Economics Bulletin

Volume 39, Issue 1

Determinants of the Default Rate of Individual Clients in Brazil and the Role of Payroll Loans

Aline B. Schuh
Federal Institute of Rio Grande do Sul

Pascoal José Marion Filho
Federal University of Santa Maria

Daniel Arruda Coronel
Federal University of Santa Maria

Abstract

Payroll Loans are a relatively recent type of personal loan in the Brazilian credit market, and therefore its effects on the default rate of individual clients are still rather unknown. In this sense, this study aims to evaluate the influence of payroll loans and selected macroeconomic variables, such as the GDP, consumption, unemployment, inflation and the interest rate, on the default rate of individual clients between 2004 and 2016 in Brazil. This was accomplished through the estimation of a Vector Error Correction model (VECM), and through the calculation of impulse response functions, the variance decomposition and the Granger causality. The results show negative long-term relationships between payroll loans and the default rate of individual clients. It was also observed that the default rate reacts negatively to variations in the GDP. On the other hand, the unemployment rate, the interest rate and inflation showed positive long-term relationships with the default rate, and for the consumption variable, the results were inconclusive. It is noteworthy that, except for the consumption index, all other relationships were in agreement with the literature and with the expected behavior, confirming, therefore, that the macroeconomic scenario played a determinant role in the behavior of default rates, and that payroll loans contributed to mitigate the default rates of individual clients in the period.

Citation: Aline B. Schuh and Pascoal José Marion Filho and Daniel Arruda Coronel, (2019) "Determinants of the Default Rate of Individual Clients in Brazil and the Role of Payroll Loans", *Economics Bulletin*, Volume 39, Issue 1, pages 395-408
Contact: Aline B. Schuh - abschuh@gmail.com, Pascoal José Marion Filho - pascoaljmarion@yahoo.com.br, Daniel Arruda Coronel - daniel.coronel@uol.com.br.
Submitted: January 26, 2018. **Published:** February 18, 2019.

Economics Bulletin

Submission Number: EB-18-00087

Determinants of the Default Rate of Individual Clients in Brazil and the Role of Payroll Loans

Aline B. Schuh
Federal Institute of Rio Grande do Sul

Pascoal José Marion filho
Federal University of Santa Maria

Daniel Arruda Coronel
Federal University of Santa Maria

Abstract

Payroll Loans are a relatively recent type of personal loan in the Brazilian credit market, and therefore its effects on the default rate of individual clients are still rather unknown. In this sense, this study aims to evaluate the influence of payroll loans and selected macroeconomic variables, such as the GDP, consumption, unemployment, inflation and the interest rate, on the default rate of individual clients between 2004 and 2016 in Brazil. This was accomplished through the estimation of a Vector Error Correction model (VECM), and through the calculation of impulse response functions, the variance decomposition and the Granger causality. The results show negative long-term relationships between payroll loans and the default rate of individual clients. It was also observed that the default rate reacts negatively to variations in the GDP. On the other hand, the unemployment rate, the interest rate and inflation showed positive long-term relationships with the default rate, and for the consumption variable, the results were inconclusive. It is noteworthy that, except for the consumption index, all other relationships were in agreement with the literature and with the expected behavior, confirming, therefore, that the macroeconomic scenario played a determinant role in the behavior of default rates, and that payroll loans contributed to mitigate the default rates of individual clients in the period.

Submitted: January 26, 2018.

1. Introduction

More than three decades ago, Friedman (1981) had already suggested that the behavior of the credit market is important for the economic activity. Since then, the financial system has been the topic of many academic researches. It is well known, for example, that a greater availability of credit can have positive impacts on the macroeconomic scenario, due to increases in consumption, investments and production (Rodríguez and Venegas, 2012).

It was possibly to this end that the Brazilian government encouraged the granting of credit in Brazil in recent years. As highlighted by Teixeira and Pinto (2012), the expansionary credit policy, which began after the first term of former president Luiz Inácio Lula da Silva (2003-2006), aimed to expand the domestic market. These actions were supported by microeconomic reforms, which included the expansion of payroll loans for workers of the private sector, retirees and pensioners (Morais and Saad-Filho, 2011).

As a result, payroll loans became a relevant option for individual clients and have grown exponentially, mainly due to the advantages this type of credit offers, such as lower interest rates (Borça Jr. and Guimarães, 2015). In addition, according to Paim (2015), the existence of guarantees (automatic payroll deduction) and the satisfactory level of profitability motivated the financial institutions to dispute these clients.

Besides these advantages, Ribeiro (2015) explains that the credit restriction policy for payroll loans is less rigid, which facilitates its granting; however, this fact allows borrowers to increase their level of debt and consumption. Moreover, Barone and Sader (2008) point out that one of the main problems in this type of operations is the misuse of resources, especially by low-income clients and retirees. This way, borrowers might reduce their net income, increase their level of debt and expose themselves to the possibility of default in other commitments.

