ARTICLES

Submitted 12-21-2021. Approved 11-29-2022

Evaluated through a double-blind review. Associate Editor: Elizabeth Krauter

Reviewers: Fabio Gallo, Fundação Getulio Vargas, Escola de Administração de Empresas de São Paulo, São Paulo, SP, Brazil. One of the reviewers did not authorize the disclosure of their identity

Peer review report: the peer review report is available at this URL

Translated Version | DOI: http://dx.doi.org/10.1590/S0034-759020230301x

COLLATERALS OF RURAL CREDIT IN BRAZIL: ACCESS, LOAN TERMS, AND DEFAULT

Garantias de crédito rural no Brasil: Acesso, condições e inadimplência

Garantías de crédito rural en Brasil: Acceso, plazos de préstamo e incumplimiento

Alexandre Pinho Menezes[1] | e-mail alexandre.pinhom@gmail.com| ORCID: 0000-0001-6401-3933

Rafael F. Schiozer[1] | rafael.schiozer@fgv.br | ORCID: 0000-0003-3890-6345

Lucas N. C. Vasconcelos[*1] | lucas.nogueira.cabral@gmail.com | ORCID: 0000-0003-2252-1950

[*]Corresponding author

[1]Fundação Getulio Vargas, Escola de Administração de Empresas de São Paulo, São Paulo, SP, Brazil

ABSTRACT

This study investigates the relation between the types of collateral offered in rural loans in Brazil and the access to credit, loan conditions and default rates. We use a proprietary database of rural loans from one of the largest private banks in Brazil containing more than 110 thousand loan observations. Our results show that the use of fiduciary lien improves the access to loans for more opaque borrowers (i.e., those with shorter relationship with the bank). This type of collateral gives the bank the ability to seize collateral quicker, reducing loss given default, even if these borrowers are riskier, given that they present higher default rates on average. Our results also show that loan conditions are less restrictive as relationship length increases, and that this effect is more intense among loans collateralized by fiduciary lien.

Keywords: Rural credit, collaterals, fiduciary lien, access to credit, default.

RESUMO

Este estudo investiga a relação entre os tipos de garantia oferecidos em empréstimos ao produtor rural no Brasil e o acesso, as condições de crédito e a inadimplência. Usamos uma base de dados proprietária e inédita de crédito rural de um grande banco privado brasileiro com mais de 110 mil observações de empréstimos. Os resultados apontam que o uso da alienação fiduciária permite que tomadores mais opacos (i.e., com menor tempo de relacionamento com o banco) consigam acesso a crédito. Esse tipo jurídico de garantia dá ao banco a capacidade de retomar o ativo mais rapidamente, reduzindo a perda em caso de inadimplência, mesmo que os tomadores sejam mais arriscados, uma vez que apresentam maiores taxas de inadimplência (default). Nossos resultados mostram que as condições dos empréstimos são menos restritivas com o aumento do tempo de relacionamento bancário, e que esse efeito é mais intenso nos empréstimos com alienação fiduciária.

Palavras-chave: *Crédito rural, garantias, alienação fiduciária, acesso ao crédito, inadimplência.*

RESUMEN

Este estudio investiga la relación entre los tipos de garantía ofrecidos en los préstamos a los productores rurales en Brasil, el acceso al crédito, las condiciones del préstamo y el incumplimiento. Utilizamos una base de datos propietaria e inédita de crédito rural de un gran banco privado brasileño con más de 110 mil observaciones de préstamos. Los resultados muestran que el uso de la alienación fiduciaria permite a los prestatarios más opacos (es decir, con menor tiempo de relación con el banco) acceder al crédito. Ese tipo de garantía le da al banco la capacidad de recuperar el activo más rápidamente reduciendo la pérdida en caso de impago, incluso si esos prestatarios son más riesgosos, ya que presentan mayores tasas de incumplimiento. Nuestros resultados también muestran que las condiciones de los préstamos son menos restrictivas a medida que aumenta la duración de la relación bancaria, y que este efecto es más intenso en los préstamos con alienación fiduciaria.

Palabras clave: *Crédito rural, garantías, alienación fiduciaria, acceso al crédito, incumplimiento.*

INTRODUCTON

Agribusiness is an important source of revenues for the Brazilian economy, accounting for 26% of the national gross domestic product (GDP) in 2020 (Escola Superior de Agricultura Luiz de Queiroz [ESALQ], 2021). Financial institutions provide funding to the sector, particularly small and medium-sized producers' costs, investments and sales. One of the obstacles in this market is the difficulty to monitor activities, given some level of informality among these producers. Collaterals therefore play an important role in the access to credit. According to a World Bank (Fleisig et al., 2000) study, the low access to credit in emerging countries is due to the limited possibilities for small and medium-sized borrowers to use their assets as collateral in loan agreements. Normally, it is not the lack of assets that hampers access to credit, but rather the lack of a mechanism that enables the lender to seize collateral rapidly and with little legal uncertainty.

The aim of this study is to investigate how the use of types of collateral with different levels of loan recovery capacity is associated with access to credit by more opaque borrowers, loan conditions (interest rates, grace periods and lending volume) and default rates. To this end, we used a proprietary rural loan database provided by one of the three largest Brazilian private banks (hereinafter, "the Bank"). The sample comprehends more than 110,000 loans distributed over 10 Brazilian states. The granular level of information (by loan) and the detailed information about collaterals, borrowers' geographic location, grace periods, and loan outcomes allows us to investigate research questions which could not be addressed using public databases.

The literature indicates the existence of two streams that explain the relationship between collateral and access to credit. Under conditions of information asymmetry, borrowers have more information than the financial institutions, and offer collateral to obtain more favorable conditions in the lending process. In this case, collaterals are associated with less risky borrowers, since the cost of offering collateral is smaller for these borrowers who do not intend to default (Bester, 1985). Under conditions of moral hazard, riskier borrowers (i.e., those with a greater propensity to default) have incentives to offer collateral that mitigates their lower creditworthiness (Tirole, 2005).

Another important point is how easily the lending bank can seize and sell the assets in case of default. In the model of Jappelli et al. (2005), the greater a bank's ability to seize and sell collateral, the smaller the constraints to credit, and the greater the access to loans by less creditworthy, more opaque borrowers. Research indicates that the greater the liquidity, the greater the value of the collateral: negotiable securities are thus more valuable than real estate, receivables and inventories, which in turn are more valuable than fixed assets (Luck & Santos, 2019). Finally, institutional factors, such as lender protection, increase recovery rates and access to credit (Degryse et al., 2020).

Between 2004 and 2005, Brazil implemented reforms to improve the credit environment and ensure more rights for lenders in order to decrease losses from loan default. Araújo et al. (2012) show that these reforms raised the recovery rate from less 1% in the pre-reform period to 17%

in 2008. Doonik and Capelletto (2015) show that the proportion of collateralized loans increased by 13 percentage points two years after the reform, and that the level of overcollateralization decreased significantly, indicating that the same borrower was using the same collaterals to access a greater loan value.

