time-invariant individual fixed effects, which might capture individual characteristics that financial intermedi-

aries might not observe, such as individual propensity to default. We use the monthly income by RAIS, which contains much more time variability than the income brackets provided by the SCR. In fact, the income dummies drop once we use the SCR income dummies and control for individual fixed effects. Results for personal loans are presented in Table A7 - see Columns (1) and (2). For comparison, we also present regressions with similar regressors but without the fixed effects control - see Columns (3)-(6).

Table A7: Interest Rates and Individual Characteristics - Personal loans

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate
Maturity	-2.585***	-2.585***	-3.377***	-3.421***	-3.456***	-3.505***
	(0.0340)	(0.0340)	(0.0389)	(0.0414)	(0.0308)	(0.0325)
Maturity^2	0.0157***	0.0157***	0.0197***	0.0206***	0.0205***	0.0215***
	(0.000426)	(0.000426)	(0.000494)	(0.000533)	(0.000362)	(0.000391)
Log of loan	1.063***	1.064***	-3.577***	-3.301***	-3.431***	-3.144***
	(0.100)	(0.100)	(0.102)	(0.105)	(0.103)	(0.105)
Wage (RAIS)	-0.000235***	-0.000231***	-0.00397***	-0.00342***	-0.00397***	-0.00342***
	(4.08e-05)	(4.08e-05)	(6.76e-05)	(6.18e-05)	(6.82e-05)	(6.26e-05)
Wage (RAIS)^2	7.02e-10***	6.91e-10***	1.53e-08***	1.32e-08***	1.52e-08***	1.31e-08***
	(1.28e-10)	(1.28e-10)	(8.22e-10)	(7.26e-10)	(8.12e-10)	(7.18e-10)
Age	4.967***	4.970***	-1.696***	-1.641***	-1.768***	-1.711***
	(0.274)	(0.274)	(0.0516)	(0.0516)	(0.0536)	(0.0535)
Age^2	0.0346***	0.0345***	0.0325***	0.0316***	0.0338***	0.0329***
	(0.00344)	(0.00344)	(0.000690)	(0.000691)	(0.000715)	(0.000716)
Fin. Literacy		-0.107***		-1.698***		-1.687***
		(0.0394)		(0.0200)		(0.0188)
Female			12.36***	12.83***	12.42***	12.89***
			(0.175)	(0.176)	(0.181)	(0.182)
Constant	-51.26***	-51.23***	313.4***	310.6***	314.7***	311.8***
	(6.254)	(6.254)	(1.775)	(1.778)	(1.837)	(1.842)
Observations	2,665,503	2,665,503	2,689,149	2,689,149	2,594,005	2,594,005
R-squared	0.814	0.814	0.190	0.191	0.230	0.231
Risk dummies	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	NO	NO
Indiv. FE	YES	YES	NO	NO	NO	NO
Munic. FE	NO	NO	YES	YES	NO	NO
Munic.xTime FE	NO	NO	NO	NO	YES	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Although most payroll loans are primarily directed to civil servants and retirees, we also run the regressions for formal workers who have access to a payroll loan. This corresponds to less than 8% in our sample and therefore the sample is far for being representative for payroll loans. We observe that the

relationship between formal wage income and interest rate becomes positive once we control for individual fixed effects - Columns (1) and (2); while this relationship is negative when we do not control for individual fixed effects - Columns (3) and (6).

Table A8: Interest Rates and Individual Characteristics - Payroll loans

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate
Maturity	0.147***	0.147***	0.0520***	0.0523***	0.0508***	0.0510***
	(0.00483)	(0.00483)	(0.00292)	(0.00309)	(0.00292)	(0.00309)
Maturity^2	-0.00154***	-0.00154***	-0.00171***	-0.00174***	-0.00169***	-0.00172***
	(3.55e-05)	(3.55e-05)	(2.63e-05)	(2.76e-05)	(2.63e-05)	(2.76e-05)
Log of loan	0.238***	0.238***	0.0208	0.0478**	0.0408**	0.0635***
	(0.0182)	(0.0182)	(0.0201)	(0.0213)	(0.0201)	(0.0214)
Wage (RAIS)	0.000158***	0.000158***	-0.000552***	-0.000663***	-0.000472***	-0.000575***
	(2.66e-05)	(2.66e-05)	(1.66e-05)	(1.59e-05)	(1.54e-05)	(1.52e-05)
Wage (RAIS)^2	-1.91e-09***	-1.91e-09***	5.03e-09***	9.55e-09***	4.39e-09***	8.48e-09***
	(3.77e-10)	(3.77e-10)	(6.46e-10)	(6.33e-10)	(5.78e-10)	(5.76e-10)
Age	2.650***	2.650***	0.430***	0.462***	0.419***	0.450***
	(0.0909)	(0.0909)	(0.0102)	(0.0104)	(0.0101)	(0.0103)
Age^2	-0.0235***	-0.0235***	-0.00645***	-0.00680***	-0.00636***	-0.00671***
	(0.00103)	(0.00103)	(0.000121)	(0.000124)	(0.000120)	(0.000123)
Fin. Literacy		0.000350			-0.252***	-0.242***
		(0.00704)			(0.00300)	(0.00304)
Female			-1.236***	-1.241***	-1.147***	-1.151***
			(0.0298)	(0.0299)	(0.0299)	(0.0299)
Constant	-37.15***	-37.15***	34.82***	34.48***	34.90***	34.59***
	(2.171)	(2.171)	(0.317)	(0.334)	(0.316)	(0.333)
Observations	1,688,832	1,688,832	1,695,284	1,616,982	1,695,284	1,616,982
R-squared	0.590	0.590	0.151	0.215	0.153	0.216
Risk dummies	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	NO	YES	NO
Indiv. FE	YES	YES	NO	NO	NO	NO
Munic. FE	NO	NO	YES	NO	YES	NO
Munic.xTime FE	NO	NO	NO	YES	NO	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

A.5 Bankruptcy

We use the standard international definition of non-performing loans (NPLs), that is, a 90-day past-due threshold. In Brazil, after some days of delinquency (usually 45 days, depending on each bank's rules), the default credit record of an individual is sent to Serasa (a credit bureau that keeps a record of all delinquent individuals), and this credit record is accessible to other banks. Therefore, if a client becomes delinquent in one bank, all the other banks will know this

information. In general, after a client becomes delinquent in a type of credit, all the other types of credit are shut down for this individual. According to the Consumer Protection Code (**Law No. 8078/90**), after five years, this negative credit record is canceled, and the consumer will be able to acquire new bank credit. This is the approach taken in the model.

A.6 Description of Data Moments

- Debt-to-Income (ex-housing): This data has been reported monthly since March 2005 by the Brazilian Central Bank. The debt-to-income ratio is the value corresponding to the expected payments for debt service with the Banking System and the monthly income of families in a quarterly moving average, seasonally adjusted.

- Households Using Debt: This is a survey[22], and it has been reported monthly by Confederação Nacional da Indústria (CNC) since January 2010. This survey aims to draw a profile of indebtedness in Brazil, following the level of commitment of consumers with debts and their perception of their ability to pay.

- Real interest rate: The real interest rate is calculated using the effective nominal interest rate (Selic) per annum and the 12-month rolling average of the inflation rate (IPCA). The nominal interest rate is available at the Brazilian Central Bank, and the inflation rate is released by IBGE.

