



# **The Effects of the Brazilian Economic Recession of 2014-2016 on the Default Credit Card and in Private Label Card in the Food Retail**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors CAT and PRV designed the study, performed the statistical analysis and wrote the first draft of the manuscript. All authors managed the analyses of the study. All authors managed the literature searches. All authors read and approved the final manuscript.*

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## **ABSTRACT**

This study explores the effects of the Brazilian recession from 2014 to 2016 on the default of market credit cards and Private Label cards in food retail in a comparative way, through econometric analysis. The research evaluates the credit card default response in the market and, also, Private Label cards, after simulating shocks in macroeconomic variables such as Gross Domestic Product, wages, and unemployment rate, among others, through the application of an autoregressive vector model (VAR model). The data, on a monthly basis, were collected at the Central Bank of Brazil, the Brazilian Institute of Geography and Statistics and at a company in the private label card market. In addition, precedence tests are applied in order to check if there was any causality "in the sense of Granger" on the default of the market credit card and the Private Label card. Among the results found, it was possible to identify that the default rates of the credit card in the market and of the Private Label have different behaviors, from the simulations of the impulse response functions to the identification of the variables that precede them, being that the default of the Private Label card preceded a higher number of variables when compared to the default of credit cards in the market.

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## 1. INTRODUCTION

The Brazilian economy underwent profound transformations from the mid-1990s, with the implementation of the Real Plan in 1994, which promoted the stabilization of prices in the economy after decades of high inflation. From the 2000s onwards, the beginning of the upward cycle of commodity prices benefited the Brazilian economy, promoting accelerated economic growth with an expansion of the credit market and a drop in interest rates. The 2007/2008 international financial crisis temporarily interrupted the growth trajectory. After the impacts of the subprime crisis, the Brazilian economy recovered quickly, but a combination of an adverse international scenario with unsustainable domestic macroeconomic policies (excessive central government spending) and a certain leniency with inflation resulted in one of the biggest recessions in history, affecting economic growth and directly impacting the credit market.

Brazil went through the biggest economic recession in its history between 2014 and 2016, according to the Economic Cycles Dating Committee of the Getúlio Vargas Foundation, a period in which the Gross Domestic Product (GDP) contracted by seventeen percentage points. In addition to the drop in output, an unemployment rate reached 12.0% of the population in December 2016 and increased to 13.7% in March 2017. The downturn in the economy brought several consequences, such as the indebtedness of families, the drop in salary mass and, in the financial market, the reduction of credit granting by institutions and the increase in defaults.

Due to this moment experienced in the Brazilian economy in the period from 2014 to 2016, this study seeks to identify the effects on credit card default in the Brazilian market and Private Label credit cards in the food retail in a comparative way, through an analysis econometric. The problem investigated in this research arose from the observation of the real case of a private label credit card company focused on food, which, during this period, did not show any deterioration in its default indicators in its portfolio. Due to the maintenance of default rates during the recession period, the company's management did not change its credit policy, maintaining the approval and credit granting rates even in the

face of the systematic deterioration of macroeconomic indicators, unlike the market in general, which reduced concession rates to control default rates.

However, in the second half of 2017 and especially in 2018, after Brazil technically came out of recession with an interruption of the consecutive declines in GDP, one operation analyzed showed a strong deterioration of its portfolio due to high default rates. On the other hand, credit card market indicators in general presented by the Central Bank of Brazil (BCB) remained stable with a slight drop from 2017 onwards.

Therefore, the objective of this study is to verify a possible precedence of macroeconomic indicators over default through the application of causality tests in the Granger sense, as well as simulated effects of shocks on macroeconomic variables on default through an autoregressive vector model (VAR). The results obtained in this analysis will help the market to take preventive decisions if a new economic crisis such as the one mentioned occurs again, especially for the case of the card company observed in this study. The name of the private label credit card company used in this research was intentionally omitted for reasons of strategy and confidentiality, despite the permission obtained for the use of data, econometric analysis and conducting the research.

The historic expansion of the card market in Brazil was driven by economic and social development together with the action of participants in the electronic payments system. Some factors, such as the expansion of network capillarity, expansion of the cardholder base through the emergence of new issuers and increased banking access, in addition to technological advances, which ensured greater speed and security of transactions, helped to consolidate "plastic culture" in Brazil. Since then, the market has been consolidating year after year to the detriment of the use of cash and, especially, checks. According to the Brazilian Association of Credit Card and Services Companies (ABECS), the year 2018 ended with approximately 40% of private consumption in Brazil transacted via card compared to only 19.5% in 2009. There are already more than 50 issuers of card, more than 20 acquirers, more than 10 brands and more than 200 fintechs and

payment facilitators. In transaction volume, 2018 closed with R\$1.55 trillion of total volume transacted, R\$965 billion of which on credit card alone.