Fiduciary lien (FL), created with the reforms introduced by Law n. 10,931 of 2004 (2004), became the type of collateral which enables recovery most easily, since the lender has legal ownership of the asset offered as collateral until the loan is fully repaid, while the borrower has possession of it for their own use. Unlike other types of collateral (e.g., mortgage and pledge), seizure of the asset is done out of court, in a less costly, quicker manner, thus reducing losses for the lender. In this respect, the study of Assunção et al. (2014) shows that FL has afforded low-rate borrowers more access to loans to buy vehicles in Brazil after its implementation.

In line with the results of Assunção et al. (2014), our results indicate that rural loans secured by FL are more likely to be provided for more opaque borrowers, i.e., those with a shorter relationship with the bank, suggesting that its use allows access to credit for borrowers who would not otherwise get loans. This effect is greater in states where the Bank has less penetration: fewer branches compared to other banks. Because of its smaller market penetration, the Bank is supposed to have less information about the quality, productivity and risks of farmlands in these regions, therefore collaterals become even more important than in other regions. However, we did not find better loan conditions for more opaque borrowers who use FL as collateral: loan terms only become less restrictive as relationship length increases. Finally, FL borrowers present higher default rates, a result consistent with the logic whereby banks accept greater risk when they can use a type of collateral that implies reduced loss given default. Taken together, these results suggest that FL can be the type of collateral that maximizes the access to credit for more opaque, riskier clients.

Our study contributes to the literature in a number of fronts. First, it contributes to the literature on rural loans (Assunção et al., 2020; Castro & Teixeira, 2012, among others) as it is the first study about the role of collaterals in the rural loan market. Other articles deal with different subjects (e.g., deforestation, productivity, production and land use), but do not address the access to credit for more opaque borrowers. Our article contributes by showing that an arrangement which allows for quicker collateral recovery increases access to credit for more opaque borrowers, precisely those who struggle to finance their production. This result is particularly important in an environment where the production value depends on less predictable factors, such as climate and crop pests, which are difficult to be managed with financial instruments (e.g., derivatives). Monitoring agricultural activities is also complex and costly for banks, since these activities are characterized by long production cycles (with loans with monthslong grace periods) and, frequently, small-sized (opaque) producers.

Second, it contributes to the wide literature that investigates lenders' direct effect on access to credit (Levine, 1998; Porta et al., 1998) and the role of collaterals in emerging markets (Calomiris et al., 2017; Campello & Larrain, 2016; Degryse et al., 2020; Fleisig et al., 2006). In Brazil, the literature had investigated the effect of collaterals on consumer credit (Assunção et al., 2014;

Doornik and Capelletto, 2015; Ponticelli & Alencar, 2016), whereas we provide evidence on how an efficient collateral recovery can expand the access to production loans. We provide evidence that superior collateral can be a complement when monitoring is costly (when banks' physical presence is smaller), contributing to the literature on loan monitoring (Diamond, 1984; Heitz et al., 2022). Finally, our paper contributes to the vast literature on the relationship between collaterals and bank loans (Bester, 1985; Cerqueiro et al., 2016; Tirole, 2005) and theories that link financial development to economic growth, such as Rajan and Zingales (1998) and Duygan-Bump et al. (2015).

COLLATERALS OF RURAL LOANS AND HYPOTHESES

In the literature, two streams seek to explain the motivation for using collaterals. On the one hand, the literature of moral hazard holds that borrowers with a high default probability offer collateral to conceal their low creditworthiness (Tirole, 2005). Empirical evidence supports this literature by showing that companies with a higher default probability provide collateral in their loans (Berger & Udell, 1990). On the other hand, the literature of information asymmetry holds that borrowers have more information than the financial institutions. Given the asymmetry, it is difficult for banks to evaluate the creditworthiness of more opaque borrowers, creating worse conditions for good borrowers and better ones for bad borrowers. One way of signaling creditworthiness is the provision of collateral by good borrowers: because they are more able to fulfill loan agreement terms, providing collateral is less costly to them, due to improved agreement terms (Bester, 1985).

Another stream of literature points out that not all collaterals are the same: some collaterals allow for greater loan recovery by financial institutions in case of default. Therefore, these collaterals affect the value that can be recovered and the loan conditions. In the empirical field, Campello and Larrain (2016) point out that reforms which increase the range of collaterals and the swiftness of their recovery alleviate financial restrictions and expand firms' investment. Degryse et al. (2020) find that a higher level of lender protection increases the expected recovery rates for movable collaterals compared to non-movable ones, and shifts the composition of collaterals to movable assets, increasing debt capacity and lessening lenders' liquidation bias.

In Brazil, using data on auto loans, Assunção et al. (2014) point out that reforms which increase recovery speed have enabled banks to lend more resources to riskier, more financially restricted borrowers. The gain in recovery efficiency allowed for more favorable conditions for borrowers, such as greater lending volume, longer maturity and lower interest rates. Based on the arguments above, we formulate our first hypothesis:

> H1: Collaterals and access to credit: collaterals with a greater loan recovery capacity enable borrowers on which the Bank has less information (more opaque borrowers) to get access to credit.

In this study, the focus is on the three main collaterals observed in the loan agreements of our sample: fiduciary lien (FL), rural pledge (RP) and rural mortgage (RM). In this menu, the FL described by Law n. 9,514, of November 20, 1997 (1997), presents greater loan recovery efficiency, since the borrower transfers to the lender (the Bank) ownership of the asset that will collateralize the operation until de loan is repaid (Araújo et al., 2012).

On the other hand, the other collaterals present a smaller loan recovery efficiency for the financial institution. In the RP, described by Law n. 492, of August 30, 1937 (1937), the borrower pledges assets like crops, animals and agricultural tools, but they can also use the pledged collaterals until they are seized by the financial institution. In the RM, described by Decree-law 167, of February 14, 1967 (1967), ownership and possession are not transferred before the loan is concluded. Thus, the financial institution must take legal measures to effect its right to the mortgaged asset so as to sell it and recover part of the loan value.

In line with the literature of bank relationship, our main borrower opacity measure is the length of the relationship between the borrower and the bank. Thus, our test for the first hypothesis consists in examining the association between client-bank relationship length (dependent variable) and the use of FL compared to other types of collateral (independent variable), controlling for other factors. A negative relationship between these variables is expected.

> H2: Access to credit and bank presence: the effect described in Hypothesis I is more intense in locations where the bank has a smaller presence.

The test for hypothesis II is performed by including a relative measure of the bank's physical presence as a moderating variable in the test equation for hypothesis I. A greater use of FL in locations where the bank has a smaller physical presence is expected, ceteris paribus.

Using a quick recovery collateral decreases the incentive for borrowers to default, suggesting that loans with FL have a lower level of default than other loans. On the other hand, a collateral works as a substitute for information. According to the rationale behind hypothesis I, the bank will provide loans to more opaque clients using FL, which can lead to a positive relationship between using FL and default. The logic assumes that the FL borrower pool is more opaque, and that the bank is not able to select borrowers as well as it would be with clients with a longer relationship. Because the bank's loss with FL is smaller than with other forms of collateral, the bank's effective loss can be smaller by using FL, even if the default rate is higher. Indeed, Assunção et al. (2014) show that the use of FL has increased the number of defaults. Thus, the relationship between the use of FL and default rate can be either positive or negative, depending on the intensity of each of the effects, thus becoming an empirical question. In line with previous results, we formulate the third hypothesis.