- Income Gini index: Data for 2020 from the World Bank. World Development Indicators.

- Wealth share, top 10%: Data for 2019 from the World Inequality Database (WID). Available at https://wid.world/country/brazil/.

- Income share, top 10%: Data for 2019 from the World Inequality Database (WID). Available at https://wid.world/country/brazil/.

- Wealth-income ratio: Data for 2019 from the World Inequality Database (WID). Available at https://wid.world/country/brazil/.

[22]This survey is called Pesquisa Endividamento e Inadimplência do Consumidor (PEIC).

A.7 Wedges

Here we present the regression results for the interest rate wedge using our credit register data. For each type of loans, i.e., personal and payroll, we proceed in the following steps:

- First, we run a logit regression of default on loan characteristics (maturity, maturity squared, log of loan, risk), personal characteristics (income, occupation, gender, age) and fixed effects of time and municipality. Then we get predicted the predicted probability of default.
- With the predicted probability of default we calculate the risk-cost-free rate for each individual and then the calculate the interest wedge (actual rate-risk-cost-free rate).
- We then run a regression of the wedge on observable characteristics, such as those presented in Tables A9 and A10.

For the wedges used in the calibration, we consider the regression presented in column (2) of Tables A9 (personal) and A10 (payroll). Since the wedge corresponds to all costs not related to default, we set the risk dummy at the highest risk score (i.e., AA) to construct the wedge. For personal loans, this decreases the constant by 79.78pp, while for payroll loans there is a minor change in the constant. Since our model period is one year, we let maturity to be equal to 12 months. The wedge still vary by income, age, occupation and loan size, as described by the regression coefficients of Column (2) of Tables A9 and A10.

Table A9: Wedges and individual characteristics - Personal loans

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Loan rate	Loan rate	Loan rate	Loan rate	Loan rate
Maturity	-1.907***	-1.827***	-1.827***	-2.132***	-2.177***
	(0.0945)	(0.0944)	(0.0948)	(0.0209)	(0.0168)
Maturity^2	0.00763***	0.00749***	0.00745***	0.0124***	0.0128***
	(0.00111)	(0.00111)	(0.00111)	(0.000250)	(0.000185)
Log of loan	-4.065***	-4.254***	-4.147***	-3.586***	-3.401***
	(0.141)	(0.142)	(0.143)	(0.0574)	(0.0574)
No income	85.83***	75.15***	77.31***	73.42***	75.72***
	(0.737)	(0.708)	(0.727)	(1.191)	(1.285)
Up to 1 mw	60.94***	49.50***	50.40***	46.68***	48.34***
	(0.479)	(0.500)	(0.502)	(0.409)	(0.433)
From 1 to 2 mw	43.94***	37.40***	38.07***	29.00***	29.90***
	(0.385)	(0.389)	(0.391)	(0.295)	(0.308)
From 2 to 3 mw	32.04***	27.13***	27.65***	22.53***	23.09***
	(0.320)	(0.319)	(0.321)	(0.283)	(0.296)
From 3 to 5 mw	21.52***	17.66***	18.15***	14.62***	15.17***
	(0.250)	(0.243)	(0.244)	(0.274)	(0.287)
From 5 to 10 mw	10.51***	8.469***	8.839***	7.216***	7.523***
	(0.182)	(0.166)	(0.167)	(0.259)	(0.270)
From 10 to 20 mw	1.926***	1.135***	1.513***	0.591**	0.693***
	(0.122)	(0.119)	(0.119)	(0.251)	(0.260)
Retired	0.395***	0.910***	1.189***	-3.682***	-3.747***
	(0.125)	(0.121)	(0.121)	(0.401)	(0.417)
Civil Serv	-12.12***	-7.871***	-7.471***	-9.582***	-9.196***
	(0.182)	(0.172)	(0.171)	(0.162)	(0.162)
Informal	3.373***	3.336***	3.598***		
	(0.0693)	(0.0678)	(0.0664)		
Age	1.271***	1.253***	1.269***	0.339***	0.338***
	(0.0113)	(0.0111)	(0.0112)	(0.0262)	(0.0273)
Age^2	-0.0127***	-0.0120***	-0.0121***	-0.00148***	-0.00128***
	(0.000118)	(0.000113)	(0.000113)	(0.000329)	(0.000342)
Female	7.879***	8.636***	8.647***	4.273***	4.342***
	(0.0623)	(0.0607)	(0.0611)	(0.0946)	(0.0977)
Fin. Literacy				-1.345***	-1.328***
				(0.0135)	(0.0133)
Constant	102.8***	143.1***	141.4***	141.8***	140.7***
	(0.394)	(0.683)	(0.691)	(1.071)	(1.115)
Observations	20,483,498	20,483,498	20,464,737	2,984,011	2,888,871
R-squared	0.273	0.295	0.307	0.287	0.323
Risk control	NO	YES	YES	YES	YES
Time FE	YES	YES	NO	YES	NO
Munic. FE	YES	YES	NO	YES	NO
Munic.xTime FE	NO	NO	YES	NO	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated coefficients for income dummies are relative to those earning more than 20 mw. Estimated coefficient for occupations are relative to formal workers.

Table A10: Wedges and individual characteristics - Payroll loans

	(1)	(2)	(3)	(4)	(5)
VARIABLES	wedge	wedge	wedge	wedge	wedge
Maturity	0.00824***	0.00978***	0.00965***	-0.00483	-0.000357
	(0.000300)	(0.000300)	(0.000301)	(0.00920)	(0.0113)
Maturity^2	-3.25e-05***	-3.43e-05***	-3.41e-05***	-0.000173**	-0.000223**
	(2.04e-06)	(2.09e-06)	(2.10e-06)	(8.19e-05)	(0.000101)
Log of loan	-0.460***	-0.497***	-0.496***	-0.336***	-0.336***
	(0.00381)	(0.00370)	(0.00375)	(0.00977)	(0.0114)
No income	2.509***	2.543***	2.561***	2.819***	2.816***
	(0.0232)	(0.0247)	(0.0249)	(0.0975)	(0.106)
Up to 1 mw	2.534***	2.499***	2.509***	3.010***	3.021***
	(0.0229)	(0.0243)	(0.0243)	(0.0831)	(0.0916)
From 1 to 2 mw	2.427***	2.406***	2.415***	2.854***	2.880***
	(0.0231)	(0.0241)	(0.0241)	(0.0787)	(0.0853)
From 2 to 3 mw	2.242***	2.242***	2.247***	2.706***	2.708***
	(0.0227)	(0.0238)	(0.0238)	(0.0758)	(0.0818)
From 3 to 5 mw	1.953***	1.970***	1.983***	2.439***	2.432***
	(0.0224)	(0.0235)	(0.0235)	(0.0772)	(0.0830)
From 5 to 10 mw	1.481***	1.485***	1.494***	1.878***	1.863***
	(0.0219)	(0.0233)	(0.0232)	(0.0733)	(0.0780)
From 10 to 20 mw	0.502***	0.491***	0.501***	1.231***	1.213***
	(0.0183)	(0.0188)	(0.0187)	(0.0684)	(0.0717)
Retired (payroll)	-0.852***	-0.886***	-0.893***	0.161***	0.161***
	(0.0151)	(0.0154)	(0.0157)	(0.0190)	(0.0203)
Civil Serv (payroll)	-2.511***	-2.563***	-2.574***	-2.073***	-2.131***
	(0.0201)	(0.0203)	(0.0208)	(0.0205)	(0.0219)
Age	0.0511***	0.0516***	0.0514***	0.0359***	0.0403***
	(0.00107)	(0.00111)	(0.00112)	(0.00313)	(0.00327)
Age^2	-0.000422***	-0.000427***	-0.000425***	-0.000672***	-0.000736***
	(9.15e-06)	(9.53e-06)	(9.64e-06)	(3.57e-05)	(3.72e-05)
Female	0.102***	0.0874***	0.0879***	-0.232***	-0.237***
	(0.00276)	(0.00276)	(0.00277)	(0.0118)	(0.0125)
Fin. Literacy				-0.0868***	-0.0863***
				(0.00248)	(0.00255)
Constant	17.82***	16.06***	16.08***	14.97***	14.79***
	(0.0645)	(0.0712)	(0.0725)	(0.173)	(0.194)
Observations	20,524,507	20,524,507	20,506,221	1,864,303	1,777,400
R-squared	0.486	0.498	0.507	0.335	0.360
Risk control	NO	YES	YES	YES	YES
Time FE	YES	YES	NO	YES	NO
Munic. FE	YES	YES	NO	YES	NO
Munic.xTime FE	NO	NO	YES	NO	YES

