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CREDIT RATIONING AND HIGH INTEREST RATES: AN APPLICATION OF STRUCTURAL VECTOR AUTOREGRESSION AND VECTOR ERROR-CORRECTION MODELS

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RACIONAMENTO DE CRÉDITO E TAXAS DE JUROS ELEVADAS: UMA APLICAÇÃO DE MODELOS DE VETORES AUTO-REGRESSIVOS ESTRUTURAL E VETORES DE CORREÇÃO DE ERROS

OBJETIVO

É analisado o comportamento da política monetária de racionamento do crédito no Brasil, principalmente, o desempenho da oferta de crédito bancário privado diante das oscilações na taxa de inadimplência e da taxa de juros.

METODOLOGIA

As séries de oferta de crédito, de inadimplência das pessoas jurídicas tomadoras de empréstimos e a taxa de juros básica do Banco Central do Brasil referem-se período de 2000 e 2009. Utilizaram-se as técnicas de cointegração e cocaracterização para identificar um sistema de vetores autorregressivos estruturais e de correção de erros, levando-se em consideração a existência de uma quebra estrutural nas séries.

RESULTADOS E CONCLUSÕES

Os testes identificaram uma relação linear de longo prazo entre crédito, taxa básica de juros e inadimplência, onde as decomposições das variâncias indicam que a taxa de juros básica explica boa parte das flutuações de curto e longo prazo na oferta dos créditos bancários privados.

IMPLICAÇÕES PRÁTICAS

O resultado destaca a influência da taxa básica de juros sobre o volume de crédito. Além de contribuir para decisões governamentais, essa constatação é relevante na atividade de planejamento de atividades de instituições e empresas que concedem crédito ou que dependem dele para efetivar as suas vendas.

PALAVRAS-CHAVE

Racionamento de Crédito; Créditos Bancários Privados; Vetores Auto-Regressivos.

CREDIT RATIONING AND HIGH INTEREST RATES: AN APPLICATION OF STRUCTURAL VECTOR AUTOREGRESSION AND VECTOR ERROR-CORRECTION MODELS

OBJECTIVE
This article analyzes the behavior of monetary policy credit rationing in Brazil, mainly the performance of the supply of private bank loans due to the oscillations in the default rate and borrowing base interest rate.

METHODOLOGY
It uses the default of corporate loans borrowing and the basic interest rate of the Central Bank of Brazil between 2000 and 2009. We used the techniques of cointegration and co-characterization to identify a system of structural vector autoregression and error correction, taking into account the existence of a structural break in the series.

RESULTS AND CONCLUSIONS
The test results identified a linear long-run relationship between loans, prime rate and default, where the variance decompositions indicate that the base interest rate explains most of the fluctuations in the short and long term supply of private bank loans.

PRACTICAL IMPLICATIONS
The result highlights the influence of the base rate of interest on loan volume. Besides contributing to government decisions, this finding is relevant to the planning activity of institutions and businesses that extend credit or depend on it for carry out its sales activities.

KEYWORDS
Credit Rationing; Private Bank Loans; Vector Auto Regression.

This article analyzes the behavior of monetary policy credit rationing in Brazil, mainly the performance of the supply of private bank loans due to the oscillations in the default rate of corporate loans, and borrowing base interest rate of the Central Bank of Brazil between 2000 and 2009.

INTRODUCTION

At the present juncture, the modern economic transactions take place in almost all its magnitude, for financial intermediation, more specifically, by banks that receive funds from individuals, businesses and governments, and apply it to the purchase of bonds or stocks, or do loans and loans to other people and companies, as well as running and receiving payment in cash of various nationalities, resulting from international transactions. Therefore, the transfer of monetary values is not only a physical, but virtual, by relationships of rights and guaranteed by public or private institutions that protect such a mechanism provided by banks digital medium. So people and businesses realize the demand and supply of goods and services thus composing, interactive elements inserted in the economic field through dynamic conductor, the financial market.

The regional credit rationing arises then as a result of non-availability of local financial institutions to lend in the region. According to Stiglitz and Weiss (1981), credit is rationed by banks, given the problems created by asymmetric information, i.e., banks guarantee their return basically looking for the interest rate and the risk of operations. If you do not have complete information about the project to be financed and the borrower fail to adequately assess the risk involved.