> H3: Collaterals and default: the use of collaterals with a higher loan recovery capacity is positively associated with observed default.

The test for the third hypothesis consists in regressing a binary variable for loan default against the type of collateral used (independent variable), controlling for other factors. It is worth stressing that the predicted positive association in hypothesis III does not imply a causal relationship between using FL and default. Because FL is used as a mechanism for selecting riskier borrowers, there is possibly an omitted variable (borrower creditworthiness) which positively affects default while also being negatively correlated with the use of fiduciary lien.

DATA

The proprietary data comprehend loans to rural producers (natural persons) and were provided by one of the three largest privately owned banks in Brazil. The initial sample had 168,057 loans provided between February 2015 and January 2021. On this sample, various filters were applied to ensure consistent estimations: (1) observations with a credit rating between D and H upon origination (Resolution n. 2,692/1999 of the National Monetary Council [Banco Central do Brasil, 1999]) were excluded, since this type of loan normally originates from a renegotiation of a loan in default. Including these loans could distort our results; (2) loans with missing information (i.e., without client sex, credit rating or the federation state where the loan was provided) were also excluded, since the lack of such information would impair our tests; (3) so too were loans with apparently inconsistent information, such as a negative relationship length, a negative grace period, the client being under 18 on the date of the loan, in order to avoid the inclusion of possibly misrecorded data. Finally, because one of the variables is default over the loan's lifespan, loans provided after December 2019 were also excluded. This last procedure is necessary to give enough time for default observation. In robustness tests (not reported), the sample is restricted to loans provided until 2018 in order to avoid any effects associated with the COVID-19 pandemic.

The filters above imposed a restriction regarding loans whose collaterals are uncommon. This generated collateral categories which did not present any agreement in default. Thus, loans with those collaterals were excluded from the final sample. The loans with those guarantees, when aggregated, accounted for 3% of the sample (3,657 observations). Some federation states presented few observations for each collateral type. Federative units (UF) were thus excluded that presented less than 1,000 observations, a cutoff of less than 3% of the sample. After all these filters, the final sample contains 110,662 (65.8% of the original sample).

Definition of the variables and descriptive statistics

Table 1 presents the operational definitions of the variables used. In the models that associate the type of collateral to client opacity, the variables indicating opacity are the client-bank relationship length (Relat), a dummy indicating a relationship length of less than one year (Relat < 1) and a dummy indicating whether the relationship length observed has values below the first tercile

(RelatT1), according to the literature of bank relationship. As alternative measures, we used borrower age (younger clients are supposed to be more opaque due to their shorter credit history).

In turn, the variables grace period, rate and *ln*(balance) are traditionally used as metrics for loan conditions in the literature (for example, Martins et al., 2022) and are used in models of association between collaterals and loan conditions. Grace period is defined here as the time span between the loan provision and the first repayment's due date. In over 80% of cases in our sample, the borrower repays the loan in a single installment, with no intermediate cash flow. For this reason, instead of using loan term, we used the grace period. *ln*(balance) is defined as the natural logarithm of the debit balance in the first three months of the agreement after the loan was provided, since the debit balance was not available at the time of the loan agreement. The metrics of loan conditions are important in that they reveal the best loan offer from the client's perspective when they apply for a loan, i.e., it is the condition of balance between supply and demand. Default is used as a dependent variable in models which test the association between collaterals and default.

Table 1. Definition of variables and collateral categories

Variables	Description and observations
Default	Dummy variable with value 1 if the borrower has delayed repayment for 90 days or more at any time over the loan's lifespan (0 otherwise).
Relat	Customer-bank relationship length in years at the time of the loan agreement.
Relat<1 year	Dummy variable with value 1 if the relationship is shorter than one year (0 otherwise).
RelatT1	Dummy variable with value 1 if the relationship length is below the first tercile (0 otherwise).
Age	Borrower's age in years on the date of the loan agreement.
Sex	Dummy variable with value 1 if the borrower is identified as male (0 otherwise).
FL	Dummy variable with value 1 if the collateral is fiduciary lien (0 otherwise).
RP	Dummy variable with value 1 if the collateral is rural pledge (0 otherwise)..
RM	Dummy variable with value 1 if the collateral is rural mortgage (0 otherwise)..
Grace period	Grace period of the loan in months.
Rate	Indicates the annual effective rate of the loan.
Rating	Indicates the client's origination rating. The values were substituted by a 1-4 scale where 4 = AA, 3 = A, 2 = B, 1 = C. Ratings equal to or below D were excluded. In the regression stage, these values are substituted by dummy variables.
ln(Balance)	Natural logarithm of the debit balance in the first three months from the date of the agreement.
CliSeg	Indicates the client's segment according to the bank's classification. Its value is 1 if the client is in the high income segment (0 otherwise).

Source:

Panels A, B and C in Table 2 present the main borrower variables by state, collateral and rating, respectively. The default variable is defined as the occurrence of a delay equal to or greater than 90 days at any time in the loan's lifespan. Data in Panel A show that the proportion of agreements that went into default is 3.86%, and that there is a significant variation between states, which suggests the need to introduce controls for states in the regressions (see sections 4, 5 and 6 below). The average bank-client relationship length at the time of the loan provision is approximately 17 years, and 1.58% of borrowers have a relationship length of less than one year.

In Panel B, the loans collateralized by RP present the lowest default level, followed by those secured by RM and FL, which suggests that lending with FL is used for loans for riskier clients. Loans with FL also present the smallest average relationship length and the greatest proportion of loans provided for clients with relationships shorter than a year, which suggests that this is the type of collateral required for more opaque borrowers. Panel C shows the segmentation by rating. As expected, worse ratings present higher default rates. However, there is apparently no relationship between the measures of client opacity and initial agreement rating.

Table 2. Rural loan agreements per UF, collateral and rating

Panel A - Default and relationship statistics by federative unit				
UF	**Agreements**	**Default (%)**	**Relat**	**Relat<1 year (%)**
MG	23,591	4.85	14.38	2.10
SP	19,823	2.51	22.03	0.60
PR	19,436	4.22	15.67	1.40
GO	15,299	3.58	18.39	1.70
RS	9,748	4.47	14.98	1.60
SC	7,523	4.25	13.55	2.00
MS	5,744	3.27	20.74	0.80
MT	5,002	3.72	18.51	1.10
TO	2,763	5.94	17.03	1.50
BA	1,733	4.62	20.03	0.70
Total	110,662	3.86	17.08	1.58
Panel B - Default and relationship statistics by collateral				
Garantia	**Agreements**	**Default (%)**	**Relat**	**Relat < 1 (%)**
AF	2,688	5.58	15.25	3.27
PR	12,928	1.86	18.33	1.70
HR	95,046	4.20	17.09	1.35
Panel C - Default and relationship statistics by rating				
Rating	**Agreements**	**Default (%)**	**Relat**	**Relat < 1 (%)**
AA	6,043	0.33	21.05	0.43
A	16,989	2.13	17.14	2.55
B	26,725	1.69	18.60	0.51
C	60,905	5.82	16.21	1.64

Source:

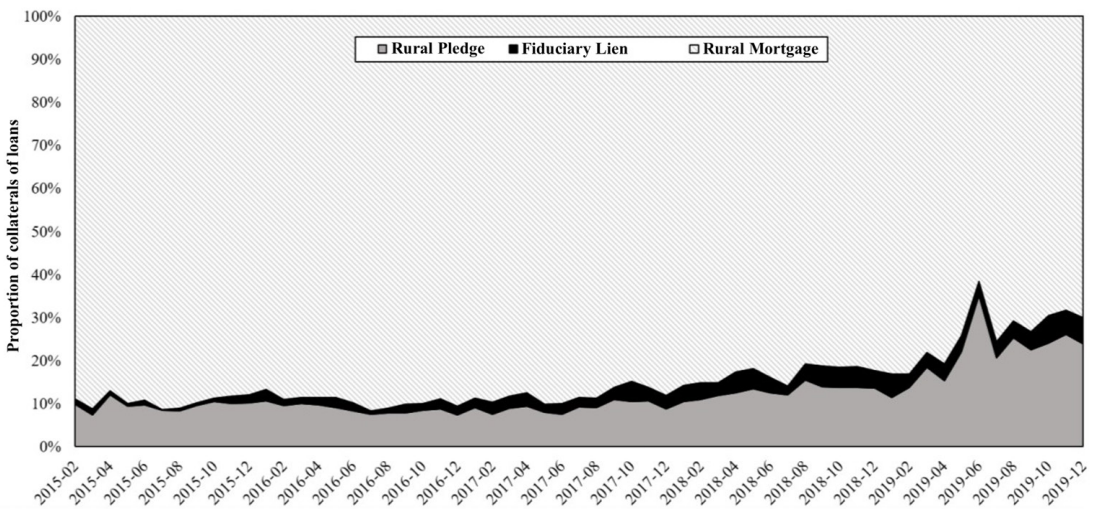
Table 3 presents the descriptive statistics for the other variables used in this study. Figure 1 presents the proportion of collaterals of the loan agreements for the crop (origination month) of the loan. There is a concentration in the RM collateral. Over the years, the proportion of RP and FL increased from 10% to approximately 30%. However, FL remains as the collateral with the smallest proportion in the sample. Figure 2 presents the average value of rural loan agreements by collateral type and loan crop. It is possible to note that FL presents a high average value (despite the seasonal variability), even though it is one of the least used collaterals. The values were adjusted for December 2019 using the Broad National Consumer Price Index (IPCA). Finally, Figure 3 presents the percentage of loans in default by collateral. Figure 3 indicates that FL presents the greatest default among the collaterals, but that difference was reduced in the more recent years of the sample. In general, the Figures indicate the importance of controlling the seasonality of loans over the crops (i.e., loan origination months) and the reduction observed as a result of defaults in the more recent years.

Table 3. Averages of the other variables of the sample by collateral

	Total Sample	FL	RP	RM
Grace period	12.741	14.610	12.788	12.681
Rate (%)	11.161	10.302	10.141	11.324
ln(balance)	11.905	12.033	11.393	11.972
CliSeg (%)	32.800	29.900	36.800	32.300

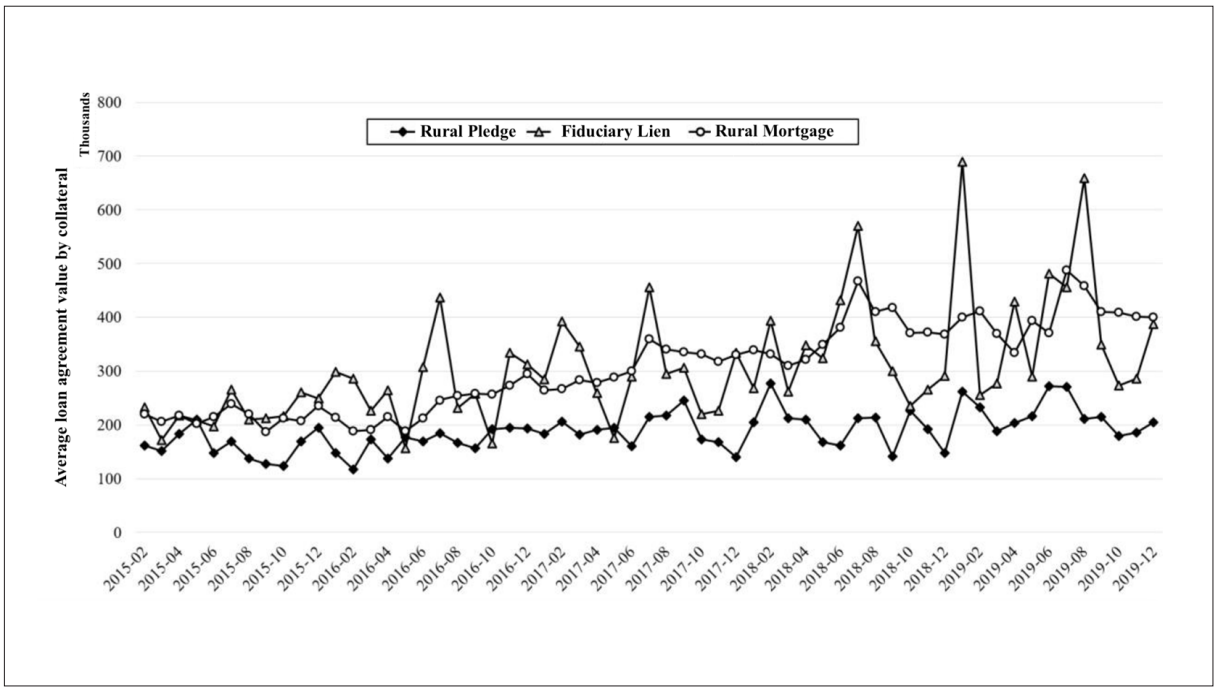
Source:

Figure 1. Proportion of collaterals by loan agreement



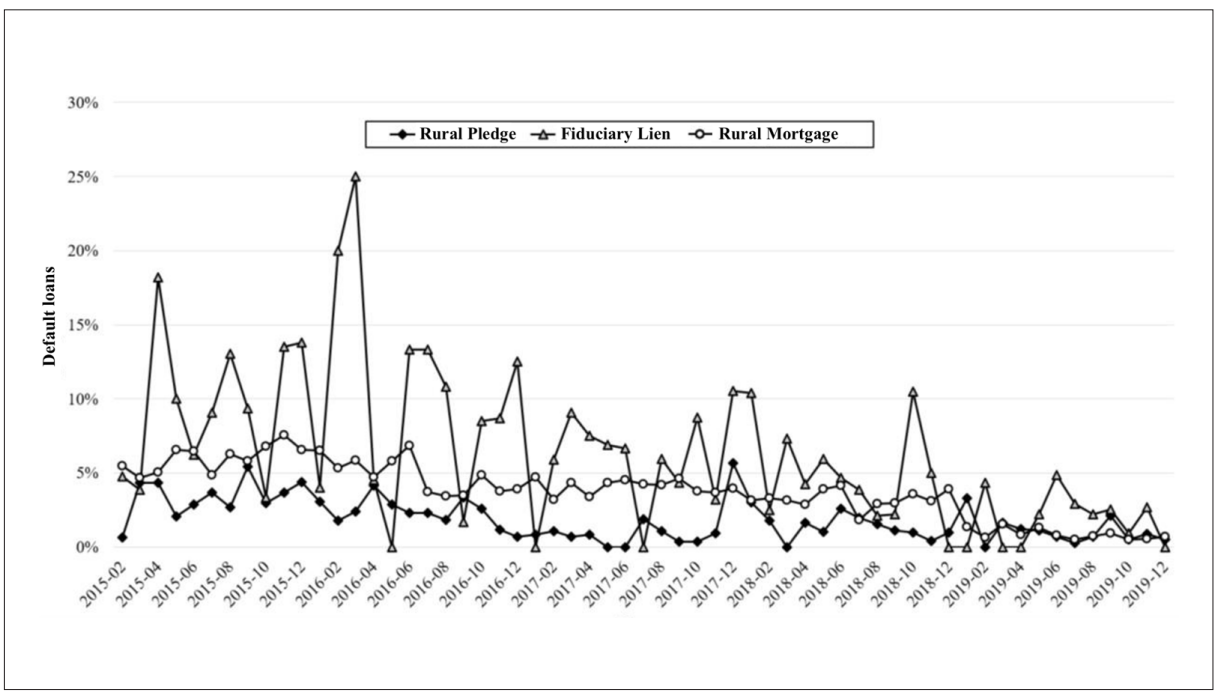
Source:

Figure 2. Average loan agreement value according to collateral



Source:

Figure 3. Loan agreement default according to collateral



Source:

EMPIRICAL TESTS AND DISCUSSION OF RESULTS

Collaterals and access to credit

In this section we test whether collateral FL allows more opaque clients to gain access to credit (first hypothesis). To that end, because it is not possible to observe directly the level of opacity, we will use three proxies for borrower opacity level. In order to test whether the collateral is associated with borrower opacity, we estimate the regression described by Equation 1:

$$\text{Opaque}_i = \alpha_0 + \alpha_1 \cdot \text{FL}_i + \text{L}_i + \text{B}_i + \delta_t \cdot \delta_e + \epsilon_i \quad (1)$$

where Opaque is one of the three opacity proxies, namely: i) a dummy variable with value 1 if the relationship length is shorter than one year at the time of the loan agreement, and zero otherwise (Relat < 1), through which we sought to capture the idea that the loan is being provided for a client who is "new" to the bank; ii) the client's age at the time of the loan agreement (Age). FL is the dummy with value 1 if the collateral provided is FL, and zero otherwise. According to Hypothesis I, the coefficient α_1 is expected to be positive for cases (i), and negative for cases (ii) and (iii), indicating that FL is used for more opaque clients on average. L is the vector of control variables of the loan: grace period, rate, rating, and debit balance. B are borrower characteristics: bank relationship length, age, sex, and client segment. δ_t is a set of dummies for the federative units (e). Thus, the specifications contain a fixed effect of $\delta_t \cdot \delta_e$. These fixed effects capture macroeconomic fluctuations both at the national level (such as variations in interest rates, GDP, inflation, etc.) and at the state level, as well as variations in climate conditions (heterogenous among the states) which can affect rural productivity and the seasonal demand for loans. The standard errors of this and the other regressions are robust to heteroscedasticity and clustered at the month-state level, $\delta_t \cdot \delta_e$.

Table 4 presents the coefficients estimated for Equation 1. For each of the three dependent variables, we ran a specification with and without the controls for loans and borrower (the odd columns show the results without controls, and the even columns, the results with controls). Except for the regression whose dependent variable is Age, no statistical significance was lost when the controls for loan (L) and borrower (B) characteristics were added. The interpretation of the regressions' coefficients follows the specifications with controls (even columns).

The main coefficient in column 2 indicates that the use of FL is associated with a probability 1.4 percentage point greater that the borrower has less than a year of relationship with the bank. This result is statistically significant at 1% level and economically relevant, since the proportion of loans provided for borrowers with less than one year of relationship is only 1.58% of the sample. In column 4, FL is associated with borrowers with an average relationship length 1.9 year shorter compared to other collaterals. Finally, in the regression reported in column 6, the coefficient of interest shows a negative association between the use of FL and borrower age, as expected, but without statistical significance.

These results are consistent with Hypothesis I whereby collaterals with greater loan recovery capacity allow greater access to credit for more opaque borrowers, suggesting that FL may be an "entry collateral" for more opaque borrowers. Our results are also consistent with the literature that proposes that collaterals are substitutes for information (Berger & Udell, 1990; Tirole, 2005), and that more efficient legal mechanisms of collateral recovery increase the access to credit for more opaque borrowers (Assunção et al., 2014; Campello & Larrain, 2016; Doornik & Capelletto, 2015).

Table 4. Regression of opacity against collaterals

	(1)	(2)	(3)	(4)	(5)	(6)
	Relat < 1	Relat < 1	Relat	Relat	Age	Age
FL	0.019***	0.014***	-2.811***	-1.944***	-1.998***	-0.266
	(0.004)	(0.004)	(0.260)	(0.210)	(0.322)	(0.277)
Intercept	0.013***	0.082***	17.266***	-20.65***	53.914***	47.068***
	(0.000)	(0.007)	(0.006)	(0.601)	(0.008)	(0.580)
Controls (L+B) •	N	Y	N	Y	N	Y
$\delta_t \cdot \delta_e$	Y	Y	Y	Y	Y	Y
Obs	110,662	110,662	110,662	110,662	110,662	110,662
Adjust. R^2	0.0129	0.0515	0.1242	0.3278	0.0234	0.2222

Note. *, ** and *** represent statistical significances at 10%, 5% and 1% level, respectively. All standard errors were clustered at the month-state level ($\delta t \cdot \delta e$). Standard errors are shown in parentheses. • The control variables are removed from the regression as they are used as dependent.

Source:

Segmentation by bank presence in the federative units

In this section, we test the second hypothesis in order to explore bank presence heterogeneity in each federative unit. To create the bank presence variable, we used the number of branches of the bank that provided the rural loan database in relation to the total number of bank branches in that state. This variable has a monthly frequency in each federative unit and is made available at the Central Bank of Brazil's open data website. Then, we segmented the sample by bank presence terciles. The argument is that FL supposedly gives more opaque clients greater access to credit, and that it is more important in states where the bank has a smaller penetration or suffers more competition.

Table 5 presents the specifications with controls segmented by bank presence. We used only the terciles classified as low and high bank presence due to space limitations. The estimated coefficients of the regressions indicate that the results shown in Table 4 are concentrated in the states with a smaller bank presence: in states where the bank has a low level of presence, FL is associated with a probability 1.9 percentage point greater that the borrower has less than one

year of relationship with the bank compared to the other collaterals. This effect does not show in states where the bank has a high presence. Finally, in column 3 (4), in states with a smaller (greater) presence of the bank, FL is associated with borrowers with a bank relationship length 2.3 (1.5) year(s) shorter compared to other collaterals. These results are consistent with our Hypothesis II, suggesting that, indeed, the channel that makes FL more used for riskier clients is information asymmetry.