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Estimated coefficients for income dummies are relative to those earning more than 20 mw. Estimated coefficient for occupations are relative to formal workers.

A.8 Decomposition of the Variance of the Error

In Section 2 we run regressions of the loan interest rates on a very rich set of loan and borrower characteristics. Despite these characteristics being a very rich set of variables, they explain at most 33% and 23% of the observed variability in loan interest rates for personal and payroll loans, respectively. In this appendix, we aim to understand plausible factors that could explain the remaining 67% and 77% of the variation in loan interest rates. We therefore look at the variance of the residual. The idea is that for some types of borrower-loan observations the variance of the error can be small (e.g. civil servants) – with almost no heterogeneity, while for others (e.g. informal workers) the variance can be large. Consequently, the regression of the variance of the residual on observable characteristics gives us this information. This regression can be interpreted as a decomposition of the variance of error since the unconditional variance of the error is the weighted average of the conditional variance of the error over covariates. Results are reported in Table A11 for personal loans and Table A12 for payroll loans.

Table A11: Personal loans

	(1)	(2)	(3)
VARIABLES	Res. Var.	Res. Var.	Res. Var.
Maturity	-1,922***	-1,938***	-2,006***
	(380.7)	(382.1)	(383.2)
Maturity^2	20.96***	21.11***	21.56***
	(4.504)	(4.513)	(4.496)
Log of loan	1,799***	1,813***	3,185***
	(425.3)	(427.5)	(570.4)
No income			15,648***
			(827.4)
Up to 1 mw			13,635***
			(1,461)
From 1 to 2 mw			10,812***
			(1,306)
From 2 to 3 mw			8,411***
			(1,023)
From 3 to 5 mw			5,867***
			(697.2)
From 5 to 10 mw			2,996***
			(365.3)
From 10 to 20 mw			1,147***
			(176.9)
Retired (personal)			1,051***
			(187.9)
Civil Serv (personal)			-1,929***
			(529.0)
Informal (personal)			699.3***
			(33.66)
Age			301.9***
			(15.17)
Age^2			-2.448***
			(0.138)
Female			1,491***
			(99.08)
Pr. default (personal)	18,499***	18,562***	18,070***
	(1,106)	(1,110)	(897.1)
Constant	19,308***	19,450***	-6,597***
	(1,881)	(1,888)	(378.1)
Observations	20,464,730	20,464,737	20,464,737
R-squared	0.345	0.351	0.366
Time FE	YES	NO	NO
Munic. FE	YES	NO	NO
Munic.xTime FE	NO	YES	YES

Notes: Robust standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1. Estimated coefficients for income dummies are relative to those earning more than 20 mw. Estimated coefficient for occupations are relative to formal workers.

Table A12: Payroll loans

	(1)	(2)	(3)
VARIABLES	Res. Var.	Res. Var.	Res. Var.
Maturity	-0.194***	-0.193***	-0.108***
	(0.00283)	(0.00285)	(0.00172)
Maturity^2	0.000728***	0.000728***	0.000573***
	(1.64e-05)	(1.65e-05)	(9.37e-06)
Log of loan	1.508***	1.515***	-0.451***
	(0.0145)	(0.0147)	(0.0134)
No income			-10.62***
			(0.131)
Up to 1 mw			-9.704***
			(0.117)
From 1 to 2 mw			-8.507***
			(0.119)
From 2 to 3 mw			-5.338***
			(0.122)
From 3 to 5 mw			-4.425***
			(0.121)
From 5 to 10 mw			-3.540***
			(0.117)
From 10 to 20 mw			-1.937***
			(0.109)
Retired (payroll)			-18.40***
			(0.0975)
Civil Serv (payroll)			-13.54***
			(0.136)
Age			-0.355***
			(0.00749)
Age^2			0.00196***
			(5.93e-05)
Female			0.381***
			(0.0176)
Pr. default (payroll)	8.559***	8.333***	8.965***
	(0.249)	(0.249)	(0.256)
Constant	11.54***	11.43***	59.28***
	(0.135)	(0.135)	(0.398)
Observations	20,506,214	20,506,221	20,506,221
R-squared	0.035	0.055	0.099
Time FE	YES	NO	NO
Munic. FE	YES	NO	NO
Munic.xTime FE	NO	YES	YES

Notes: Robust standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1. Estimated coefficients for income dummies are relative to those earning more than 20 mw. Estimated coefficient for occupations are relative to formal workers.

A.9 Default

Table A13: Defautl by income - Personal loans

	N	mean	sd	p10	p50	p90
			No income			
Rate (personal)	286392	176.36	162.47	34.49	122.71	457.78
Default (personal)	286392	0.13	0.34	0.00	0.00	1.00
			Up to 1 mw			
Rate (personal)	3463517	205.84	244.82	40.10	128.78	551.29
Default (personal)	3463517	0.08	0.27	0.00	0.00	0.00
			From 1 to 2 mw			
Rate (personal)	5878785	174.14	220.72	38.48	109.10	381.28
Default (personal)	5878785	0.08	0.27	0.00	0.00	0.00
			From 2 to 3 mw			
Rate (personal)	3651135	140.82	187.96	32.76	90.12	233.20
Default (personal)	3651135	0.06	0.24	0.00	0.00	0.00
			From 3 to 5 mw			
Rate (personal)	3521102	125.94	182.91	29.08	77.54	186.89
Default (personal)	3521102	0.05	0.21	0.00	0.00	0.00
			From 5 to 10 mw			
Rate (personal)	2978184	96.40	144.59	25.19	64.59	151.53
Default (personal)	2978184	0.04	0.18	0.00	0.00	0.00
			From 10 to 20 mw			
Rate (personal)	1216717	73.67	107.35	20.70	54.65	119.97
Default (personal)	1216717	0.03	0.18	0.00	0.00	0.00
			+10 mw			
Rate (personal)	1783721	69.60	99.45	19.56	52.34	113.38
Default (personal)	1783721	0.03	0.17	0.00	0.00	0.00
			+20 mw			
Rate (personal)	567004	60.87	79.21	17.46	46.68	104.43
Default (personal)	567004	0.03	0.17	0.00	0.00	0.00