As a result, banks take defensive actions and ration credit. Moreover, they are not inclined to raise interest rates, because they are aware that two perverse phenomena may occur: adverse selection, i.e., good borrowers do not accept the high rates charged and flee risk of bank credit, leaving only the greatest risks; incentive to choose riskier projects, because, if the firm is indifferent to risk and have two pro-

jects, an increase in interest rates will lead to the choice of a greater profit on success, but probably more risky.

In Brazil, the policy of high interest rates became the main visible instrument of inflation control. The Central Bank of Brazil began to signal to the market a monetary policy of gradual reduction of the basic interest rate. But despite this practice, the fall in the interest rate was not significantly perceived by private agents or through the channel of interest rate and not the credit channel. Even so, there were positive signs of economic growth, at least until September 2008, when the financial crisis of U.S. banks emerged. Thereafter, the Central Bank of Brazil, despite some resistance, initiated monetary policy more robust reduction of the basic interest rate aimed at reversing the braking devices of credit by banks in the face of the global financial crisis.

Anyway, despite this tendency to reduce the basic interest rate, the interest rate market is still relatively high and the behavior of banks is still clear credit rationing, compared with other countries such as China, Russia, India, Vietnam, Mexico, South Korea, UK, France, and Germany. The hypothesis here is that this fact is due not only to the degree of confidence of private agents due to uncertainty about the future, but also the policy of credit rationing practiced by Brazilian banks. The theory of asymmetric information Stiglitz is adequate to explain this behavior of banks under the action of an active monetary policy rate high basic interest as practiced by the Central Bank of Brazil in recent years.

Whereas the description of the above scenario, grows the importance of using models that are able to analyze the effects of the structural shocks in explaining fluctuations in

economic variables in a given period of time . In literature there are several models for this purpose, especially the vector auto regression structural models (SVAR). The impact of economic policy measures, changing preferences and technological innovations are some examples of these shocks.

The importance of properly characterizing the properties of macroeconomic series, beyond the purely statistical interest – such as more efficient estimates of the model parameters under a set of restrictions – refer to practical considerations, such as the effectiveness of countercyclical policies against forward growth policies . Or even possible to identify and distinguish the relative importance of the impacts of economic policies related to the management of aggregate demand relative to supply shocks demand.

Motivated by the above, the purpose of this paper is to formalize an empirical application of the theory of credit rationing of Stiglitz applied to the case of money market in Brazil face the monetary policy of high interest rates from June 2000 to March 2009. The article was organized aiming at building a model of credit rationing that would allow the elements to an application through templates vector auto regression.

This text has been organized into five sections, besides the introduction and conclusion: the first section discusses the theory of credit rationing of Stiglitz and the consequences of the high interest rate on the supply of credit policy; in the second section, we present vector auto regression model and structural vector auto regression model; in the third section presents estimation and analysis of results; in the fourth section presents results of empirical model, and finally the case of credit rationing in the American subprime crisis.

THE MACROECONOMIC MODEL CREDIT RATIONING STIGLITZ

The basic argument of the theory of credit rationing is that the credit market does not act only as a mere intermediary between savers and investors, but also dealing with a diversity of contractual problems arising from asymmetric information about investment projects whose financing is negotiated between borrowers (firms) and lenders (banks) . According to Hermann (2000, p.56 -57) "these problems of information not only shape the institutions operating in the financial market and debt instruments, but also affect how monetary policy actions are transmitted to the real economy".

There are several definitions of credit rationing. But not all situations of unmet needs of borrowers can be defined as credit rationing. Jafee (1971) and Stiglitz (1990) defined the following types of credit rationing: Type I credit rationing: this occurs when the company cannot take credit on the amount they would under the conditions of the current interest rate; Type II credit rationing: this occurs when, between identical borrowers, some companies wanting to borrow fail, while others do not .

The theory of credit rationing depends on the existing information asymmetry between borrowers and lenders in the credit market. Two reasons have been given to explain credit rationing by banks, but by that of the high interest rates to clear markets: adverse selection and moral hazard. In this article, given the constraint of space, not the entire macroeconomic model formalizing the theory of credit rationing appears. Anyway, we discuss the basics of credit rationing and monetary policy of high interest rates.

Credit rationing and information asymmetries

In the credit market, credit rationing to borrowers is associated with two problems of asymmetric information: adverse selection and moral hazard. These factors near the banks of the borrowing companies through the process of selecting and monitoring projects, such as Stiglitz (1988) recalls. This occurs because of information asymmetries in the credit rationing model, hindering diversification and transfer of risks of lenders and borrowers in the money market, banks endow enough to influence the supply of credit to borrowers power and therefore in definition of agent that you assume the risk of the lender and the borrower.