On the other hand, as stated by Borça Jr. and Guimarães (2015), the resources from payroll loans can be used to replace more onerous debts and reduce the probability of default. Given these two scenarios, it is noteworthy that the stimulus to the granting of payroll loans can have different effects on the default levels of individual clients.

The literature shows that default on the financial system is caused by different factors, but among those, Chu (2001) highlighted that the economic activity is determinant. Nevertheless, there are evidences that part of the increase in personal bankruptcies is related to the liberalization of credit (Dick and Lehnert, 2007).

Based on these theoretical assumptions, this study aims to evaluate the influence of payroll loans and selected macroeconomic variables, such as the GDP, consumption, inflation, unemployment and the interest rate, on the default rate of individual clients between 2004 and 2016 in Brazil. The apprehension in relation to this subject is based on the prerogative that indebtedness and financial crises are related (Russo, Riccetti and Gallegati, 2016). Therefore, an expansion model that facilitates the granting of credit may become limited to generate growth. In addition, payroll loans are a relatively new type of loan in Brazil, and its effects have already been questioned by authors such as Bresser-Pereira (2008), who considers that economic growth stimulated by distributive policies is unsustainable.

Although the impacts of macroeconomic factors on default rates have been examined extensively, the role of payroll loans is relatively ignored in the literature, even though payroll loans have already been considered as one of the main means to stimulate the consumer market in Brazil (Coelho, Mello and Funchal, 2012).

Furthermore, this research proposal was stimulated by recent discussions about the possible negative impacts of increasing the commitment limit with payroll loans, which went from 30% to 35% of the borrower's income in 2015, and more recently, on the possibility of using the employee´s severance fund (FGTS) as a guarantee for payroll loans, as authorized by a Federal Law in 2016.

2. Macroeconomic Context and Default

The behavior of credit and default can negatively affect the economic scenario, and even generate bubbles and crises. According to Capelletto and Corrar (2008), the variables most associated with the occurrence of crises are related to the quality and the volume of credit granted, and to the level of interest rates.

This finding was even more evident after the 2008 crisis. For Jappelli, Pagano and Di Maggio (2013), the subprime crisis corroborated the importance of domestic credit in determining the stability of the financial and economic system. The authors, who analyzed the behavior of default and its relationship with the financial fragility in the USA, the UK and Germany between 1994 and 2001, identified positive relationships between the variables, that is, higher default rates implied greater financial fragility in the analyzed countries.

It is important to note, however, that, as the occurrence of default can influence the economic context, the literature also points out that macroeconomic variables and the behavior of the credit market itself can affect default rates. Regarding this matter, Castro (2012), who examined the relationship between bank credit risk and the macroeconomic situation of Greece, Ireland, Portugal, Spain and Italy between 1997 and 2011, observed that credit risk is higher when there is an increase in the granting of credit and in interest rates. Similarly, Dick and Lehnert (2007) investigated personal bankruptcy in the USA and found that part of the increase in default levels occurred due to the liberalization of the credit market. In addition, the authors concluded that the unemployment rate played a determining role for the phenomenon.

Agarwal and Liu (2003), who analyzed credit card data from 1995 and 2001, also found conclusive evidences of the negative impact of unemployment on consumer delinquency and bankruptcy. Analyzing different macroeconomic variables, Abaidoo (2018) also concluded that adverse macroeconomic conditions, specially inflation, negatively impact loan delinquency rates among US commercial banks.

Exploring the Brazilian context, Schechtman and Gaglianone (2011) analyzed how credit risk in Brazil reacts in vulnerable macroeconomic scenarios and they identified negative relationships between credit risk, the GDP and credit volume, and positive relationships between the level of credit, unemployment, inflation and credit risk. Furthermore, Zaniboni and Montini (2015) found that, in longer time horizons, the relationship between the Brazilian GDP and default is negative, as expected.

Linardi and Ferreira (2009) investigated the banking spread in Brazil and the determinants of default rates between 2000 and 2008 and evidenced that increases in the GDP gap and in the workers' income reduced the default rates. On the other hand, the increase in the Selic rate and in the expectation of inflation caused an increase of the default rates. In this same perspective, Zaniboni and Montini (2014) identified that the higher the level of formal employment in services in Brazil, the lower the levels of default.

Similarly, Souza, Neto and Silva (2016) verified how economic variables explained the default rate of individual clients in Brazil between 2003 and 2015. The authors observed that the default rate responded positively to inflation and unemployment in the period.

Other factors can also explain the occurrence of default in the Brazilian credit market. The Brazilian Central Bank (BACEN) (2014) attributed the reduction of default rates in personal credit operations in 2014 to the lower consumption expansion and to the increase in the concession of payroll loans, which offered longer terms and lower costs.