Table A14: Defautl by income - Payroll loans

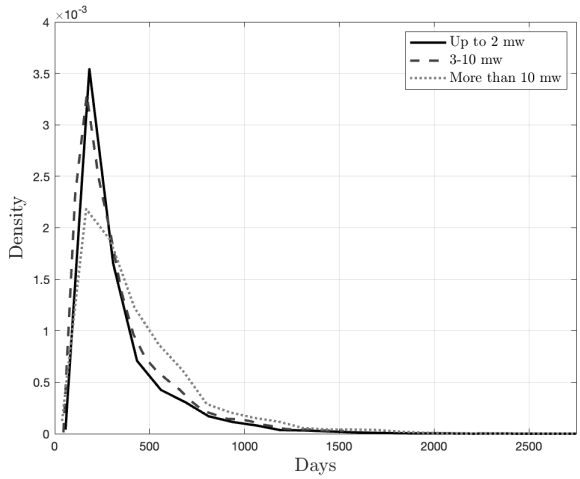
	N	mean	sd	p10	p50	p90
			No income			
Rate (payroll)	620403	28.55	3.56	24.90	28.78	31.84
Default (payroll)	620403	0.04	0.18	0.00	0.00	0.00
			Up to 1 mw			
Rate (payroll)	5280156	28.93	14.51	24.16	28.74	31.99
Default (payroll)	5280156	0.02	0.15	0.00	0.00	0.00
			From 1 to 2 mw			
Rate (payroll)	5599994	28.70	9.55	22.28	28.32	31.99
Default (payroll)	5599994	0.02	0.15	0.00	0.00	0.00
			From 2 to 3 mw			
Rate (payroll)	2640289	27.99	10.06	20.84	27.90	33.70
Default (payroll)	2640289	0.02	0.13	0.00	0.00	0.00
			From 3 to 5 mw			
Rate (payroll)	3223064	26.95	9.11	20.11	26.68	32.77
Default (payroll)	3223064	0.02	0.12	0.00	0.00	0.00
			From 5 to 10 mw			
Rate (payroll)	2508538	25.76	9.19	18.99	25.05	32.45
Default (payroll)	2508538	0.01	0.11	0.00	0.00	0.00
			From 10 to 20 mw			
Rate (payroll)	883808	24.36	8.42	17.45	23.58	31.47
Default (payroll)	883808	0.01	0.09	0.00	0.00	0.00
			+10 mw			
Rate (payroll)	1179718	24.23	8.30	17.31	23.43	31.53
Default (payroll)	1179718	0.01	0.10	0.00	0.00	0.00
			+20 mw			
Rate (payroll)	295910	23.83	7.93	16.76	22.84	31.66
Default (payroll)	295910	0.01	0.10	0.00	0.00	0.00

A.10 Time-to-Default (in days)

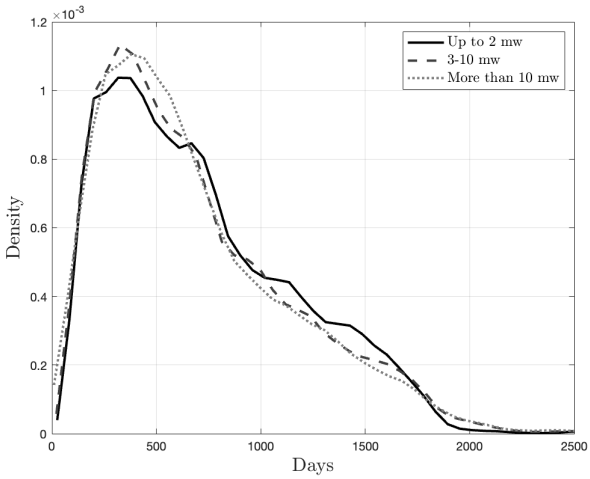
Figure A5 depicts the density of the time (in days) when defaults occur for personal loans (Panel (a)) and payroll loans (Panel (b)) across different income levels for 2015. For personal loans, most defaults occur at the beginning of the debt contract. For this type of credit, there is almost no difference in the time-

Figure A5: Time-to-Default for 2015

(a) Personal Loans



(b) Payroll Loans



Notes: Panel (a) and Panel (b) display the time-to-default for personal loans and payroll loans, respectively.

to-default for individuals earning up to 2 minimum wages and those earning between 3 and 10 minimum wages. For individuals earning more than 10 minimum wages, there is a higher density in later periods.

For payroll loans, the time-to-default is more evenly distributed over the duration of loan contracts. In addition, there is almost no difference in the shape of time-to-default densities across different income groups.

B Simple Model of Banking

This section reports a simplified (toy) model in which a finite number N of banks strategically compete à la Cournot to offer loans ℓ to consumers of a given income level y. Consumers only value consumption today but have a one unit of the consumption good in the future against which they can borrow resources now. These consumers can exert effort n in order to shop around for a better interest rate, such that the interest rate is R/n.

Assuming logarithmic utility in consumption and quasi-linearity in shopping effort, the consumer's problem reads:

$$\max_{c,\ell} \log c - n$$
$$\text{s.t. } c = y + \frac{1}{R/n}.$$

The solution to this problem yields $n = 1 - Ry$ and $\ell = (1 - Ry)/R$. The elasticity ϵ of the loan with respect to the interest rate R is given by:

$$\epsilon(R, y) = \frac{1}{1 - Ry}.$$

Hence, high-income individuals are more elastic with respect to the interest rate charged by banks.

Consider now the problem of the banks. Banks are homogeneous and compete à la Cournot. The only cost a bank faces when issuing a loan is given by the interest rate it pays to its depositors, $\bar{R}$. Hence, bank i's problem can be written as follows:

$$\max_{\ell} \left[R\left(\ell_i + \sum_{j \neq i} \ell_j, y \right) - \bar{R} \right] \ell_i,$$

where, with a slight abuse of notation, $R(\ell, y)$ represents the inverse demand function for loans.

Since banks are homogeneous, the symmetric Nash equilibrium yields the following:

$$\frac{R - \bar{R}}{R} = \frac{1}{N\epsilon(R, y)},$$

where $\epsilon(R)$ is the elasticity of the loan demand with respect to the interest rate.

According to the consumer's problem, the elasticity increases with the individual's income. Hence, the interest rate spread is lower for high-income borrowers. This is consistent with the interest rate wedges in the quantitative model in the main text that decline with income. Moreover, a more competitive market (higher N) also leads to lower interest rates. The loan portability reform introduced in Brazil in 2013 (Section 6) led to lower interest rates. Through the lens of this simple model, such a reform can be thought of as allowing borrowers to interact with more banks (higher N) and accessing lower rates.

C More Quantitative Results

C.1 Model Dynamics

Figure C6 shows the benchmark asset distribution by income and age in the model, as well as the debt use distribution by income and age. We do not have such counterparts in the data and therefore we are not able to compare the fit of such distributions. Assets rise with income and with age until retirement. Debt use falls with income and is larger for young individuals.