The ABECS survey also highlights that 95% of credit card holders use the card every month. In the credit modality alone, total transactions reached 9.4 billion. This movement represented a 15% increase in the credit balance in the credit card portfolio compared to 2017, the largest growth in relation to all other individual credit portfolios, according to the Central Bank of Brazil (BCB).

The global credit card market is characterized by an oligopoly from the standpoint of existing payment arrangements, as only four US companies manage millions of cards worldwide: Diners Club, founded in 1950 and purchased in 1981 by Citibank; American Express, also known as Amex; Visa initially created under the name of Americard, with activities started in 1958; and, finally, Mastercard, which appeared in 1977, according to Dos Santos and Pereira [1]. In addition to these four companies that dominate the market worldwide, there are two other companies that stand out in Brazil. Hipercard, created in 1970, as a loyalty card of Grupo Bomprego. Hipercard became a credit card – initially private label – in 1993, and its partners are mainly super and hypermarkets; and Elo, the result of a joint venture between Banco do Brasil, Caixa Econômica Federal and Bradesco, created in 2011, whose expansion has been quite significant since then, according to ABECS. It is noteworthy that the industry participants mentioned above are the entities that regulate their payment arrangements and the entire system that involves their transactions, covering several issuers (banks and administrators) and acquirers (acquirers such as Rede and Cielo). And, in these cases, the market is much more fragmented, although in Brazil it is still dominated by large banks that, in addition to being the largest issuers, also control the largest merchant acquirers. In this scenario, new entrants have challenged the most traditional entities in the payment industry, and have been acquiring part of this market through technology-based innovations. Companies like Stone and Nubank, for example, demanded that the big and traditional players innovate so as not to have their market share threatened.

According to Perez and Bruschi [2], there are five main players in the Credit Card industry:

cardholder consumers, merchants that accept cards, brands, card issuers and merchant acquirers. They are organized into two main types of payment arrangements: closed arrangements, such as Diners, American Express and Private Label; and open arrangements, in the case of Mastercard and Visa. Open arrangements are the most frequent in the industry. In closed arrangements, a single institution typically issues credit cards to consumers (cardholders) and accredits (acquires) shopkeepers or companies that accept to transact with their cards. As a closed arrangement, this same institution sets the fees on both sides. On the cardholder's side, they charge an annuity fee, interest rate and services for using the card. On the shopkeepers' side, a fee is charged on the transaction value (discount rate or Merchant Discount Rate - MDR, as referred to in the industry). Due to the presence of these three participants (flags, cardholders and shopkeepers), a single institution plays the role of the Issuer, the Accrerator and the Flag.

Private Label cards are classified as limited-purpose closed arrangements, as the cards issued can only be used within a single network of retailers, such as the Lojas Renner card, which was a pioneer in Brazil. Open arrangements have this name because any financial institution can join the brand, which becomes the brand's direct customer instead of the holders. Once the issuer and/or acquirer (accreditors) joins a brand, the issuer can seek and issue cards to their customers and the acquirer (accreditors) can also acquire retailers or companies that accept their cards. Normally, the payment for purchases made with a card at a particular retailer is made by the cardholder's bank to the purchaser linked to the retailer. In open schemes, also known as four parts, the brand charges fees (switch fee) from its direct customers (issuer and acquirer) but also defines the fee that the issuer charges the acquirer for the transaction carried out between the cardholder and the merchant of the acquirer. This fee is called the interchange fee and has been at the center of an international regulatory debate in this industry for the past 10 years.

The term "Private Label" refers to private label products. Large retail chains usually place their brand on some product lines sold in their stores, according to Alves and Menezes [3]. In order to increase market share, their turnover or their profit margin, large retailers, usually in conjunction with leading consumer goods

industries, create private label products. These products have more affordable prices and are usually equivalent in quality to the leading products in the market.

Private Label cards have been used in the United States for approximately a century, as described by Nunes [4] and, in Brazil, they began to be implemented at least 40 years ago. Such cards are issued by large retail chains such as supermarkets, department stores, apparel and pharmacies. The stores and points of sale of these retail chains make up the private network for the acceptance of Private Label cards.