3. Methodology

The present study was based on the Vector Error Correction Model (VECM), which allowed the estimation of simultaneous equations to model the relations between the variables. Formally, the empirical model employed is expressed in (1):

$$Default_t = \alpha_0 + \beta_1 GDP_t + \beta_2 cons_t + \beta_3 selic_t + \beta_4 unemp_t + \beta_5 inf_t + \beta_6 PRL_t + \varepsilon_t \quad (1)$$

in which: *Default* = default rate of individual clients; *GDP* = gross domestic product; *cons* = consumption index; *selic* = over-Selic interest rate; *unemp* = unemployment rate; *inf* = inflation rate; *PRL* = volume of payroll loans granted in the period.

The time series data employed in the model are monthly and cover the period between January 2004 and June 2016. The default rate of individual clients and the volume of payroll loans granted were obtained from the monthly press releases from BACEN. The GDP and the inflation rate (IPCA – consumer price index) were collected from the BACEN time series database; the over-Selic interest rate and the unemployment rate (rate of unemployment in the Metropolitan Region of Sao Paulo) were from the database of the Institute for Applied Economic Research (IPEADATA). As for the consumption, a proxy was used. The variable chosen was the sales volume of the extended retail trade from the Brazilian Institute of Geography and Statistics (IBGE).

The selection of variables considered those with higher incidence in the literature, and according to the availability of the national databases. The time series in unit of monetary value (R$) were deflated through the IPCA index.

The choice for the VECM occurred after the stationarity tests (ADF and KPSS) and the cointegration test of Johansen. The CUSUM test (detailed in Brown, Durbin e Evans, 1975) was also carried out to verify the stability of the parameters. In addition, the impulse response functions, the variance decomposition, and the Granger Causality Test were calculated. The modeling was performed using Eviews 9.0. All timeseries were transformed into natural logarithm, to normalize the deviations.

4. Results and Discussion

4.1 Stationarity, Cointegration and Structural Break Tests

Firstly, the ADF and KPSS tests were performed to verify the presence of unit roots in all timeseries used in this study. The results are shown in Table 1, and confirm, according to the ADF test, that all variables are stationary when estimated at first difference. The KPSS test results also corroborate the stationarity of the series at first difference, except for the GDP. Despite the divergence, the results of the ADF test indicate that the GDP is stationary at first difference, at a significance level of 1%, thus giving support to confirm its stationarity.

Table 1. ADF e KPSS test results

Variable	ADF				KPSS			
	At Level		At First Difference		At Level		At First Difference	
	τ_t	τ_μ	τ_t	τ_μ	τ_t	τ_μ	τ_t	τ_μ
Payroll	-1,73	-1,66	-12,36*	-12,41*	1,23	0,13	0,17*	0,08*
Default	-2,57	-2,88	-4,28*	-4,29*	0,28	0,16	0,05*	0,05*

GDP	-1,90	0,43	-4,10*	-4,61*	1,41	0,23	0,57	0,27
Consumption	-1,76	0,91	-16,83*	-17,23*	1,31	0,25	0,60	0,21*
Selic	-2,332	-1,43	-3,17**	-3,62**	0,67	0,24	0,25*	0,14**
Unemployment	-0,52	2,52	-2,69***	-3,47**	0,41	0,27	0,32**	0,10*
Inflation	-5,42*	-5,63*	-8,62*	-8,62*	0,53	0,12	0,09*	0,09*

Source: Elaborated by the authors based on the results.

Note: τ_t denotes analysis with constant; τ_μ denotes analysis with constant and trend. *, **, *** denote significance level of 1%, 5% e 10%, respectively.

Subsequently, the existence of long-term relationships between the series was verified. However, before performing the Johansen test, it was necessary to define the length of the lags. The results, which are outlined in Table 2, show that the criteria differ in relation to the maximum number of lags.

According to the Akaike's criterion, the ideal number of lags would be eight. The Schwarz's criterion indicated the need for one lag, while the Hannan-Quin criterion pointed to the presence of two lags. Considering this divergence, we chose to follow Stock's (1994) recommendation and use the Schwartz's criterion, since it is considered more robust and parsimonious.

Table 2. Lag order selection criteria test

Lag	LogL	LR	FPE	AIC	SBIC	HQIC
0	562,7914	NA	9,40e-13	-7,828048	-7,682338	-7,768837
1	1746,505	2234,050	1,08e-19	-23,80992	-22,64425*	-23,33624
2	1858,257	199,8943	4,47e-20	-24,69375	-22,50811	-23,80560*
3	1919,219	103,0345	3,83e-20	-24,86223	-21,65662	-23,55960
4	1983,035	101,5673	3,18e-20	-25,07092	-20,84534	-23,35381
5	2026,034	64,19536	3,59e-20	-24,98639	-19,74084	-22,85482
6	2093,113	93,53215	2,95e-20*	-25,24102	-18,97550	-22,69497
7	2138,143	58,34903	3,39e-20	-25,18511	-17,89962	-22,22458
8	2195,401	68,54834*	3,39e-20	-25,30142*	-16,99596	-21,92642

Source: Elaborated by the authors based on the results.