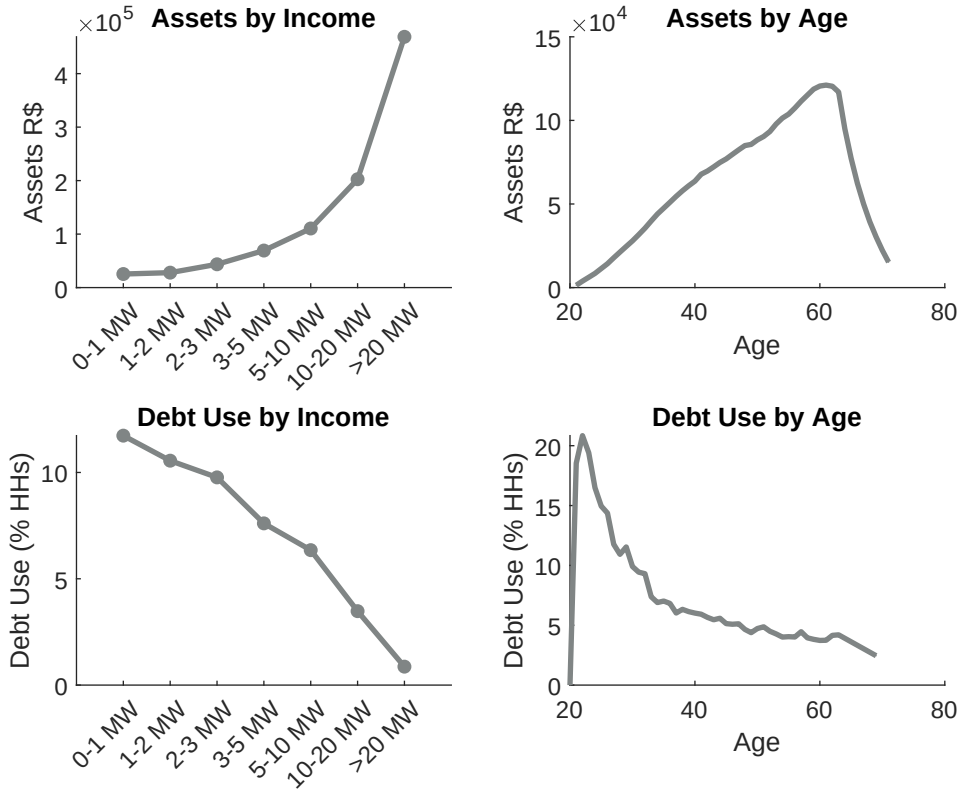


Figure C6: Assets and Debt Use by Age and Income

C.2 Extreme Scenario: No Wedges - Additional Figures

Here we display additional Figures related to the mechanisms of the model when we eliminate loan interest rate wedges.

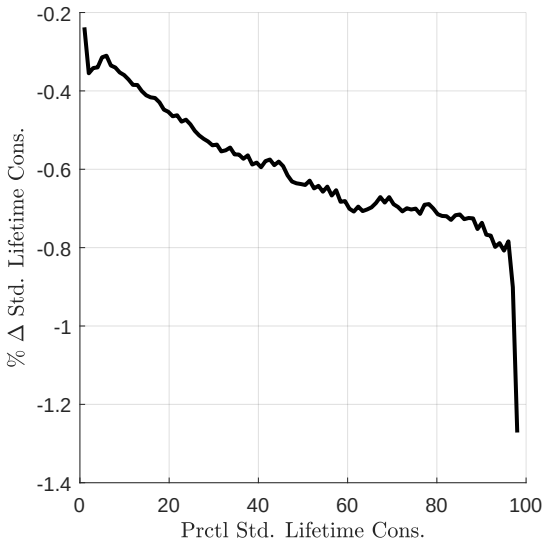
Figure C7 deals with the standard deviation of consumption over a household's life. It shows that the drop in volatility is largest for those with the largest consumption volatility in the baseline.

These changes to consumption patters are reflected in the changes to debt and asset profiles, as shown in Figure C8. The consumption shifting of the young and poor is reflected in negative changes to net assets for the poor, in particular, (top-left panel) and young (top-right panel). These changes are also reflected in the increased debt use for the poor and young (middle panels).

The bottom-left panel shows that the lowest earners are not increasing their debt exposure on the intensive margin. Given the observed drop in net assets, we can infer that they are actually financing higher consumption by *saving* less.

Figure C7: No Wedges: Changes in Lifetime Average Consumption and in Lifetime Standard Deviation of Consumption

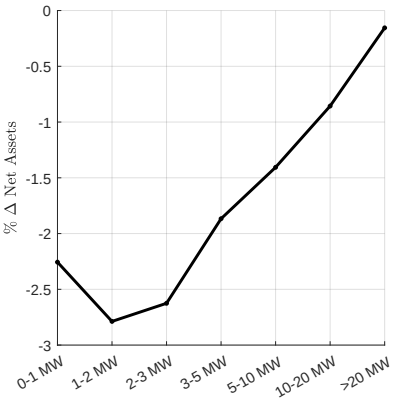
(a) Δ Std. Cons. by Std. Cons.



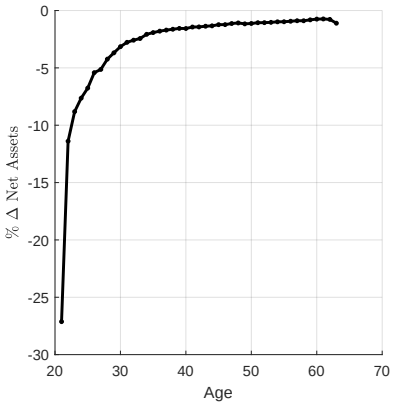
Notes: Plots the % change from the baseline in the standard deviation of consumption over the household's lifetime for each percentile in that standard deviation in the baseline.