Thus, changes in the perception of risk of the borrower and the lender, resulting from exogenous shocks induce the plaintiffs bank credit to review their investment decisions and banks to diminish the supply of credit companies. The information asymmetries occur in a banking contract - between borrowers (entrepreneurs) and lenders (banks), when one party has more information than the other: either ex ante to the peculiarities of the product being bought or sold, is ex post, as a result of the actual product.

The factor of adverse selection deals with the problems of imperfect information that are associated with the heuristic model of ex ante credit rationing, and the moral hazard factor that deals with the problems of imperfect information associated with the heuristic model of credit rationing ex post.

In the credit rationing model of Stiglitz no perfect markets, and the fact that agents are unaware of the future consequences of their decisions makes room for instrumental uncertainty that is associated with the future consequences of

the credit agreements. There is also the credit rationing model of Stiglitz, environmental uncertainty is the uncertainty that is associated with values of various assets in the future. Accordingly, both levels of uncertainty affect perceptions of risk for business and influence the composition of the portfolio resulting from the decision making of agents. This, in turn, turns establishing a relationship between risk and uncertainty, but one should not confuse risk with uncertainty, since uncertainty refers to any situation of lack of knowledge about expected future results before making a decision in the present, while risk means the cost of a decision and applies the any kind of uncertainty.

In this sense, the risks involved in the investment and production decisions cannot be completely guaranteed, since insurance markets are incomplete, and the notion of risk by assigning the cost of wrong decisions shall be more important. Information asymmetries derive uninsurable risks and not reducible uncertainty probabilistically calculable risk at the time of decision. Indeed, the information asymmetries affect prices, profits and equity value of companies. Therefore, those companies that are averse to taking risks more conservative decisions when they contract debts and banks embody risks in their contracts.

Indeed, when the interest rate increases, firms behave cautiously due to the principle of increasing risk of Kalecki. In turn, banks rationing credit defend themselves because they know that a high interest rate causes a drop in the rate of net return on applicants credit companies. The risk of default by the borrowing firm can also cause certain disequilibrium in the money market, because it really market interest rate was equal for all companies would balance.

In view of Stiglitz (1990), banks are businesses that play the role of intermediary between borrowers and lenders of credit. However, as the establishment of credit agreements there is no definite certainty that the commitments made in this will be completed in future, banks seek to select and monitor their customers providing a registry with the best possible information, even though these do not are complete. Under these conditions arise the problems of adverse selection and moral hazard.

In a high interest rate environment, when there is excess demand for credit, banks act rationing the supply of credit rather than further increase the rate of short-term interest. In fact, banks act thereby reducing the availability of credit through the increased requirement for collateral or change in vesting periods and amortization, and other bureaucratic means, sustain Blinder and Stiglitz (1983); Stiglitz and Weiss (1992).

Default risk is the explanation for this behavior of banks. To the extent that banks have imperfect information about the projects of the plaintiffs credit business - that banks can not differentiate a priori those of low and high risk, but only the average risk - in such a situation an increase in interest rates can cause two effects: first, the high interest rates of credit adversely affects potential candidates with the removal of entrepreneurs who present the best projects and lower bank risk; and, second, encourages entrepreneurs of the worst designs and high risk as natural candidates to bank credit, although the effect of moral hazard . These effects may contribute to reduce the expected banks due to the higher probability of default or bankruptcy of borrowers, especially in a recessionary environment as now returns. For this reason, banks prefer to ration credit.

Thus, despite the increase in interest rates of application mean an increase in the expected rate of return on banks, in an instrumental and environmental uncertainty environment also increases the probability of default by borrowers, not to mention the rising cost of capture, as noted by Greenwald and Stiglitz (1988). The key to unravel the logic behind the heuristic model of credit rationing of Stiglitz, therefore, lies in its explanation of how the information asymmetries between firms and banks affect the currency market.

The information asymmetries between borrowers and lenders give rise to problems of adverse selection and moral hazard. Therefore, banks ' aversion to risk of default - for lack of sufficient information to select and monitor their borrowers - may lead banks to adopt the strategy of credit rationing by other mechanisms in addition to the increased rate of interest on loans.