Note: * denotes lag order selected by the criterion.

After the definition of the optimal number of lags, the Johansen cointegration test was performed. The results are detailed in Table 3 and show the existence of four and six cointegration vectors, according to the eigenvalue and trace statistic, respectively. These results confirm the occurrence of long-term relationships between the series.

Table 3. Johansen cointegration test

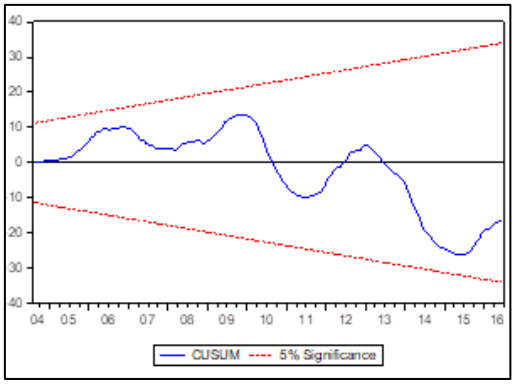
Number of Cointegration Vectors	Eigenvalue	Critical Value (5%)	Trace Statistic	Critical Value (5%)
None	59,32882*	46,23142	223,1967*	125,6154
At most 1	53,15408*	40,07757	163,8679*	95,75366
At most 2	46,74528*	33,87687	110,7138*	69,81889
At most 3	29,11845*	27,58434	63,96850*	47,85613
At most 4	16,75628	21,13162	34,85005*	29,79707
At most 5	14,78899	14,26460	18,09378*	15,49471
At most 6	3,304791	3,841466	3,304791	3,841466

Source: Elaborated by the authors based on the results.

Note: * denotes the rejection of the hypothesis at the 5% level.

Finally, the CUSUM statistical test was carried out, as illustrated in Figure 1. The results show that the sums of the residues are within the critical range of 5%, that is, there is no indication of instability over the period, confirming that the VECM could be estimated.

Figure 1. CUSUM Test



Source: Results from Eviews.

4.2 Vector Error Correction Model

The VECM was estimated with one lag and four cointegration vectors. The results of the long-term estimates are detailed in Table 4 and show that the behavior of payroll loans, unemployment, inflation, GDP and the Selic rate were significant to explain the default rate in the long run. However, the same did not occur for the consumption variable.

Table 4. Results of VECM long-term estimates

Default	Payroll	Consumption	Unemp.	Inflation	GDP	Selic
1,0000	-1,310550	0,164477	4,629215	0,912337	-11,13826	2,022998
	(0,25319)	(2,21811)	(0,66634)	(0,14470)	(4,24611)	(0,41208)
	[5,17611]	[-0,07415]	[-6,94728]	[-6,30513]	[2,62316]	[-4,90924]

Source: Elaborated by the authors based on the results.
Note: Standard errors in ( ); t-statistics in [ ].

The coefficients show that an increase in the volume of payroll loans, in the order of 1%, entails a reduction of -1.31% in the default rate. This reduction confirms the negative relation expected and proves that payroll loans have contributed to improve the default situation of individual borrowers. For Borça Jr. and Guimarães (2015), one of the reasons for this is the use of payroll loans to pay off other more expensive debts, such as overdrafts.

The unemployment rate was also decisive for the default rate, as the increase of unemployment in the order of 1% reflects in a 4.63% increase in the level of default in the period. This behavior meets the expected results (BACEN, 2014; Schechtman and Gaglianone, 2011; Souza, Neto and Silva, 2016).

Similarly, the relationship between inflation and the default rate of individuals corroborates the results obtained by Souza, Neto and Silva (2016) and by Schechtman and Gaglianone (2011). Table 4 shows that an increase of inflation, in the order of 1%, implies an increase of 0.91% in default. Such a positive relation can be attributed to the negative effect that inflation has on the purchasing power, and consequently on the income of individuals.

The importance of income and the economic scenario on agents' ability to pay off their debts was also confirmed by the relationship between the default rate and the GDP, which presented

a negative correlation, as suggested by Schechtman and Gaglianone (2011), and by Zaniboni and Montini (2015). The effects were elastic, since an increase in the order of 1% in the GDP implies a reduction of the level of default by 11.14%.

Finally, Table 4 indicates that the increase of the Selic rate, in the order of 1%, entails a 2.03% increase in the default rate. This relationship corroborates the results obtained by Linardi and Ferreira (2009). According to the authors, it is consistent to expect such relationship, as it generally impacts the interest rates charged by banks on loans, reflecting the amount to be paid to settle debts, and due to its negative effects on the economic activity.

Regarding the VECM results for the short-term estimates, these were significant for all variables, except for consumption, as shown in Table 5.