Figure C8: No Wedges: Assets and Debt by Income and Age

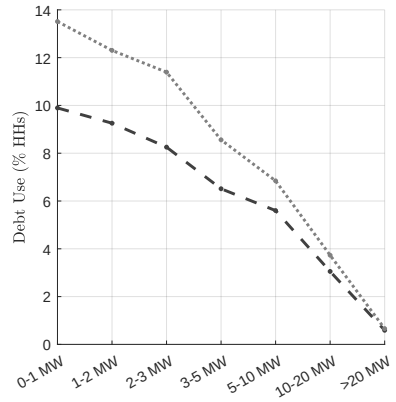
(a) Δ Assets by Income



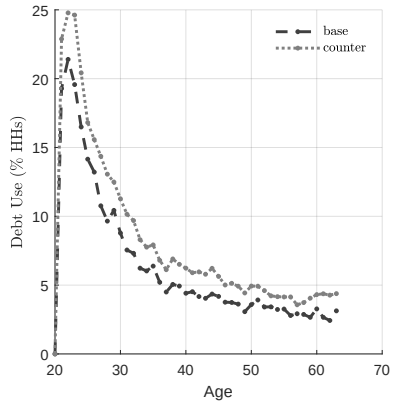
(b) Δ Assets by Age



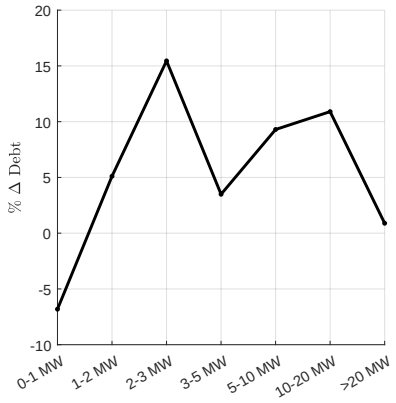
(c) Δ Debt Use by Income



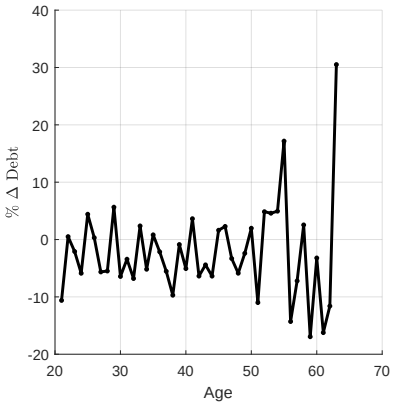
(d) Δ Debt Use by Age



(e) Δ Debt by Income



(f) Δ Debt by Age



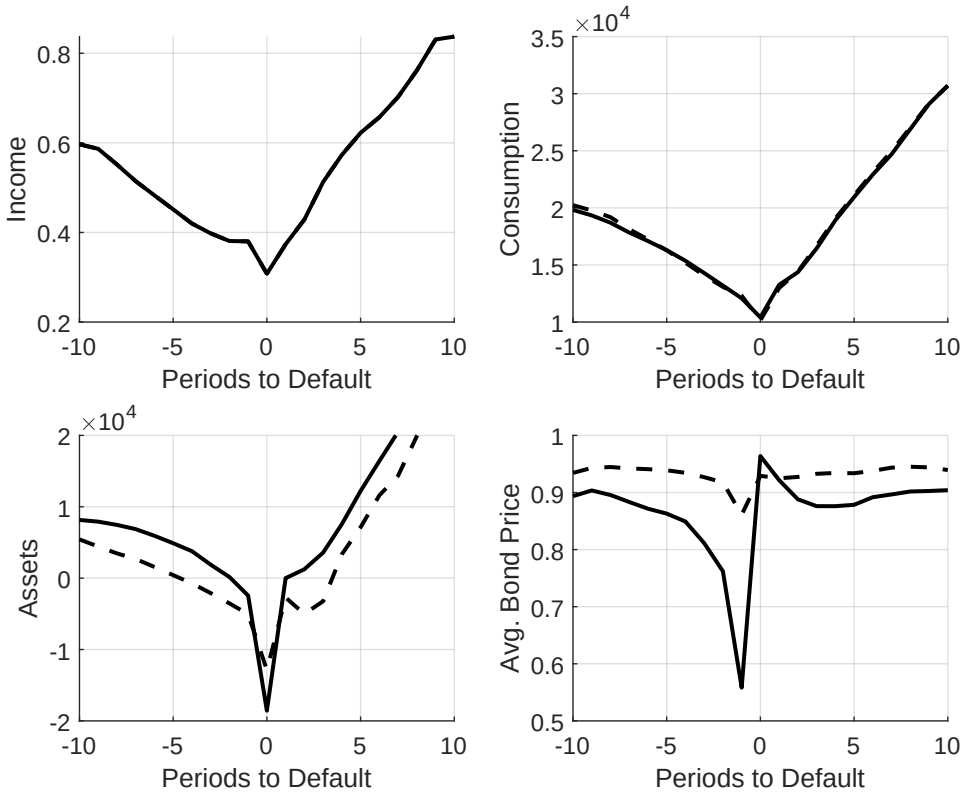
Notes: Solid lines indicate % changes from the baseline to the counterfactual. Dashed lines indicate baseline case. Dotted lines indicate counterfactual case. For the case of debt, an positive % change in debt corresponds to a more negative net asset position.

Figure C9 displays the typical default path in the baseline and in the counterfactual without any wedge. These plots are constructed by observing the median level of debt defaulted on in the baseline and tracking all the households who default on that debt level before and after their default. The plots are the average among these households.

There are a few interesting points to note in this figure. The first is that the typical household that defaults in the baseline does not default in the counterfactual - despite the same history of income and expenditure shocks (top-left panel). This can be observed from the bottom-right panel which plots the average bond price which plummets at time $t-1$ in the baseline but stays high in the counterfactual. Secondly, the households in the counterfactual are carrying less wealth into $t-10$ than under the baseline. They also enter debt from $t-5$ and are able to sustain this negative net asset position until they exit it - without defaulting - in period $t+3$. By contrast, in the baseline, households maintain a higher level of wealth in the run-up to their default - only becoming indebted immediately beforehand.

Finally, despite the divergent paths for debt, default and bond prices, it is striking that the consumption paths are similar. It seems that the lower wedges allow the household avoid default but market discipline still prevents an excessive run-up in debt and forces deep consumption cuts.

Figure C9: No Wedges: Path for Typical Default Event



Notes: Solid line in the baseline while the dotted lines are the counterfactual. Plots show the path around a (baseline) default event for household income (normalised by average income), consumption, assets, and the (weighted) average bond price over bonds and personal loans. The paths are constructed by taking the median debt defaulted on in simulations and plotting the path of the baseline variables before and after the default event. Since several households may share the median debt at default, an average is taken. These exact same households are tracked over the same periods in the counterfactual (whether or not a default occurs in the counterfactual) and the resulting paths are the dotted line.

C.3 Payroll Expansion - Additional Figures

Here we display additional Figures related to the mechanisms of the model when we expand access to payroll loans for all formal workers. Notice that formal workers also have the option to use personal loans, which has higher continuation value (or low recovery rate) under default.

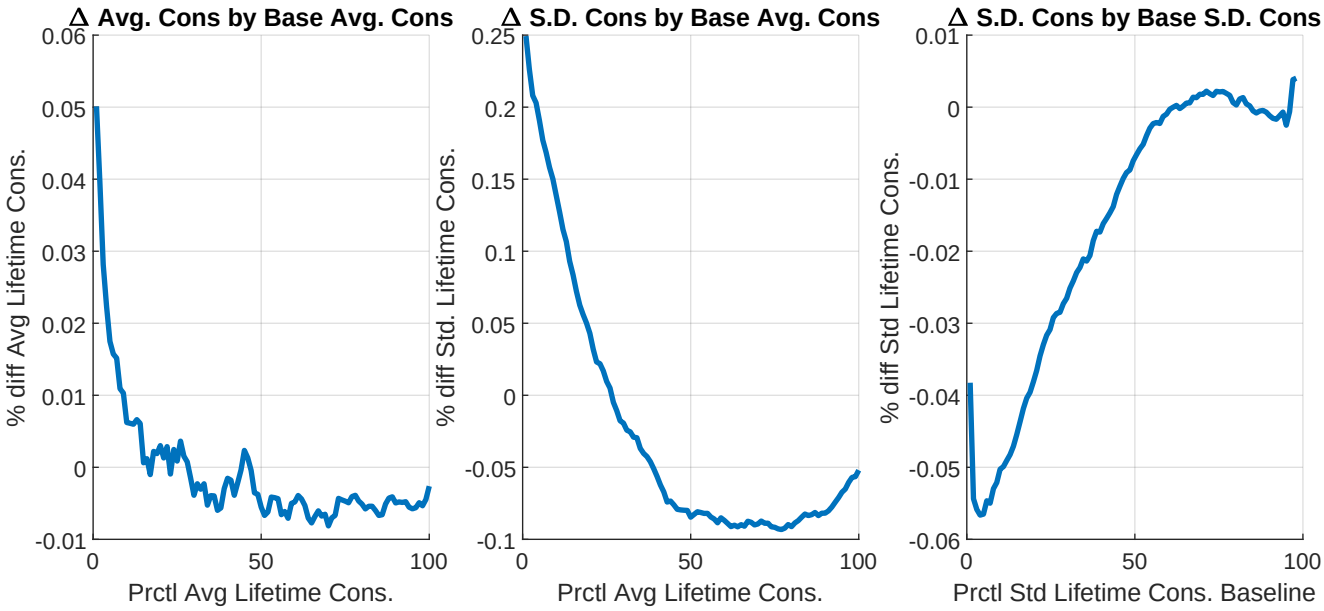
Figure C10 shows changes in lifetime consumption and in standard deviation of consumption over the lifetime. Observe that the lifetime effects on the mean and standard deviation of consumption for this counterfactual experiment are small. The model predicts a slight increase in the standard deviation of consumption for the poorest quartile of individuals. Some of these individuals might transit from the informal sector to the formal sector in some periods of their life.