The policy interest rate and credit rationing

In neo Keynesian vision supply rationing credit is macroeconomic phenomenon and therefore, is relevant debate rate high interest policy Brazil. Stiglitz and Weiss (1981), Greenwald and Stiglitz (1985), Stiglitz (1988) developed a theoretical model of credit rationing that associates the credit supply of banks rationed demand from companies to finance their investments. However, if credit is rationed is possible that the policy of increasing interest rates is not the only reliable element to measure the effects of the action of the Central Bank on aggregate demand. It is reasonable to assume that the variables of a quantitative nature - as the rationed amount of credit offered by banks and the default rate - also have relevance in the assessment of credit rationing policy.

The starting point of the credit rationing model is the observation that bank credit operations are constrained by information asymmetry banks negotiating loan agreements with its customers, without the sure knowledge of the real ability to pay in the future. The information asymmetries arise due to the fact that banks obtaining detailed information about the borrowers not only involve menu costs as costs of monitoring the investment project being financed. In such a situation, the credit supply (Ls) is not only defined as a function of the interest rate of the bank, but the net return risk-adjusted rate of default. The model admits the following simplifying assumptions:

i) There is a continuum of entrepreneurs who demand bank loans, each of which has an indivisible investment project that requires initial funding of K value;

ii) All applicants credit companies have an allocation of own resources of equal value aw < k and therefore have to borrow from the banks of the remaining amount to achieve their indivisible investments;

iii) All investment projects have the same expected gross return Y_i, but they differ in risk;

iv) The successful projects have investment income,Y_i^s, where i is the index of the projects, and unsuccessful, have average yield, Y^f, it could even be zero;

v) Loans are the unamortized type with single principal payment (B) and interest (r) end period.

According to the assumptions above, the amount of funding that businesses need to undertake their investment projects is given by:

$$K - W = B \qquad (1)$$

The probability of success of the investment project of the borrowing firm credit is given by P_i and the failure or failure by $(1 - P_i)$. Thus, relationship between, P_i and Y_i, implies that the expected gross return is given by:

$$Y_i = P_i Y_i^s + (1 - P_i) Y^f \quad (2)$$

In fact, the borrowings of banks by companies are a special form of debt default, in which the borrower pays a certain specified amount of (1 + r) B if he is able to pay. But the possibility of default, which is assumed to occur if the project is unsuccessful, then he would pay the present value of the return available, Y^f. That is, we assume, therefore, that for unsuccessful projects have:

$$Y_i^s > (1 + r)B > Y^f, \text{ for all i.} \quad (3)$$

The asymmetry of information, as the key element of the credit rationing model, explains that while companies know their odds of success, the banks do not know. Therefore, in the absence of some mechanism to classify potential borrowers from the banks for class probability of the type successfully and without success, banks make their lending to all firms that a priori are willing to pay interest rates the loan to be granted.

Thus, if banks decide to ration credit, they could not do so discriminating makers of high-risk low risk among all those who were willing to borrow resources. Assuming that banks and companies are neutral to risk, then the expected return to the investor would be given by:

$$E(\pi_i) = P_i Y_i^s + (1 - P_i) Y^f \quad (4)$$

Or:

$$E(\pi_i) = P_i[(1 + r)B] + (1 - P_i) Y^f \quad (5)$$

Theoretically, $0 \leq P_i \leq 1$. However, assuming that there is no risk investment projects (with $P_i = 1$) and nor totally risky (with $P_i = 0$), then we have that: $0 < P_i < P$, where P indicates the highest probability of approval of investment project success with the bank, so that $0 < P < 1$.

Similarly, (1 - P) defines the minimum level of bank risk in each period, such that:

$$E(\pi_i) = P_i[Y_i^S - (1+r)B] \quad (6)$$

The payoff of the expected return, for any "ongoing project" companies that make loans to the banks, is given by:

$$E(\pi_i) = (1+r)B\int_0^P P_i g(P_i)dP_i + Y^f \int_0^P (1-P_i)g(P_i)dP_i \quad (7)$$

Wherein P = is the probability cutoff;

I.e, the cutoff rate of the probability of success, from which customers take loans from banks;

$g(P_i)$ is the density function of the probability of success P;

B e Y^f are fixed and equal for all companies values. B being fixed, the equation of the demand for credit (Ld) is given by:

$$Ld = \varphi(P_i, Y_i^S, r) \quad (8)$$

Where in:

$\frac{dLd}{dP_i} > 0; \frac{dLd}{dY_i^S} > 0; \frac{dLd}{dr} < 0; \frac{dLs}{dr} > 0$ and $\frac{dLs}{LP} > 0$

Accordingly, the balance of the credit market is given by:

$$Ls(P_i, r) = Ld(P_i, Y_i^S, r) \quad (9)$$

Hermann (2000, p.58) notes that "the novelty of the neo-Keynesian version is simply the rejection of the ceteris pari-

bus condition, which admits that the probability distribution is kept unchanged as the interest rate r varies".