Although there is no specific literature on Private Label cards in food retail, this is neither a recent nor a rare practice in the Brazilian market. Of the 20 largest supermarkets in Brazil appointed by the Brazilian Association of Supermarkets in Brazil (ABRAS), most of them have Private Label cards such as Carrefour, Atacadão, GBarbosa, Irmãos Muffato, BH Supermarkets, Cia Zaffari, Epa Supermarkets, Sonda Supermercados, Savengnago Supermercados, Supermarkets Leader, Spani Atacadista and Amigão Supermercados. Others have co-branded cards, which, in addition to the store's brand, also have an international brand such as Visa or Mastercard, such as Extra, Assaí, Comper Supermercados, Angeloni, Bahamas Supermarkets and Coop Cooperativa de Consumo. Finally, only 3 chains in the ranking do not have any credit card modality: Mart Minas Supermercados, Super Nosso and AM/PM Edibles. In this ranking of the 20 largest, 2 of them are operated by the Card Administrator object of this study, in addition to another 180 medium-sized supermarket chains.

In this context, the study was structured as follows: section 2 will cover the research methodology, which consists of the application of the Granger precedence tests and the application of the vector autoregressive model (VAR). In section 3, the results of the econometric analysis will be presented. Finally, section 4 will present the conclusion of the research.

## 2. METHODOLOGY

In order to carry out a comparative analysis of the behavior of private label credit card defaults with the average behavior of the market in relation to macroeconomic variables, a multivariate model of autoregressive vectors, popularly known as the VAR Model, will be used.

Additionally, to assess whether credit card default in the market and, more specifically, Private Label card default, was preceded by economic recession, causality tests in the Granger sense will be carried out to assess whether the main macroeconomic variables preceded default.

Thus, this section presents the study methodology and the data used. As the study by Vartanian and Garbe [5] pointed out, the Brazilian recession began in 2014 and ended in 2016. To achieve the objectives of this research, macroeconomic and credit market data in Brazil were collected monthly since January 2013 until December 2018 precisely so that it would be possible to assess whether the default in the card market was preceded by the Brazilian economic recession.

The data, collected in the form of time series, were obtained from the Central Bank of Brazil, the Brazilian Institute of Geography and Statistics and a company in the Private Label credit card sector. Regarding the techniques used, an average test was initially applied to assess whether there was a difference between the Private Label card market and the credit card market as a whole.

Next, a VAR model was estimated using impulse response functions. Finally, the analysis of the Granger tests was carried out. Next, the details of the data and the methodology will be presented so that, in the next section, the results are analyzed.

### 2.1 Variables Used

For the estimation of the econometric model and other analyses, the variables used, with monthly periodicity in the period between January 2013 and December 2018, with their respective acronyms, are presented below. It is worth noting that the beginning of the period was intended to capture the relationship between the data in the year prior to that established at the beginning of the crisis and the end of the period is justified by the availability of data at the time of the survey.

- i) Unemployment Rate, which is sourced from the IBGE (Tx\_Desoc);
- ii) Indebtedness of families with the National Financial System in relation to the accumulated income of the last twelve months - %, whose source is the BCB-DSTAT (Endiv\_SFN);

- iii) Monthly GDP - Current values (R\$ million) - Deflated by the IPCA, obtained in BCB-DEPEC (GDP\_Des);
- iv) Credit concessions with non earmarked resources - Individuals - Total credit card - R\$ (million) - Deflated by the IPCA, obtained from the BCB-DSTAT (Conces\_Des);
- v) Default in the credit portfolio with non earmarked resources - Individuals - Total credit card - %, whose source is the BCB-DSTAT (Over90\_M);
- vi) Default in the Private Label Food Retail Credit Portfolio - Individuals - %, whose source is the Private Card Administrator object of this study (Over90\_PL);
- vii) Expanded payroll - PNADC (quarterly moving average) - R\$ (million) - Deflated