Table 5. Regression of opacity against collaterals

	(1)	(2)	(3)	(4)	(5)	(6)
	Relat < 1	Relat < 1	Relat	Relat	Age	Age
Bank Presence	Low	High	Low	High	Low	High
FL	0.019***	0.005	-2.347***	-1.530***	-0.157	-0.228
	(0.006)	(0.005)	(0.356)	(0.314)	(0.419)	(0.485)
Intercept	0.117***	0.059***	-22.707***	-15.370***	48.309***	44.969***
	(0.013)	(0.010)	(0.849)	(1.012)	(0.994)	(1.051)
Controls (L+B) •	Y	Y	Y	Y	Y	Y
$\delta_t \cdot \delta_e$	Y	Y	Y	Y	Y	Y
Obs	36,988	36,122	36,988	36,122	36,988	36,122
Adjust. R^2	0.0562	0.0506	0.2867	0.2835	0.1969	0.2267

Note. *, ** and *** represent statistical significances at 10%, 5% and 1% level, respectively. All standard errors were clustered at the month-state level ($\delta t \cdot \delta e$). Standard errors are shown in parentheses. • The control variables are removed from the regression as they are used as dependent.

Source:

Loan collaterals and conditions

In this section, we test whether the collateral with greatest loan recovery capacity (FL) presents a relationship with interest rates, grace period and loan value. The model of Japelli et al. (2005) establishes that collaterals alleviate credit rationing, which could lead to longer grace periods, a greater lending volume, and lower rates. On the other hand, if better collaterals allow access to credit for restricted borrowers (i.e., borrowers who would not have access to credit without providing collaterals, or providing worse collaterals), this selection mechanism would lead to a positive association between interest rates and the use of FL (as found by Assunção et al., 2014). To test the association between loan conditions and collateral type, we estimated Equation 2:

$$Y_i = \beta_0 + \beta_1(AF_i) + \beta_2(RelatT1_i) + \beta_3(AF_i \cdot RelatT1_i) + L_i + B_i + \delta_t \cdot \delta_e + \epsilon_i \quad (2)$$

where Y_i is the measure of loan conditions: rate, grace period and *ln*(balance). More advantageous loans present lower rates, longer grace periods and greater balances. The RelatT1 variable is a dummy with value 1 if the relationship length is below the first tercile, and zero otherwise. We used this measure in the form of a dummy variable to facilitate interpreting the coefficients. In addition, we excluded observations whose relationship length is situated in the distribution's intermediate tercile. This was done so that the interpretation of coefficients allows comparing short- versus long-relationship clients. It is expected that a shorter relationship is a proxy for the amount of information the bank has about the client. Therefore, less known clients are more opaque to the financial institution, which is supposed to imply higher rates, shorter grace periods and smaller agreement values.

In Equation 2, the main coefficient of interest is β_3. This coefficient measures the moderating effect of FL on bank relationship length. It is expected that FL allows for decreased interest rates, longer grace periods and increased balance for borrowers with a shorter relationship. However, before we estimated Equation 2 with the interaction between AF and RelacT1, we estimated the effects separately with and without controls for the characteristics of loan L and borrower B.

Table 6 presents the results of the estimation of Equation 2. In columns 1 through 3, we have the regressions without the controls and using only the FL dummy. The results indicate that FL is associated with an interest rate 0.63 percentage point higher compared to the other collaterals, a grace period approximately half a month above the other collaterals, and a balance approximately 9.8% below the other collaterals. When controls are added (columns 4 through 6), the interest rate and grace period coefficients do not change sign, but the sign of *ln*(balance) becomes positive, indicating an increase by approximately 4.6%. Still in columns 4, 5 and 6, the coefficients of the relationship dummy indicate that short-relationship borrowers borrow at higher rates, with shorter grace periods and with a smaller balance, all of which are consistent with the idea that more opaque clients are given worse loan conditions.

In columns 7 through 9, we added interactions between FL and the opacity dummy. In column 7, the result indicates that the loans with FL and a long relationship do not present higher interest rates (first coefficient not significant) than the base category. In contrast, the second coefficient indicates that loans with a short relationship and not using FL present an interest rate 0.277 percentage point higher than loans which do not use AF either, but have a long relationship, confirming that opacity (short relationship) is positively associated with interest rate. The third coefficient shows that, among loans with FL, clients with a short relationship borrow at a higher interest rate on average. The difference between loans that use FL and have a short relationship in relation to those which use other collaterals and have a long relationship is 0.926 percentage point (given by the sum of coefficients $\beta 1, \beta 2$ e $\beta 3$).

In column 8, we have the effect on the grace period. Loans with FL and a long relationship present a grace period 1.35 month longer than those with other collaterals and a long relationship. Loans with a short relationship but with other collaterals present a grace period 0.159 month (approximately 5 days) shorter. The third coefficient indicates that, among loans with FL, those provided for short-relationship borrowers present a grace period 1.3 month shorter.

Finally, column 9 presents the effect on balance. Loans with FL and a long relationship present a balance 15.02% (= $e^{0.140} - 1$) greater than those with other collaterals and a long relationship. Among the loans with a short relationship but with other collaterals, they present a balance 26.94% smaller (= $e^{-0.314} - 1$). Finally, the third coefficient shows that, among loans with FL, the balance is 13.8% smaller (= $e^{-0.148} - 1$).

The implications of the results shown in Table 6 are that AF does improve grace period and balance conditions, but only when the relationship is already long. Therefore, borrowers with a longer bank relationship can obtain longer grace periods and greater values by using FL. Considered together with the regressions in Table 3, the results indicate that, for more opaque clients (with a short relationship), FL can work as a credit access tool, but not as a mechanism for improving loan terms (besides selection itself). To reinforce the findings of this section, we re-estimated Equation 2, changing the RelatT1 dummy for relationship length in years (Relat) and using a complete sample. The results are qualitatively similar to those presented in Table 5 and are not reported in order to save space.

While our tests are not directly comparable to those of Assunção et al. (2014) for the auto loan market, our inferences reveal nuances peculiar to rural loans. For example, the results of Assunção et al. (2014) show that there was a reduction in the rates of loans using FL, though the older the financed vehicle, the smaller the reduction. Assuming that used car buyers are more opaque, the results are consistent with ours in that the effect of reduced loan cost with FL occurs among less opaque borrowers. Both that study and ours seem to indicate that, among more opaque borrowers, FL seems to be more linked to credit access than to loan conditions.