The argument of the neo-Keynesian Stiglitz is that the cast of probabilities of successful projects that banks operate is negatively affected by the increase in the interest rate, r, so that, in a situation such that Ld> Ls banks can choose to ration credit by bureaucratic means, instead of raising the interest rate, Greenwald, Stiglitz and Weiss (1984).

In this case, the credit market would balance by rationing the amount of credit offered with Ld > Ls to interest rate already established, r_0, and not with Ls = Ld with some interest rate $r_1 > r_0$. Put another way, the banks' credit rationing ends up excluding those borrowers, whose projects are prone to failure, through rationing the amount of credit that offered by other restrictive criteria, force the adjustment of demand to the point where the balance of the credit market, Ls = Ld occurs.

This conclusion arises from how the credit rationing model specifies the functions of corporate behavior. Now assuming an entrepreneur decides to borrow from a bank. In this case, the main feature of this payoff to the investor is that payment of credit is decreasing in the probability of success Pi. It is important to remember that it is the same for all investment projects, so that a low P_i implies a high yield, Y_i^s, such that:

$$E(\pi_i) = Y_i - Y^f - P_i[(1+r)B - Y^f] \qquad (10)$$

This equation (10) is decreasing in P_i. This means that high-risk investors are willing to pay more to the banks for a loan. This is the basic source resulting from the rationing of bank credit policy. This source of income clearly depends on the fact that the contract between the borrower and the

bank is a contract for default risk, as reported in Blanchard and Fisher (1988). The net expected value of the company is given by:

$$E(\pi_i^L) = P_i[Y_i^S - (1+r)B] \quad (11)$$

Where:

$$\frac{dE(\pi_i^L)}{dr} = -P_i B < 0 \quad (12)$$

The Equation (12) shows that the expected return net of the company declines when the interest rate is increased. As noted by Greenwald and Stiglitz (1987) an increase in the interest rate of loans could even balance the credit market, but at the cost of excluding potential borrowers less risky for banks - which means the revelation of the effect of adverse selection.

That is the main reason for the increase in interest rate is not an effective tool for selection of good borrowers to private banks and justifies the possibility of balance by adjusting the amount of credit rationed. The credit rationing occurs when Ls (r *) < Ld (r *), so that it sets up a market equilibrium neo-Keynesian because there is a variable that fit, ready, demands quantities (Ld) and offered (Ls) market.

Review of the empirical literature

In the econometric literature, more recently, has increased the application of VAR and VEC models for estimating and predicting the effects of monetary policy targets high rate of interest on credit rationing by banks to borrowers. The effect of monetary policy on the supply of credit through the credit channel was measured by the degree of transmission of innovations (shocks) of different variables subject to the

triangular Choleski decomposition. The results confirmed that the transmissions of the impact of monetary policy on interest on credit rationing banks are not manifested directly by interest channel, but by the rate of monetary growth.

Teles and Miranda (2006) investigated the differential impact of monetary policy and other short-term shocks on aggregate output of the Brazilian regions. The methodology consisted of a combination of unobserved components and techniques for vector auto regression or VAR. The empirical model ships covered the long period between 1947-2000 used the variables of regional cycles, the real money stock and a proxy - the price of oil. Use the first-difference was needed to avoid spurious results. The impulse response functions have made it clear that the regional cycle does not quickly adjust to specific shocks.

The only region with a smooth adjustment was the Northeast. The decomposition of the variance of regional cycles it was found that regional cycles are caused by the monetary policy of high interest rates and the impulses responses are asymmetric across regions.

Borges and Da Silva (2005) using the methodology of structural SVAR model estimated the natural rate of interest of Brazil. In the inflation targeting regime, knowledge of the natural rate of interest is important for the Central Bank ex ante define the trajectory of its main monetary policy instrument - the basic interest rate. In this sense, the results of the study confirmed that the real interest rate of the Brazilian economy, between September 2000 and December 2003, the patient was systematically higher than the rate of more volatile nominal interest rates in the period. Based on this observation, we analyze the quality of monetary policy of high interest rates in this period.