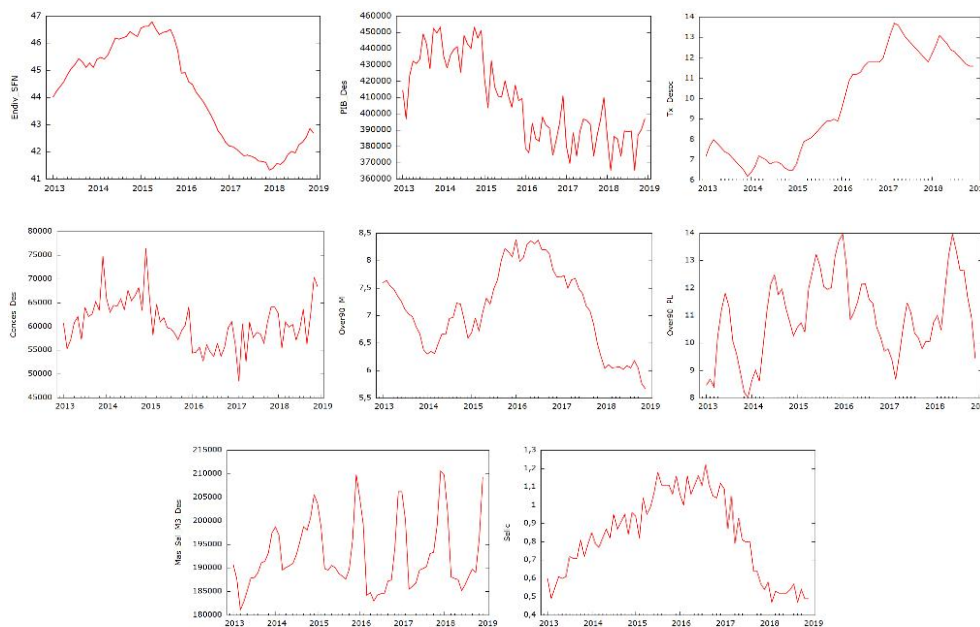
- by the IPCA, whose source is the BCB-DEPEC (Mas\_Sal\_M3\_Des);
- viii) Interest rate - SELIC accumulated in the month - % a.m., obtained from the BCB-DEMAB (SELIC).

Table 1 shows the descriptive statistics of the variables used in the study, in which it can be observed that the delinquency rate of credit cards in the market had an average lower than that of Private Label credit cards. The standard deviation is also smaller, which means lower volatility of credit card defaults in the market in the period analyzed. In addition, the graphs in Fig. 1 show how default indicators reached their highest levels in 2016, as well as the basic interest rate (SELIC).

**Table 1. Descriptive statistics of variables**

Variable	Mean	Median	Minimum	Maximum	Std. Deviation
Tx_Desoc	9.76	9.25	6.20	13.70	2.50
Endiv_SFN	44.12	44.45	41.33	46.79	1.83
PIB_Des	408,075.62	403,760.39	365,167.40	453,308.97	25,558.95
Conces_Des	60,781.00	60,777.33	48,462.11	76,485.97	5,012.76
Over90_M	7.13	7.14	5.67	8.39	0.76
Over90_PL	10.97	10.98	8.03	13.97	1.48
Mas_Sal_M3_Des	192,661.78	190,093.27	181,091.76	210,562.33	7,345.34
Selic	0.83	0.82	0.47	1.22	0.23

Source: Own elaboration based on calculations made in the Gretl econometric package



**Fig. 1. Evolution of variables in the period 2013-2018**

Source: Central Bank of Brazil and IBGE.

## 2.2 Econometric Methodology

The vector autoregressive (VAR) model will be used to test the effect of a shock on a variable in the model on credit card default. The technique was initially suggested by Sims [6] as an alternative to the use of simultaneous multivariate equations. Thus, VAR models examine linear relationships between each variable and the lagged values of itself and of all other variables, imposing as restrictions on the structure of the economy only the choice of the relevant set of variables and the maximum number of lags involved in the relationships between them. In VAR models, the number of lags is usually chosen based on statistical criteria such as Akaike or Schwarz according to Vartanian [7]. According to Ruberto [8], some factors directly influence household indebtedness, such as interest rate, unemployment rate, expected inflation, Broad Consumer Price Index (IPCA), GDP, exchange rate and the national confidence index of the consumer. In addition to the research by Ruberto [8], Paquin and Weiss [9] used the multiple regression technique to test some indicators in relation to the default of an individual, among which the unemployment rate and, also, the commitment index stand out of income.

As described in the literature, the mathematical form of the VAR model is as follows:

$$y_t = A_1 y_{t-1} + \dots + A_N y_{t-N} + Bx_t + \varepsilon_t$$

where,

- $y_t$  = endogenous variable vector
- $x_t$  = exogenous variable vector
- $A_1 + \dots + A_N$  and  $B$  = matrices of coefficients to be estimated
- $\varepsilon_t$  = self-correlated innovation vector

The study will also apply the statistical precedence test, known in the literature as Granger's causality test. According to Maddala and Lahiri [10], the causality test in the sense of Granger is not intended to identify a precedence relationship in its sense of endogeneity. Considering two time series  $X_t$  and  $Y_t$ , the causality test assumes that the relevant information for the prediction of the respective variables  $X$  and  $Y$  is contained only in the time series about these two variables. From the causality tests in Granger's sense, it will be possible to identify whether one or more indicators precede credit card default, and, if so, in which time lag.