Table 5. Results of VECM short-term estimates

Default	Payroll	Consumption	Unemp.	Inflation	GDP	Selic
0,015993	-0,079049	0,007535	0,041489	-0,297183	-0,000994	-0,036625
(0,00579)	(0,02483)	(0,00501)	(0,00819)	(0,10403)	(0,00049)	(0,01766)
[2,76079]	[-3,18304]	[1,50354]	[5,06533]	[-2,85667]	[-2,04884]	[-2,07336]

Source: Elaborated by the authors based on the results.
Note: Standard errors in ( ); t-statistics in [ ].

The coefficient referring to the payroll loan variable indicates a negative relation and reveals that the short-term imbalances are corrected with a speed of 7.90% each month. This means that the default rate reacts relatively fast to changes in payroll loans, that is, there is an expressive degree of sensitivity among these variables in the short term. The speed of this response can be attributed to the destination of resources, which could have been used to replace debts, as detailed previously (see Borça Jr. and Guimarães, 2015). In this case, it can be inferred that, in addition to contributing to improve the liquidity of borrowers, the funds from payroll loans might have been immediately directed to settle overdue operations.

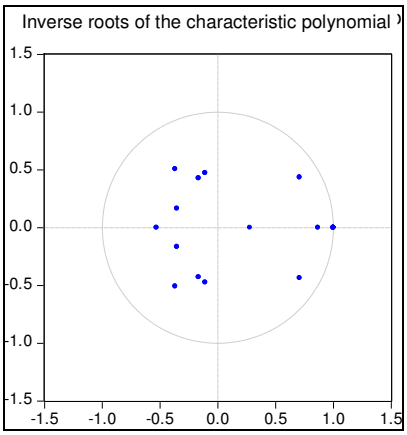
Similarly, the result obtained for the unemployment variable reveals that short-term imbalances are corrected with a speed of adjustment of 4.14% each month, indicating that changes in the labor market do not take long to influence the capacity of payment of individual clients. A similar reaction was obtained for the Selic interest rate coefficient, which expresses that imbalances in relation to its long-term values are corrected at a rate of 3.66% each month.

An even faster response is observed for the inflation variable, since its short-term imbalances are corrected with a rate of 29.72% in each period. As mentioned earlier, high inflation impairs economic stability, reducing the purchasing power of the population, and the results indicate that its effects are quickly perceived by individual borrowers.

The same, however, does not occur for the GDP, since the coefficient obtained shows that short-term imbalances tend to be corrected slowly, with an adjustment speed of 0.01% each month. The sense of the relationship is negative, confirming the important role that the increase of income levels and the improvement in the economic scenario exert on the default rates, nevertheless, this answer happens gradually.

As a final step of the VECM estimation, the inverse roots of the characteristic polynomial were verified, as shown in Figure 2. The results confirm that the stability condition of the model was met, since no root is contained outside the unit circle.

Figure 2. Inverse roots of the characteristic polynomial

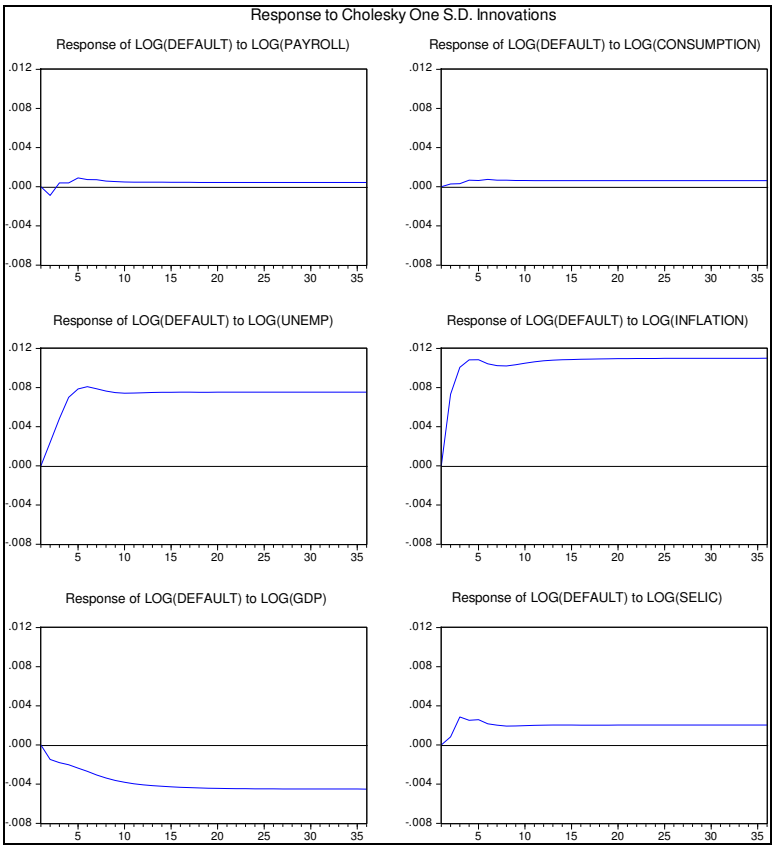


Source: Results from Eviews.