Figure **??** shows that the corresponding changes to the paths for debt and asset management depict very limited changes relative to those observed in the baseline. Despite small changes to consumption and debt patters, there are some observed changes in default among formal workers. The overall default rate for formal workers drops from 2.1% to 1.5%. Among the formal workers earning less than twice the minimum wage the model default rate drops from 2.6% to 1.6%. The lower default rates might be explained by the fact that interest rate expenses are much lower for households who have now access to payroll loans.

It is worth to understand whether payroll loans are generally preferred in the counterfactual because personal loans have a much larger wedge, or would household's prefer payroll loans even if personal loans were just as cheap. Figure C12 helps to investigate this by plotting a counterfactual where personal loans have the same low wedge as payroll loans. The only remaining difference is now the rate of garnishing for payroll loans in the event of default. Clearly, in the absence of this, the loans would be identical and the portfolio choice between personal and payroll loans would be indeterminate.

This figure shows that when making the wedge on personal loans just as cheap, payroll loans are household's first choice for entering into debt - they also have lower endogenous interest rate since recovery rates are higher than for those of personal loans. However, payroll loans are not so preferred that households only rely on them to smooth consumption. As the interest burden

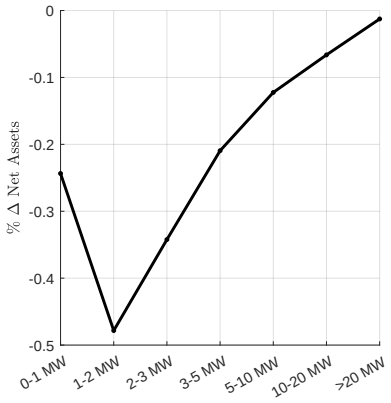
Figure C10: Payroll Expansion: Changes in Lifetime Average Consumption and in Lifetime Standard Deviation of Consumption



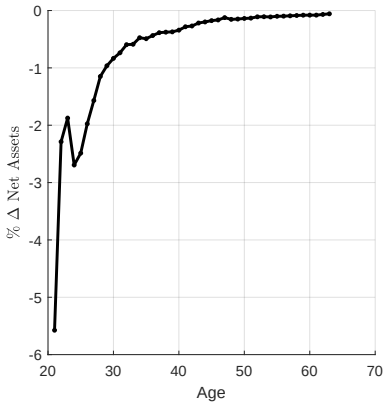
Notes: Left panel: Plots the % change in household consumption by percentile of average lifetime consumption in the baseline. Middle panel: Plots the % change from the baseline in the standard deviation of consumption over the household's lifetime for each percentile in the average lifetime consumption in the baseline. Right panel: Plots the % change from the baseline in the standard deviation of consumption over the household's lifetime for each percentile in that standard deviation in the baseline.

Figure C11: Payroll Expansion: Assets and Debt by Income and Age

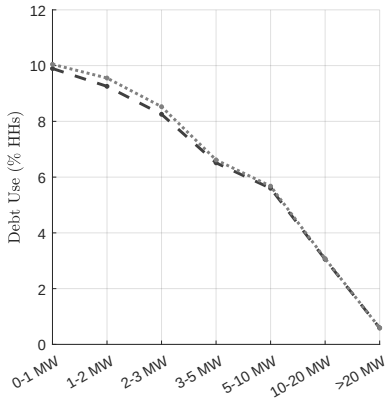
(a) Δ Assets by Income



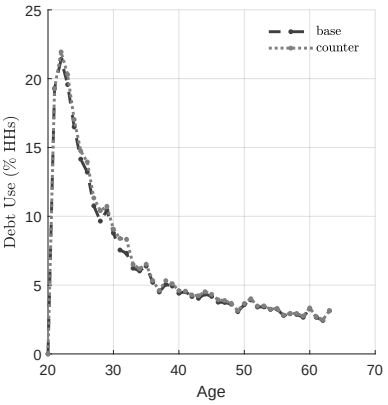
(b) Δ Assets by Age



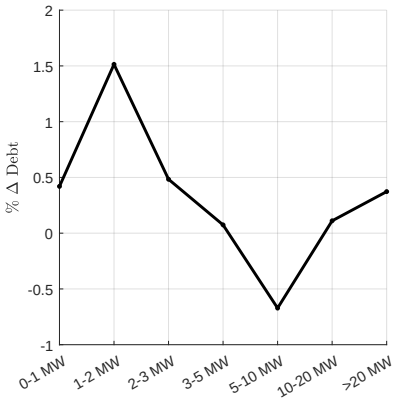
(c) Δ Debt Use by Income



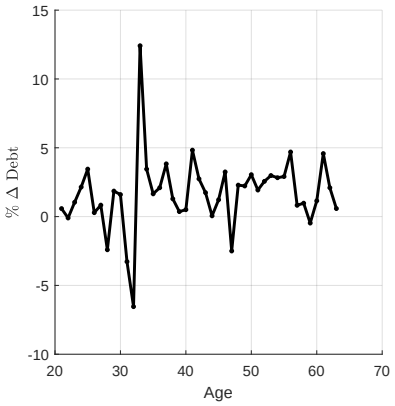
(d) Δ Debt Use by Age



(e) Δ Debt by Income



(f) Δ Debt by Age



Notes: Solid lines indicate % changes from the baseline to the counterfactual. Dashed lines indicate baseline case. Dotted lines indicate counterfactual case. For the case of debt, an positive % change in debt corresponds to a more negative net asset position.

and probability of default increase, households choose to use both personal and payroll loans.