## 3. RESULTS AND DISCUSSION

### 3.1 Test of Averages

The econometric analysis started with a test of the means of the variables Over90\_M and Over90\_PL to identify whether, statistically, the default of Private Label cards is equal to or different from the market as a whole. Although, graphically, the variables show different behaviors, their variations can be statistically similar and, if so, the study could focus on just a VAR model and a causality test in the Granger sense considering that the behavior and the result of tests would be the same for the two variables.

As a result of the means test, shown in Table 2, the null hypothesis that the means are equal was rejected, that is, the means of the series of the variables are statistically different. Based on this conclusion, the research followed the development of a VAR model for market default and another for Private Label default. Likewise, two causality tests in the Granger sense were performed, one for each default variable.

**Table 2. Means test**

	<b>Default in the non-earmarked credit portfolio - Individuals - Total credit card - %</b>	<b>Default Private Label Card Retail Food</b>
Average	0.08	0.11
Variance	0.00	0.00
Observations	72.00	72.00
Z	-16.59	
One-tailed critical z	1.64	
Two-tailed critical z	1.96	

Source: Own elaboration based on calculations made in Excel

**Table 3. Unit root tests**

Level	Lags	Constant	Trend	Test Statistic	p-value	First Difference	Lags	Constant	Trend	Test Statistic	p-value
Tx_Desoc	10	Yes	No	-1.73	0.42	Δ Tx_Desoc	3	No	No	-2.62	0.01
Endiv_SFN	2	No	No	-0.61	0.45	Δ Endiv_SFN	1	No	No	-3.43	0.00
PIB_Des	10	No	No	-1.62	0.10	Δ PIB_Des	10	No	No	-4.63	0.00
Conces_Des	2	Yes	No	-1.93	0.32	Δ Conces_Des	10	No	No	-4.62	0.00
Over90_M	3	No	No	-0.83	0.36	Δ Over90_M	2	No	No	-2.83	0.00
Over90_PL	8	Yes	No	-1.96	0.31	Δ Over90_PL	10	No	No	-2.28	0.02
Mas_Sal_M3_Des	10	Yes	No	-2.16	0.22	Δ Mas_Sal_M3_Des	9	No	No	-4.72	0.00
Selic	5	No	No	-0.58	0.47	Δ Selic	4	No	No	-2.27	0.02

*Source: Own elaboration based on calculations made in the Gretl econometric package*

### 3.2 Unit Root Tests

The first step in developing a VAR model is to identify whether the time series are stationary or not. A time series is said to be stationary when it develops in time randomly around a constant mean, reflecting some form of stable equilibrium. For all variables used in the estimation, the Dickey Fuller augmented unit root test was applied, according to Dickey and Fuller [11]. According to the result in Table 3, the presence of a unit root was identified in all series, which indicates that the series are non-stationary.

Consequently, it was necessary to apply the test in the series in first differences. According to the results presented in Table 3, the differentiated series did not show a unit root, that is, they were all stationary in the first difference. Therefore, for the development of the VAR model and the other tests, stationary series were used.

### 3.3 VAR Model with Market Default (Over90\_M)

After testing the unit root of the variables and resolving the issue of non-stationarity of the series by using the first differences, the best multivariate model was chosen in terms of the number of lags. In this sense, three lag selection criteria were applied (Akaike, Schwarz and Hannan-Quinn including a constant and with a maximum lag of 5). The criteria pointed to distinct lags and, applying the principle of parsimony, the smallest number of lags indicated by the tests was chosen, which indicated the VAR (1) as the most appropriate model.

After estimating the VAR model, the default response after shocks to the variables used in the model was simulated. It is worth noting that the stability of the model was ensured by the analysis of the inverse roots of the autoregressive polynomial, which were found within the unit circle. For the estimation, the variables were ordered so that the most important or impacted one, that is, default, was last considering the Cholesky decomposition applied in the VAR model solution and, therefore, the sequence of variables was: Tx\_Desoc\_d, Endiv\_SFN\_d, PIB\_Des\_d, Concessions\_Des\_d, Mas\_Sal\_M3\_Des\_d, Selic\_d and Over90\_M\_d.

Fig. 2 allows us to visualize the impulse response functions estimated for the market's credit card default behavior. After a shock to the unemployment rate, there is a positive

momentum that dissipates about six months later. Default initially responds negatively to the GDP shock and positively after two months, dissipating after seven months. Considering a shock to the wage bill, delinquency responds sharply positively and dissipates only after ten months. And, finally, delinquency has a large fluctuation after a shock to the SELIC rate, initially responding positively until it dissipates seven months after the shock. Additionally, it can be observed that the response of the market's default rate has an uncertain response after a shock in the indebtedness in the national financial system and in the granting of credit, as the confidence interval can be both positive and negative in the same period.