4.3 Impulse-response functions

After analyzing the long and short-term relationships provided by the VECM, the impulse-response functions were calculated. The behavior of default rates after the introduction of shocks on the selected macroeconomic variables and payroll loans are illustrated in Figure 3.

Figure 3. Result of the Impulse-response functions



Source: Results from Eviews.

The maximum effects of the granting of payroll loans on the default rate are eliminated after approximately sixteen periods. Initially, when introducing a shock on payroll loans, the default rates decline by 0.009 percentage points in the first two periods. Immediately after this decline, the level of default rises to 0.009 percentage points in the fifth period, and gradually retreats to the sixteenth period, when it stabilizes at 0.004 percentage points.

This reaction is in accordance with the literature, as detailed previously, and reinforces the results of the VECM, which indicated that, in the short term, default is more sensitive to the variations in the concession of payroll loans, with a relatively fast adjustment speed. In the long run, the effects are stable, with a negative trend, but they are limited.

From this behavior it is possible to infer that the taking of payroll loans improves the financial situation of the borrower, either by regularizing overdue debts or by replacing more expensive debts. The fact that its effects are limited and less significant when compared to the other variables is coherent, since there is a maximum commitment level according to the payroll of the client, and the contracting of a payroll loan has an impact on the net income of the borrower, especially in the long term. In addition, it must be considered that not all defaulting clients have the possibility, or the intention, to contract a payroll loan to pay off other debts.

Regarding the behavior of the default rate against a shock in consumption, it is observed that the effects are also reduced. The increase in consumption raises the default rate by 0.007 percentage points until the seventh period. Subsequently, the effects are eliminated and stabilize close to zero. Nevertheless, the results corroborate the expected behavior. However, the confrontation of the trajectory of the variable in relation to the VECM results was not possible, since the consumption coefficients for the long and short-term equations were not significant.

A positive reaction is also observed when introducing a shock on unemployment, which results in an increase of up to 0.081 percentage points in the default rate of individual clients already in the sixth period. Subsequently, the effects are reduced, and stabilize at 0.075 percentage points. Such behavior is in line with the VECM estimates. In addition, although it is intuitive to expect the expansion of unemployment to reflect the continuous increase in default rates, it is consistent to emphasize that, if the level of unemployment remains high, it may negatively impact the credit granting and, consequently, limit the incidence of default in the long run, due to restrictions on borrowing.

It was also verified that the default rate responds quickly, and elastically, to the variations in inflation rate. When introducing a shock in inflation, the default rate increases by 0.100 percentage points in the fourth period, and continues to rise until the twenty-first period, when it stabilizes at 0.110 percentage points. The behavior observed between the default rate and inflation is in agreement with what was expected and corroborates the estimates of the VECM.

A positive reaction is also noticed in the default rate when introducing a shock on the interest rate. Despite the small fluctuation in the short term, it is observed that, in the first three periods, the default rate increases by 0.029 percentage points. Between the third and the ninth period, there is a retraction in the default rate, but it rises again in the tenth period, and stabilizes at 0.020 percentage points. In general, it is noted that the interest rate has a positive influence on the default rate of individual clients, as indicated by the VECM. In addition, the results are in line with the literature (Linardi and Ferreira, 2009; Capelleto and Corrar, 2008; Castro, 2012).

Finally, there is a negative relationship between the default rate and the GDP. Promptly, in the fourth period, the default rate falls by 0.020 percentage points, and it continues to decrease gradually. The effects are only eliminated after the 26th period, when the reduction in the default rate stabilizes at -0,045 percentage points. It is worth noting that the VECM indicated an elastic relationship between these variables and a slow rate of adjustment. When analyzing the dispersion of the impulse-response function, both VECM results are perceived, since a significant decrease of default is evident as GDP increases, and this response occurs gradually. Moreover, the negative direction of this relationship reinforces the determinant role that income

and the economic scenario exert on the financial situation of individuals, and corroborates the results pointed out by Schechtman and Gaglianone (2011) and by Zaniboni and Montini (2015).

4.4 Variance Decomposition and Granger Causality Test

The next step consisted in the variance decomposition of the prediction errors. The results are presented in Table 6 and indicate that, in the initial period, the incidence of default is fully explained by its own behavior. As time goes by, there is a significant increase in the share of unemployment, inflation and GDP. For the other variables, the participation is reduced.

Table 6. Results of the Variance Decomposition, in (%).