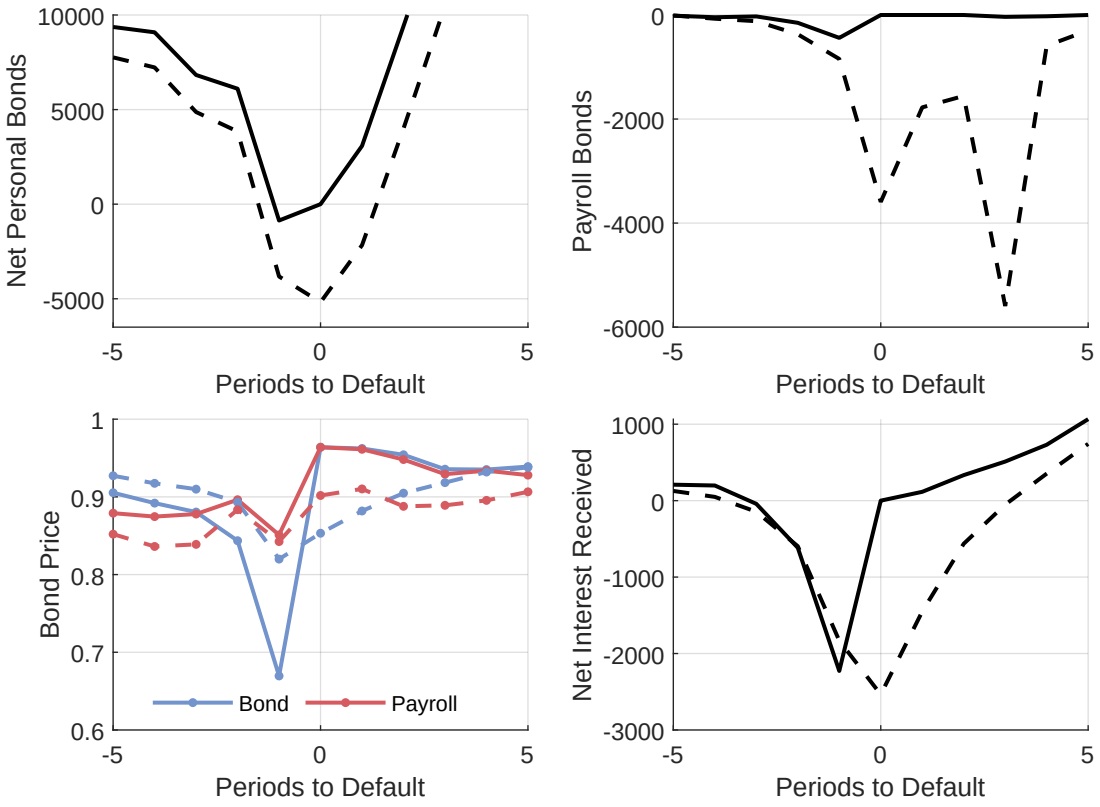
C.4 Loan Portability - Additional Results

Using municipality level data from January 2012 and December 2016, we run the following regression

$$Rate_{it} = \gamma_t + \gamma_i + \eta \ln(HHI_{it}) + \delta X_{it} + \mu_{it},$$

where γ_t and γ_i are fixed effects of municipality i and time t, and X_{it} are time-varying indicators depending whether the municipality is above the average in per capita GDP and in population size. Variable $\ln(HHI_{it})$ is the natural logarithm of the Herfindahl-Hirschman Index (HHI) of market concentration and competitiveness, which varies from 0 to 10,000. $Rate_{it}$ is the average interest rate in municipality i at month t, and we run this for payroll loans and personal loans separately. Standard errors are clustered at the state-month level. When we cluster at municipality level instead of state-month level level, the estimation is more precise. Table C15 reports the coefficient η for payroll loans – Columns (1) and (2) – and personal loans – Columns (3) and (4). In all regressions, coefficient η is positive and statistically different from zero at 99 percent confidence level. Therefore, we observe the classical relationship that competition (low concentration) tends to be associated with lower interest rates for both payroll and personal loans.

Figure C12: Personal Loans with the Same Wedge as Payroll Loans: Path for Typical Default Event



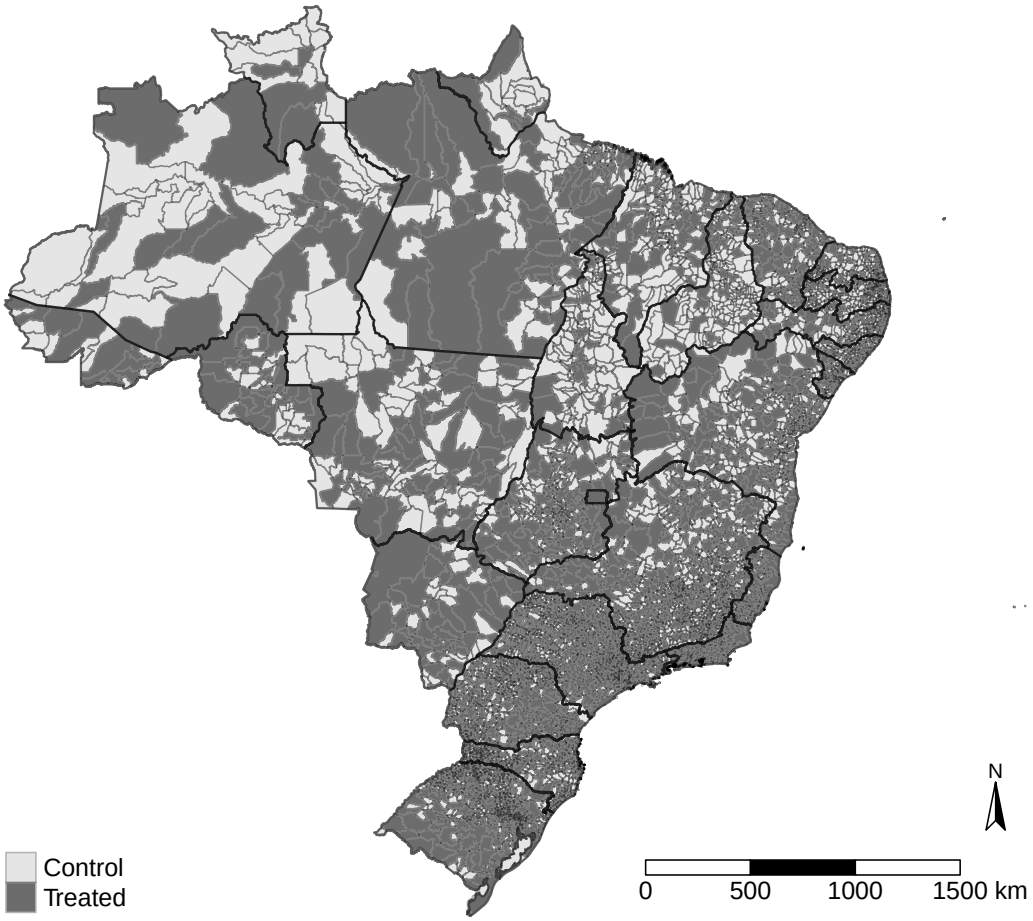
Notes: Plots show the path around default for bonds, payroll loans, bond prices of personal loans and payroll loans and the net interest received/paid around a (baseline) default event. The paths are constructed by taking the median debt defaulted in simulations and plotting the path of the baseline variables before and after the default event. Since several households may share the median debt at default, an average is taken. These exact same households are tracked over the same periods in the counterfactual (whether or not a default occurs in the counterfactual) and the resulting paths are the dotted line.

Table C15: Loan interest rates and banking concentration

	Payroll		Personal	
	(1)	(2)	(3)	(4)
VARIABLES	Loan rate	Loan rate	Loan rate	Loan rate
$\ln(HHI)$	0.58***	0.76***	5.50***	10.59**
	(0.20)	(0.14)	(2.94)	(1.61)
Observations	295,023	294,998	294,998	294,998
R-squared	0.484	0.498	0.745	0.761
Munic. FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Controls	NO	YES	NO	YES

Notes: Control covariates are time-varying indicator of GDP per capita (2011) above the median and time-varying indicator of population (2012) above the median. Standard errors are clustered at the state-month level, *** p<0.01, ** p<0.05,* p<0.1.

Figure C13: Treated and Control Municipalities in December 2013



Notes: Control municipalities had no bank or one bank in December 2013. Treated municipalities are the municipalities that had at least two banks of different brands in December 2013. Source: Authors' calculation using Estban-BCB.