Table 6. Regression of loan conditions against collaterals and relationship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Rate	**G. Period**	***ln*(Balance)**	**Rate**	**G. Period**	***ln*(Balance)**	**Rate**	**G. Period**	***ln*(Balance)**
FL	0.633***	0.444**	-0.098***	0.465***	0.522***	0.046*	0.141	1.355***	0.140***
	(0.132)	(0.173)	(0.032)	(0.120)	(0.168)	(0.026)	(0.123)	(0.247)	(0.037)
RelatT1				0.288***	-0.189***	-0.318***	0.277***	-0.159***	-0.314***
				(0.047)	(0.051)	(0.015)	(0.047)	(0.050)	(0.015)
FL × RelatT1							0.508***	-1.306***	-0.148***
							(0.185)	(0.259)	(0.047)
Intercept	11.169***	12.745***	11.883***	17.117***	14.047***	12.442***	17.113***	14.045***	12.441***
	(0.003)	(0.004)	(0.001)	(0.549)	(0.316)	(0.041)	(0.549)	(0.316)	(0.041)
Controls (L+B) •	N	N	N	Y	Y	Y	Y	Y	S
$\delta_t \cdot \delta_e$	Y	Y	Y	Y	Y	Y	Y	Y	S
Obs	74,643	74,643	74,643	74,643	74,643	74,643	74,643	74,643	74,643
Adjust. R^2	0.3291	0.2354	0.1975	0.3462	0.2389	0.3105	0.3462	0.2394	0.3106

Note. *, ** and *** represent statistical significances at 10%, 5% and 1% level, respectively. All standard errors were clustered at the $\delta_t \cdot \delta_e$ level. • The control variables are removed from the regression as they are used as dependent.

Source:

Collaterals and occurrence of default

This section presents the results of the tests for hypothesis III, carried out by applying the linear probability regression models to the test of the association between using FL and the occurrence of default. In Equation 3, we have the basic model for testing the association between the use of FL and the occurrence of default. This specification will be used with and without controls for the characteristics of loan (L) and borrower (B). All specifications include month fixed effects by borrower's federative unit,

$$\text{Default}_i = \gamma_0 + \gamma_1 \text{FL}_i + \text{L}_i + \text{B}_i + \delta_t \cdot \delta_e + \epsilon_i \quad (3)$$

where default is a variable with value 1 if the borrower is in default, and 0 otherwise, at any time of the observation. The linear probability model of Equation 3 is estimated through ordinary least squares (OLS). In a second stage, we modified the model presented in Equation 3 to test the effect of the other collaterals in the sample. Therefore, the FL dummy is replaced by two other dummies of collateral types: rural mortgage (RM) and rural pledge (RP). In specifications 1 and 2, the coefficient of interest of Equation 3, γ_1, captures the association between the use of FL as loan collateral and the event of default in relation to the other types of collateral (RP and RM), on average. In specifications 3 and 4, we used the modified model to make the comparison of RM and RP against FL. Therefore, the coefficient associated with each of these collaterals will capture the association between the use of RM or RP with the event of default in relation to FL, on average. We highlight the interpretation of *association* (and not a causal interpretation) of the coefficient, since the type of collateral is possibly associated with non-observed borrower characteristics.

Table 7 presents the results of the estimation of Equation 3. In column 1, the model is estimated through OLS without controls at the borrower and loan levels. The coefficient γ_1 indicates that loans with FL have a default 2.1 percentage points greater than loans with other types of collateral, on average, a result statistically significant at 1% level. The estimation with addition of controls, reported in column 2, our preferred specification, has a result qualitatively similar, though the magnitude of the coefficient is smaller, i.e., loans with FL present a default probability 1.4 percentage point above those of the other collaterals. In columns 3 and 4, the FL dummy is changed for RM and RP, with and without controls. As expected, the coefficients have opposite signs to what was observed in specifications 1 and 2.

The results in Table 7 indicate that, holding all else constant, the group of loans using FL as collateral presented a greater default probability. Consistent with hypothesis III, our argument is that the bank possibly requires riskier borrowers to provide collaterals with a greater capacity of recovery in case of default, which is consistent with the moral hazard models, which hold that riskier borrowers usually offer collaterals to offset their lower creditworthiness (Tirole, 2005), and with the empirical finding of Assunção et al. (2014) that FL is associated with riskier clients. However, we stress that the results cannot be interpreted in a causal manner, i.e., it would not

be correct to affirm that the use of FL causes increased occurrence of default. The previous results indicate that AF is used as a borrower selection mechanism in that it is used for more opaque (and possibly riskier) borrowers. Thus, our model of Equation 3 possibly has an omitted variable (borrower creditworthiness). The use of FL is associated with worse creditworthiness, which in turn is what causes increased default.

Table 7. Regression of occurrence of default against collaterals

	(1)	(2)	(3)	(4)
FL	**0.021*** **	**0.014*** **		
	(0.005)	(0.005)		
RP			-0.036***	-0.025***
			(0.005)	(0.005)
RM			-0.019***	-0.013***
			(0.005)	(0.005)
Intercept	0.039***	0.043***	0.060***	0.062***
	(0.000)	(0.012)	(0.005)	(0.013)
Controls (L+B)	N	Y	N	Y
$\delta_t \cdot \delta_e$	Y	Y	Y	Y
Obs	110.662	110.662	110.662	110.662
Adjust. R^2	0.0104	0.0252	0.0111	0.0255

Note. *, ** and *** represent statistical significances at 10%, 5% and 1% level, respectively. All standard errors were clustered at the MONTH × UF level. Standard errors are shown in parentheses.

Source:

Additional tests and robustness

We repeated the estimations of Table 6 using a logit model. The inferences are qualitatively similar to those reported in Table 6. The specification used adopted all the controls which varied in time (see vectors L e B, in Equation 1), thought without using fixed effects as these do not have the same interpretation as that of linear models. The results indicate that FL presents a default probability of 4.4%, against 1.7% for RP and 3% for RM. Additionally, we re-estimated the models of Tables 5, 6 and 7 using also the observations of states that had been excluded from the main tests. All the inferences continue to hold with that sample. The results of the tests of this section are not reported due to space limitations and are available upon request.

CONCLUSION

This study investigates the role of collaterals in the provision of rural loans in Brazil, using an unpublished database provided by a large bank. Our results are consistent with the central hypothesis that forms of loan in which collaterals can be recovered quicker and more efficiently allow access to credit for more opaque borrowers. More specifically, FL is associated with access to credit by borrowers with less than a year of bank relationship, and it is less likely to be used as bank relationship length increases. In addition, our results are consistent with our second hypothesis, i.e., the effect is greater in states where the bank's presence is smaller, indicating that information asymmetry can arise not only from a shorter relationship with the borrower themselves, but also due to a smaller interaction between the bank and other rural producers in the same region.

However, credit access does not translate into better loan conditions for these borrowers, since FL only presents an effect of decreased interest rates and increased grace period and loan value for clients with a longer bank relationship. Finally, we found that the increase in access also implies increased default, since this type of collateral allows the bank to take more risks by lending to more opaque clients.

This study contributes to the part of the literature that seeks to understand the effects that more efficient collaterals have on loan access, conditions and outcomes. More specifically, we contribute to the literature which analyzes rural loans (and productive credit to small entrepreneurs in general), an important topic in many emerging countries. Our article shows that the existence of agreements that allow for a quicker, more efficient recovery of collaterals can increase the access to productive credit, which is consistent with the international literature and the literature that investigates the access to consumer credit in Brazil. From the perspective of public policies, our results suggest that reforms which give lenders greater capacity to seize collaterals can expand the access to credit, particularly for those borrowers who struggle to access financing.

This is the first study to use a proprietary database of rural loans for that purpose. We emphasize that, despite the disadvantage of the impossibility of replication of data for legal reasons, the use of these data has the advantage of providing a contribution to the academic literature, with results that until this point would be restricted to the Bank's internal public. Still, as in any study conducted with a single company, it is necessary to be careful about the external validity of results. Any generalization would imply to assume that the bank in question is representative of the rural loan market in Brazil. Although it is not possible to verify that assumption, we consider that the inferences of this article can be useful to policymakers, rural producers and credit managers.