Period	Default	Payroll Loans	Consumption	Unemployment	Inflation	GDP	Selic
01	100,00	0,00	0,00	0,00	0,00	0,00	0,00
06	88,17	0,04	0,03	3,21	7,79	0,35	0,42
12	86,20	0,03	0,03	4,06	8,54	0,76	0,37
18	85,28	0,03	0,03	4,29	8,99	1,03	0,36
24	84,77	0,02	0,03	4,39	9,24	1,19	0,36
36	84,25	0,02	0,03	4,49	9,49	1,35	0,35
48	83,99	0,02	0,03	4,55	9,63	1,44	0,35

Source: Elaborated by the authors based on the results.

From the beginning, payroll loans have a low explanatory power (0.04% in the sixth period, 0.03% in the twelfth and eighteenth periods), and do not suffer significant modifications over time. The same occurs for the consumption variable, which, in the first six months, explains 0.03% of errors, and after forty-eight periods, its share continues to explain the same value.

What stands out is the representativeness of inflation, which significantly increases its explanatory power over the period, from 7.79% in the sixth month to 9.63% in the forty-eighth month. Similarly, the unemployment rate also raises its participation rate over time, initially explaining 3.21% of default errors in the sixth period, and 4.55% in the forty-eighth month.

The share of GDP is also significant and is broadly increasing. It can be observed that, in the sixth period, GDP accounts for 0.35% of default errors, but after forty-eight periods, it explains 1.44%. On the other hand, the Selic interest rate initially has a higher participation, explaining 0.42% of the forecast errors of default in the sixth period. However, in subsequent periods, this percentage gradually decreases to reach 0.35% in the forty-eighth month.

Comparing the results of the variance decomposition with the impulse-response functions, there is a consistency between the two, since the figures show that the dispersion of the default rate, due to shocks on payroll loans and consumption, is not elastic, but higher in the early periods. On the other hand, the reaction of default in the face of shocks on the other variables demonstrates a greater elasticity, especially in relation to inflation, unemployment, GDP and, to a lesser extent, the Selic rate.

The final step of the study involved the estimation of the Granger Causality test. The results are shown in Table 7 and indicate that the null hypothesis is rejected for all variables, except for the consumption variable. This means that the variations in payroll loans, the unemployment and inflation rate, the GDP and the Selic interest rate preceded the variations in the default rate of individual clients between 2004 and 2016.

Table 7. Results of the Granger Causality Test

Relationships	F Statistics	Probability
Payroll Loans → Default	2,49737	0,0459
Consumption → Default	0,32099	0,7260
Unemployment → Default	2,90604	0,0509
Inflation → Default	3,25959	0,0413
GDP → Default	2,88181	0,0503
Selic → Default	3,86777	0,0231

Source: Elaborated by the authors based on the results.

These results reinforce the other estimates previously mentioned and the evidence from the literature. Regarding consumption, the Causality test indicates that the variation of this variable does not cause the default rate of individual clients. This result agrees with those obtained by the VECM, which did not present significant coefficients for this relation, and is close to the behavior illustrated by the impulse-response functions and by the variance decomposition, which showed little significant relations between the two variables. Therefore, it is not possible to say whether, in fact, consumption is not determinant for the occurrence of default, or if the results found were not significant due to the variable used as a proxy for consumption. However, the estimated model was robust and satisfactory for the other variables analyzed, confirming the main studies on the theme, as contrasted throughout this section.

5. Final Considerations

The present study investigated the relationships between the default rate of individual clients, selected macroeconomic variables, and the granting of payroll loans in Brazil between 2004 and 2016. Estimates of the long-term econometric model revealed negative relationships between payroll loans and the default rate of individual clients, and between this and the GDP. The unemployment rate, the Selic rate and inflation showed positive long-term relationships with the default rate of individual clients. This scenario shows that the volume of payroll loans granted and the macroeconomic aggregates, especially the GDP, unemployment and inflation, and to a lesser extent, the Selic rate, were decisive factors for the default rate in the period. As for the consumption variable, the results were inconclusive.

Even though payroll loans have contributed in a smaller scale to mitigate the level of default of individual clients, this type of loan emerges as an alternative that allows the financial restructuring of borrowers. However, its effects are still limited because its granting is conditioned to the borrower´s formal income.

Although the results were consistent, it is considered as limiting the fact that the study incorporated a proxy variable for consumption that did not generate the expected results. Also, there is some difficulty in comparing the results, since payroll loans are a relatively new type of credit and almost a Brazilian exclusivity, as they are not common in other countries, so the international literature is still incipient about the subject. This gap, however, gives the possibility of further exploration. It is suggested, for example, to deepen the analysis on the capacity that payroll loans have to reduce the levels of default, introducing to the model other credit modalities for comparisons.

References

Abaidoo, R. (2018). Loan delinquency and macroeconomic conditions: An ARDL and error correction approach. *American Journal of Business*, **33**(3), 82-95.

Agarwal, S., and Liu, C. (2003). Determinants of credit card delinquency and bankruptcy: Macroeconomic factors. *Journal of Economics and Finance*, **27**(1), 75-84.