VECTOR AUTO REGRESSION MODEL AND STRUCTURAL VECTOR AUTO REGRESSION MODEL: VAR AND SVAR

The mathematical form of an unrestricted VAR model pattern can be represented as:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + B x_t + \varepsilon_t \quad (13)$$

Since Y_t is a vector k of endogenous variables, x_t is a vector d of exogenous variables, $A_1, \ldots, A_p$ and B are matrices of coefficients to be estimated and ε_t is the vector of innovations that can currently be correlated with others, but can not be auto-correlated with their own values and not the explanatory variables of the equations.

Therefore, this econometric model, as the endogenous variables appear on the right of the VAR model hand side, there is serious simultaneity problem and OLS can be an appropriate method as estimation technique. Also the assumption that innovations (disturbance terms) are not serially correlated is not restrictive for any serial correlation can be absorbed by adding more lags of the dependent variable.

According Zivot (2000), an autoregressive vector model is considered a structural vector auto regression model (SVAR) when their identification is made based on some theoretical model. However, unless the underlying structural model can be identified in the standard VAR reduced form model, analysis of results and parameters and innovations in the Choleski decomposition will not have a compelling macroeconomic interpretation.

For Enders (1995) there are two types of vector autoregressive models: the structural vector auto regression model (or SVAR) and the vector auto regression model (or VAR), in

standard form, which includes unrestricted VAR model, simplified, can be represented the following systems:

$$\left.\begin{aligned} y_t &= b_{10} - b_{12}z_t + \gamma_{11}y_{t-1} + \gamma_{12}z_{t-1} + \varepsilon_{yt} \\ z_t &= b_{20} - b_{21}y_t + \lambda_{21}y_{t-1} + \lambda_{22}z_{t-1} + \varepsilon_{zt} \end{aligned}\right\}$$ Model SVAR (p) structural.

$$\left.\begin{aligned} y_t &= a_{10} + a_{11}y_{t-1} + a_{12}z_{t-1} + \varepsilon_{1t} \\ z_t &= a_{20} + a_{21}y_{t-1} + a_{22}z_{t-1} + \varepsilon_{2t} \end{aligned}\right\}$$ Model VAR (p) in standard form or VAR (p) unrestricted.

When there is no security on endogenous nature of variables, that is, any variable can be exogenous with respect to the other, a set of n variables, then one can use an autoregressive model in which a sequence $\{y_t\}$ be affected by all the variables involved, so that any variable is also affected by other included in the system.

Note that VAR models, which include the unrestricted VAR, structural VAR (SVAR) model and the Vector Error Correction (VECM) allow an empirical analysis of the participation of each variable on changes occurring in the other. This is accomplished through the variance decomposition analysis, which takes into account the response of a variable in relation to a shock in another variable, through the analysis of the impulse response functions, maintains Sims (1986).

The main advantage of the use of models of vector auto regression (VAR) is unrestricted they are theoretical minimum requirements regarding the need for specifying the variables of their structures. In fact, with a VAR model type you need to specify only two factors: the endogenous and exogenous

variables, which should be evaluated interact so they can be included in the VAR model that you want to specify; and the greatest possible number of time lags necessary to capture most of the effects that some variables exert on each other. However, depending on the interest of the researcher, whether to pet or forecast, you can use VAR models or unrestricted VAR models with error correction (VECM).

Such a situation may be represented by a SVAR model with m lags, which allows capture contemporaneous effects (feedback) and delayed (lag) between the set of n variables. However, the effects of feedback (feedback) are defined as deterministic - which prevents a solution of structured SVAR model. Moreover, SVAR model does not appear in their reduced form equations. Anyway, it is possible, after algebraic manipulations, obtain a general formulation of an unrestricted VAR model, which assumes that the following form:

$$\vec{x}_t = A_0 + \sum_{i=1}^{m}(A_i X \vec{X}_{t-i}) + \vec{\xi}_t \text{ and } \vec{\xi}_t \sim i.i.d.N(0,\sigma^2) \qquad (14)$$

Where m represents the number of lags (lag) included in the model, is a column vector (nx1) dependent variables assumed to be constituted by stationary variables, independent variables is the column vector with time lags i, with i = 1, 2, 3, 4 ... n, n is the number of variables included in the model, it is the column vector (nx1) representing the intercepts are the column vectors (nx1) impacts coefficients vector, and, Finally, is the column vector (nx1) which is represented by the terms of forecast errors for each dependent variable included in model. The error terms are normally distributed with mean zero, constant variance and are individually uncorrelated, but may show correlation between each series of errors of the components of $\vec{\xi}_t$.