REFERENCES

Araújo, A. P., Ferreira, R. V. X., & Funchal B. (2012). The Brazilian bankruptcy law experience. *Journal of Corporate Finance*, *18*(4), 994-1004. https://doi.org/10.1016/j.jcorpfin.2012.03.001

Assunção, J., Gandour, C., Rocha, R., & Rocha, R. (2020). The effect of rural credit on deforestation: Evidence from the Brazilian Amazon. *The Economic Journal*, *130*(626), 290-330. https://doi.org/10.1093/ej/uez060

Assunção, J. J., Benmelech, E., & Silva, F. S. S. (2014). Repossession and the democratization of credit. *The Review of Financial Studies*, *27*(9), 2661-2689. https://doi.org/10.1093/rfs/hht080

Banco Central do Brasil. (1999). *Resolução nº 2.682. Conselho Monetário Nacional. Retrieved from* https://www.bcb.gov.br/pre/normativos/res/1999/pdf/res_2682_v2_L.pdf

Berger, A. N., & Udell, G. F. (1990). Collateral, loan quality, and bank risk. *Journal of Monetary Economics*, *25*(1), 21-42. https://doi.org/10.1016/0304-3932(90)90042-3

Bester, H. (1985). Screening vs. rationing in credit markets with imperfect information. *The American Economic Review*, *75*(4), 850-855. *Retrieved from* http://www.jstor.org/stable/1821362

Calomiris, C. W., Larrain, M., Liberti, J., & Sturgess, J. (2017). How collateral laws shape lending and sectoral activity. *Journal of Financial Economics*, *123*(1), 163-188. https://doi.org/10.1016/j.jfineco.2016.09.005

Campello, M., & Larrain, M. (2016). Enlarging the contracting space: Collateral menus, access to credit, and economic activity, *The Review of Financial Studies*, 29(2), 349-383. https://doi.org/10.1093/rfs/hhv069

Castro, E. R., & Teixeira, E. C. (2012). Rural credit and agricultural supply in Brazil. *Agricultural Economics*, *43*(3), 293-302. https://doi.org/10.1111/j.1574-0862.2012.00583.x

Cerqueiro, G., Ongena, S., & Roszbach, K. (2016). Collateralization, bank loan rates, and monitoring. *The Journal of Finance*, *71*(3), 1295-1322. *Retrieved from* http://www.jstor.org/stable/43869135

Decreto-lei nº 167, de 14 de fevereiro de 1967. (1967). *Presidência da República. Casa Civil, Subchefia para Assuntos Jurídicos. Retrieved from* https://www.planalto.gov.br/ccivil_03/Leis/1930-1949/L0492.htm

Degryse, H., Ioannidou, V., Liberti, J. M., & Sturgess, J. (2020). How do laws and institutions affect recovery rates for collateral? *The Review of Corporate Finance Studies*, *9*(1), 1-43. https://doi.org/10.1093/rcfs/cfz011

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *Review of Economic Studies*, *51*(3), 393-414. https://doi.org/10.2307/2297430

Doornik, B. F. N. Van, & Capelletto, L. R. (2015). *Collateral after the Brazilian creditor rights reform*. Brazilian Central Bank [Working Paper Series. n. 404]. *Retrieved from* https://www.bcb.gov.br/pec/wps/ingl/wps404.pdf

Duygan-Bump, B., Levkov, A., & Montoriol-Garriga, J. (2015). Financing constraints and unemployment: Evidence from the Great Recession. *Journal of Monetary Economics*, *75*, 89-105. https://doi.org/10.1016/j.jmoneco.2014.12.011

Escola Superior de Agricultura Luiz de Queiroz. (2021). *PIB do agronegócio brasileiro*. *Retrieved from* https://www.cepea.esalq.usp.br/br/pib-do-agronegocio-brasileiro.aspx

Fleisig, H., Safavian, M., & Peña, N. de la. (2006). *Reforming collateral laws to expand access to finance*. World Bank. https://doi.org/10.1596/978-0-8213-6490-1

Heitz, A., Martin, C., & Ufier, A. (2022). *Bank monitoring with on-site inspections*. FDIC Center for Financial [Research Paper No.2022-09]. http://dx.doi.org/10.2139/ssrn.4197344

Jappelli, T., Pagano, M., & Bianco, M. (2005). Courts and banks: Effects of judicial enforcement on credit markets. *Journal of Money, Credit and Banking*, 37(2), 223-244. http://www.jstor.org/stable/3838925

Lei nº 492, de 30 de agosto de 1937. (1937). Presidência da República. Casa Civil, Subchefia para Assuntos Jurídicos. Retrieved from https://legislacao.presidencia.gov.br/atos/?tipo=LEI&numero=492&ano=1937&ato=0530TQE5UejpXTe1f

Lei n° 9.514, de 20 de novembro de 1997. (1997). Presidência da República. Casa Civil, Subchefia para Assuntos Jurídicos. Retrieved from https://www.planalto.gov.br/ccivil_03/LEIS/L9514.htm

Lei n° 10.931, de 2 de agosto de 2004. (2004). Presidência da República. Casa Civil, Subchefia para Assuntos Jurídicos. Retrieved from http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/lei/l10.931.htm

Levine, R. (1998). The legal environment, banks, and long-run economic growth. *Journal of Money, Credit and Banking*, *30*(3), 596-613. https://doi.org/10.2307/2601259

Luck, S., & Santos, J. A. C. (2019, Outubro 10). *The valuation of collateral in bank lending* [SSRN Working Paper]. http://dx.doi.org/10.2139/ssrn.3467316

Martins, T., Schiozer, R. F. & Linardi, F. (2022). The Information Content from Lending Relationships Across the Supply Chain, [SSRN Working Paper]. https://ssrn.com/abstract=4160187

Ponticelli, J., & Alencar, L. S. (2016). Court enforcement, bank loans, and firm investment: Evidence from a bankruptcy reform in Brazil. *The Quarterly Journal of Economics*, *131*(3), 1365-1413. https://doi.org/10.1093/qje/qjw015

Porta, R. La, Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. (1998). Law and finance. *Journal of Political Economy*, *106*(6), 1113-1155. https://doi.org/10.1086/250042

Rajan, R., & Zingales, L. (1998). Financial dependence and growth. *The American Economic Review*, *88*(3), 559-586. https://doi.org/10.3386/w5758

Tirole, J. (2005). *The theory of corporate finance*. Princeton University Press.

CONFLICTS OF INTEREST

The authors have no conflict of interest to declare.

AUTHORS' CONTRIBUTION

Alexandre P. Menezes: Conceptualization, data curation, formal analysis; Investigation; Validation; Visualization; Writing – original draft.
Rafael F. Schiozer: Conceptualization, data curation, formal analysis; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing – original draft; Writing – review and editing.
Lucas N. C. Vasconcelos: Conceptualization, data curation, formal analysis; Investigation; Methodology; Software; Validation; Visualization; Writing – original draft; Writing – review and editing.