Banco Central do Brasil. (2014) "Relatório de economia bancária e crédito", Brasília. **URL:** *http://www.bcb.gov.br/pec/depep/spread/rebc_2014.pdf.*

Barone, F. M. and Sader, E. (2008) "Acesso ao crédito no Brasil: evolução e perspectivas" *Revista de Administração Pública* **42**(6), 1249-1267.

Borça Jr., G. and Guimarães, D. (2015) "Impacto do ciclo expansionista de crédito à pessoa física no desempenho da economia brasileira 2004-2013" *Revista do BNDES* **43**, 119-159.

Bresser-Pereira, L. C. (2008) "Tendência à sobreapreciação da taxa de câmbio e desenvolvimento sustentado no Brasil" *Anais do Fórum de Economia da Fundação Getúlio Vargas*, São Paulo, SP, Brasil, 5.

Brown, R. L., Durbin, J. and Evans, J. M. (1975) "Techniques for testing the constancy of regression relationships over time" *Journal of the Royal Statistical Society* **37**(2), 149-192.

Capelletto, L. R. and Corrar, L. J. (2008) "Índices de risco sistêmico para o setor bancário" *Revista Contabilidade e Finanças* **19**(47), 6-18.

Castro, V. (2012) "Macroeconomic determinants of the credit risk in the banking system: the case of the GIPSI" *Working Paper Series do Núcleo de Investigação em Políticas Econômicas*.

Chu, V. Y. T. (2001) "Principais fatores macroeconômicos da inadimplência bancária no Brasil" *Juros e spread bancário no Brasil/Banco Central do Brasil*.

Coelho, C. A., Mello, J. M. P & Funchal, B. (2012). "The Brazilian payroll lending experiment". *Review of economics and statistics*, **94**(4), 925-934.

Dick, A. and Lehnert, A. (2007) "Personal bankruptcy and credit market competition" *Staff Report/Federal Reserve Bank of New York number 272.*

Friedman, B. F. (1981) "The roles of money and credit in macroeconomic analysis" *National Bureau of Economic Research Working paper series number 831*.

Jappeli, T., Pagano, M. and Di Maggio, M. (2013) "Households´ indebtedness and financial fragility" *Journal of Financial Management, Markets and Institutions* **1**(1).

Linardi, F. de. M. and Ferreira, M. S. (2009) "Spread bancário e os determinantes da inadimplência" in *Meeting of the Brazilian Econometric Society*, Foz do Iguaçu, PR, Brasil, 31.

Morais, L. and Saad-Filho, A. (2011) "Da economia política à política econômica: o novo-desenvolvimentismo e o governo Lula" *Revista de Economia Política* **31**(4), 507-527.

Paim, B. (2015) "Perfil da dívida das famílias e o Sistema Financeiro Nacional" *Indicadores Econômicos FEE* **42**(4), 9-24.

Ribeiro, P. F. (2015) "Consumo, poupança precaucionaria, lei crédito consignado e impacto sobre a alocação de ativos e distribuição de consumo" Tese de Doutorado *Fundação Getúlio Vargas*, Rio de Janeiro, Brasil.

Rodríguez, A. and Venegas, F. (2012) "Racionamento de crédito: perspectiva de la nueva economia Keynesiana" *Revista Problemas del Desarrollo* **171**(43), 31-54.

Russo, A., Riccetti, L. and Gallegati, M. (2016) "Increasing inequality, consumer credit and financial fragility in an agent based macroeconomic model" *Journal of Evolutionary Economics* **26**(1), 25-47.

Schechtman, R. and Gaglianone, W. P. (2011) “Macro stress testing of credit risk focused on the tails” *Working Paper Series number 241,* 1-50.

Souza, C. de., Neto, O. J. de O. and Silva, J. G. da. (2016) “Pesquisa sobre a inadimplência de pessoas físicas no Brasil no período (2003-2015)” *Revista Contabilidade, Ciência e Gestão* 4(1).

Stock, J. H. (1994) “Unit roots, structural breaks and trends” *Handbook of econometrics* **4**, 2739-2841.

Teixeira, R. A. and Pinto, E. C. (2012) “A economia política dos governos FHC, Lula e Dilma: dominância financeira, bloco no poder e desenvolvimento econômico” *Economia e Sociedade* **21**, 909-941.

Zaniboni, N. C. and Montini, A. de A. (2015) “Modelo de defasagem distribuída polinomial para teste de estresse do sistema financeiro no Brasil” *Anais do Seminários em Administração*, São Paulo, SP, Brasil, 18.

Zaniboni, N. C. and Montini, A. de A. (2014) “A inadimplência de pessoas físicas do Sistema Financeiro no Brasil explicada por meio de fatores macroeconômicos” *Anais do Seminários em Administração*, São Paulo, SP, Brasil, 17.