The response graph of card default in the market to the boost in the unemployment rate reinforces the study by Albuquerque [12] who, in his research on default of individuals, identified that the unemployment rate and debt maturity directly influence default of the personal loan portfolio.

### 3.4 VAR Model with Private Label Card Default (Over90\_PL)

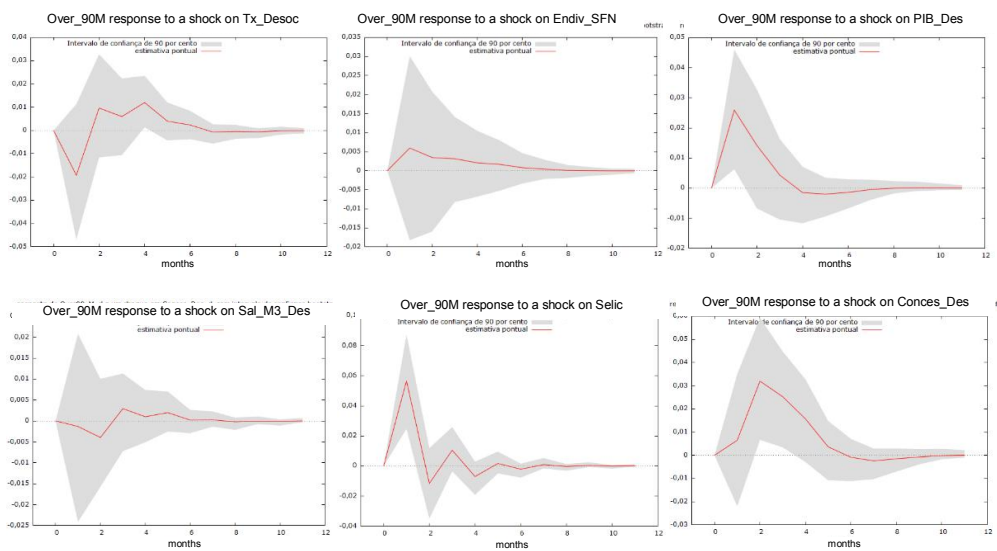
As in the Over90\_M VAR model, after the unit root tests of the variables, the best multivariate model was chosen in terms of number of lags and the same lag selection tests were applied, including a constant and with selection maximum lag equal to 5.

Differently from the credit card default model in the market, the test indicated the number of lags 5 as the most adequate according to the criteria of Akaike and Hannan-Quinn. However, the simulation of the impulse response function generated a matrix that is not positively defined, making the estimate impossible and, in this case, the solution adopted was to estimate a model with a lag, which was indicated as the most suitable by the Bayesian criterion of Schwarz. To ensure the stability of the selected model after selecting the number of lags, the inverse roots of the characteristic autoregressive polynomial were analyzed. As was done with credit card defaults in the market, as roots lie within the unit circle, the stability of the model was ensured.

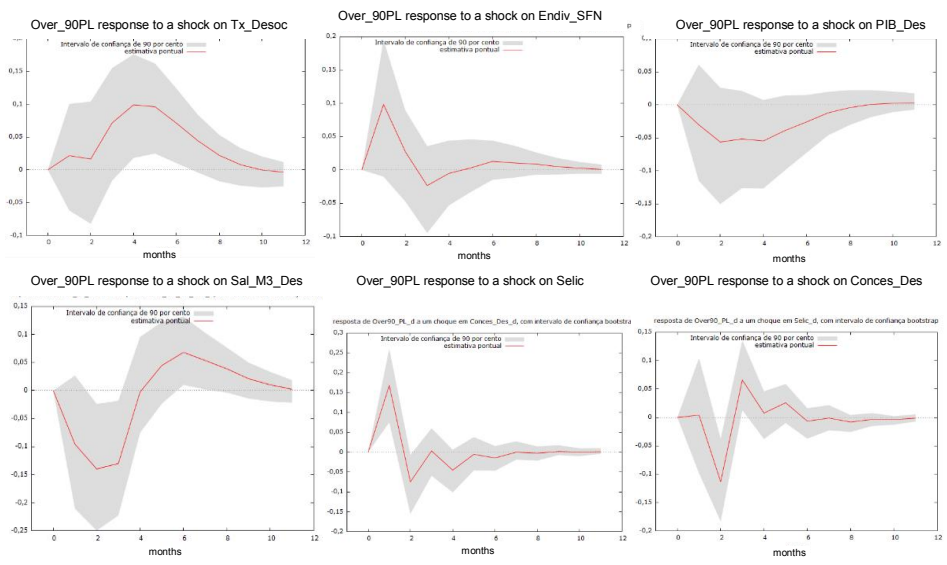
After estimating the VAR model, the response to default of Private Label cards after the shock on the variables used in the model was simulated. Again the variables were ordered so that the most important or impacted one, that is, the Private Label card default, was at the end, and



therefore the sequence of variables was: Concess\_Des\_d, Mas\_Sal\_M3\_Des\_d, Selic\_d, Tx\_Desoc\_d, Endiv\_SFN\_d, PIB\_Des\_d, and Over90\_PL\_d.



**Fig. 2. Over90\_M impulse response graphs**  
 Source: Own elaboration based on calculations made in the Gretl econometric package



**Fig. 3. Over90\_PL impulse response graphs**  
 Source: Own elaboration based on calculations made in the Gretl econometric package.

Fig. 3 presents the impulse response functions estimated for the Private Label credit card default behavior. Similar to credit card default in the market, after a shock in the unemployment rate, there is a positive boost in Private Label card default, but that dissipates only eleven months later. Private Label defaults initially respond positively to the GDP shock, having a slight

negative response after three months and dissipating after nine months. Similar to the shock to GDP, in the face of a shock in credit granting, default initially responds positively, but after two months it responds negatively and dissipates after seven months. Considering a shock to the wage bill, default initially responds negatively, reversing the response after four

months and only dissipates after eleven months. And, finally, Private Label default responds differently from the others after a shock in the SELIC rate, and initially it remains stable, starting to respond negatively after one month, reversing the response after three months in a positive way, remaining slightly stable after the sixth month until it dissipates nine months after the shock.

The impulse response graph shows that Private Label card defaults respond negatively to the debt shock in the national financial system and dissipates after nine months. However, it is not possible to consider this answer as right, as the confidence interval varied in both the positive and negative quadrants in the same period of time. In addition, the results do not corroborate the study by Silva [13], which concluded that the greater the degree of indebtedness increases the possibility of the consumer becoming in default. In the case of Private Label card default, the initial response to a debt shock is negative, demonstrating a reduction in default in the face of higher debt.

### 3.5 Causality in Granger's Sense

Finally, it was analyzed which variables preceded credit card default, both for the market and for the Private Label card, using the causality test in the sense of Granger. For this, the following steps were followed: after identifying the stationarity (or not), the series was differentiated and then the ideal number of lags was defined for each combination of series to then identify whether each of the variables preceded the delinquency of the market credit card and the Private Label card.

#### 3.5.1 Market default (Over90\_M)

As can be seen in Table 4, it is possible to reject the null hypothesis that the Indebtedness in the National Financial System, the Granting of Credit and the SELIC rate do not, in Granger's sense, cause credit card default in the market. In other words, there is evidence of precedence of these variables over credit card defaults in the market during this period. On the other hand, it is not possible to reject the null hypothesis that the Unemployment Rate, GDP and Payroll do not cause, in Granger's sense, the market's credit card default, that is, there is no evidence of their precedence variables on credit card default in the market.

The result presented evidence that corroborated the study by Silva [13], who concluded that the greater the degree of indebtedness and excess credit supply increase the consumer's propensity to default.

#### 3.5.2 Private label card default (Over90\_PL)

The result of the test on Private Label credit card default did not have the same behavior as the test on credit card default in the market, as can be seen in Table 5. In this case, the results indicated that it is possible to reject the null hypothesis that the Unemployment Rate, the GDP, the Granting of Credit, the Payroll and the SELIC rate do not cause, in Granger's sense, the default of the Private Label credit card, that is, there is evidence of precedence of these variables about Private Label credit card defaults during that period. In relation to Indebtedness in the National Financial System, it is not possible to reject the null hypothesis that indebtedness

**Table 4. Results of causality tests in Granger's sense in relation to market card default**

Variable		Obs.	Lags	F Statistics	P value
Tx_Desoc	does not Granger-cause Over90_M	68	3	0.54	0.65
Endiv_SFN	does not Granger-cause Over90_M	70	1	17.64	0.00
PIB_Des	does not Granger-cause Over90_M	67	4	0.52	0.72
Conces_Des	does not Granger-cause Over90_M	67	4	3.86	0.01
Mas_Sal_M3_Des	does not Granger-cause Over90_M	68	3	1.13	0.34
Selic	does not Granger-cause Over90_M	68	3	5.81	0.00

Source: Own elaboration based on calculations made in the Gretl econometric package

**Table 5. Results of causality tests in granger's sense in relation to private label card default**

Variable		Obs.	Lags	F Statistics	P value
Tx_Desoc	does not Granger-cause Over90_PL	67	4	10.86	0.00
Endiv_SFN	does not Granger-cause Over90_PL	70	1	0.14	0.71
PIB_Des	does not Granger-cause Over90_PL	69	2	7.38	0.00
Conces_Des	does not Granger-cause Over90_PL	68	3	9.74	0.00
Mas_Sal_M3_Des	does not Granger-cause Over90_PL	66	5	15.51	0.00
Selic	does not Granger-cause Over90_PL	68	3	4.56	0.01

Source: Own elaboration based on calculations made in the Gretl econometric package.

does not cause, in Granger's sense, the default of the Private Label credit card, that is, there is no evidence of precedence of this variable over default of the Private Label credit card.

Table 5 presented results that corroborate the evidence obtained in De Menezes Linardi [14] regarding the interest rate being a factor of default, as well as the study by Albuquerque [12], which associated default to the unemployment rate and the research by Paquin and Weiss [9] who, in the American market, found evidence of the relationship between default and the supply of credit, unemployment and the interest rate. Consequently, this result may help the analyzed company's decision-making to change its credit granting policies at the first signs of economic deterioration.

#### 4. CONCLUSION

This study aimed to carry out an econometric analysis of the effects of the Brazilian recession from 2014 to 2016 on the delinquency of the credit card in the market in general and the Private Label card in the food retail in a comparative way. From this analysis, it was possible to assess whether there is causality in the Granger sense of macroeconomic indicators with default, as well as to carry out a comparative analysis of the effects of shocks on certain variables on market credit card default in comparison with the Private card Label in food retail through impulse response functions estimated from the application of a vector autoregressive (VAR) model.

The research identified that the market and Private Label default series are not statistically

equal by means of a test of means and, therefore, the study resulted in two independent analyzes of causality tests in the sense of Granger and two VAR models.

From the simulation of the VAR model, the analysis of impulse response functions showed different behaviors for market and Private Label credit card default and similar behavior can be observed only when compared to responses after a shock in the vacancy rate, changing only the intensity and dissipation time. On the other hand, after a shock to GDP, Payroll and SELIC, the behavior of the market's default rate and Private Label responded in an inverse way.

Considering the analysis of the impulse response functions, it was possible to observe that the Private Label default response behaves differently from what is intuitively expected. It was expected, for example, that an increase in GDP would result in a reduction in defaults, which did not happen. However, Private Label defaults responded positively, indicating an increase in defaults. Similarly, market defaults also presented unexpected results, such as, for example, the analysis of a payroll shock, which resulted in a worsening of card defaults in the market, when the expected result was, in fact, a reduction. Both cases may be related to the intensity and duration of the crisis, with lasting effects on defaults despite the recovery, albeit partial, of GDP and wage bill.

Consequently, it can be seen in the graphs that the response to the indebtedness boost in the national financial system was uncertain for both cases, and for credit card default in the market, the response to a concession shock was also

uncertain. Another finding is that, in general, in addition to the responses to the impulses of market default and Private Label behaving inversely in most occasions, Private Label default takes longer to dissipate when compared to market default.

With regard to causality tests in the sense of Granger, evidence was found that the market's credit card default was preceded by indebtedness in the National Financial System, by the Granting of Credit and by the SELIC rate. On the other hand, the tests showed that, in the case of Private Label credit card default, the Unemployment Rate, GDP, Credit Concession, Payroll and SELIC rate take precedence over Private credit card default Label during the analyzed period.

These results reinforce the study by De Menezes Linardi [14], which indicates a strong relationship between default in the national financial system and the nominal interest rate based on the SELIC rate, as well as the study by Silva [13], which identified that the greater the degree of indebtedness, the more likely the consumer is to default. We can also include the study by Albuquerque [12], which identified that the unemployment rate directly influences the default of the credit portfolio in general.

After analyzing the result of the causality test towards Granger, it was evident that the economic recession experienced between 2014 and 2016 preceded the default of the Private Label credit card and, consequently, this result allows the analyzed company to make decisions to change its lending policies at the first signs of economic deterioration. On the other hand, for the market, the relationship was not so evident, probably because the market data are aggregated with all types of credit card and social classes, as well as an early move by large financial institutions to reduce exposure to risk, granting less credit and reducing limits, which somehow mitigated the effects of the economic recession on card defaults.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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