Madalla and Kim (1998) note that the unrestricted VAR models in reduced form return good predictions, since minimize the mean square error of prediction, and so have been used for short-term forecasts. However, these predictions are not supported by any economic theory. Moreover, "for the purposes of obtaining impulse response functions, variance decomposition and test the validity of economic theories, it is necessary to identify the unrestricted VAR model in structural form SVAR (p)", ponders Enders (1995, p.300 - 302). In effect, to reconcile the vector autoregression models economic theory, structural SVAR models have occupied a prominent place.

Authors such as Sims (1986) and Blanchard and Quah (1989) greatly contributed to the promotion of structural models of type SVAR that are identified with innovations (shocks) using economic theory. This new class of structural SVAR models, instead of the identification of autoregressive coefficients, focuses on the structural innovations (error terms of the system), which are analyzed as linear combinations of external shock. Liu (1960) recalls an important structural difference between the type SVAR models and structural models of simultaneous equations in levels, when considering that the latter employed more restrictions than necessary to identify the system of simultaneous equations in levels, which resulted in problems of over-identification.

Krätzig and Lütkepohl (2004, p. 160) notes that "the SVAR models have exactly the purpose of avoiding over- identification and impose many restrictions on the identification of the parameter values". Therefore, most of the SVAR models is properly identified. Thus, to rescue the SVAR model from an unrestricted VAR in reduced for, it is important to identify innovations with the economic analysis. The purpose of the model structure of type SVAR is to use economic theory

to recover the structural innovation of waste. The first proposal was to identify the triangular Cholesky decomposition, maintains Sims (1986).

The authors Sims, Stock and Watson (1981) evaluate the triangular Cholesky decomposition has become a hypothesis of the innovations on the underlying structural errors of the model. However, although very practical and functional, such identification is untheoretical and the results are sensitive to system variables according to the degree of endogenous.

Sims (1986) and Bernanke (1986) propose a different form of identification arising from restrictions of economic theory itself. Such models have come to be known as structural SVAR or simply SVAR models. Among the known structural identification schemes, has been proposed by Blanchard and Quah (1989) who used the long-term constraints derived from a theoretical model to decompose the gross national product of the United States in their temporary and permanent components.

Enders (1995, p. 322-333) states that "to understand such a proposal, it is useful to examine the relationships between terms of forecast errors and structural innovations of a SVAR model with structured variables n first-order in a compact matrix form". However, the SVAR model structured in n variables and first-order can be generalized into a SVAR model structured variables n and p-order, as already established by Lütkepohl (2005).

In the case of a system of equations with variables n and p orders, may assume a straight, $\{y_t\}$, being affected by current and past series of variables, $\{z_t\}, \ldots, \{w_t\}$, and current

and past sequences of the variable SVAR model series also being affected by $\{y_t\}$, such that:

$$B\vec{x}_t = B_0 + \sum_{p=1}^{m}\left(B_p\vec{x}_{t-p}\right) + \vec{\varepsilon}_t \qquad (15)$$

In equation (15) structured SVAR model (p), the vector $\vec{B}_0$ represents the effects on the levels intercepts that are associated with delayed terms of impacts, $\vec{x}_{t-p}$ the trends are stochastic. The coefficient matrix,$\vec{B}_p$, with p = 1, 2, ... m, Incorporates the impact of lagged variables $\vec{x}_{t-p}$ on them and on the other.

Finally, the SVAR model also incorporates the impact of feedback associated with the current variables in the face of variations on the other unit. The weights of these effects are represented by the coefficients of the matrix B.

$$B = \begin{array}{c|ccc|c} 1 & b_{12} & b_{13} & b_{1n} \\ b_{21} & 1 & b_{23} & b_{2n} \\ b_{22} & b_{32} & 1 & b_{2n} \\ \hline b_{n1} & b_{n2} & b_{n3} & 1 \end{array}$$

In this case, the coefficient matrix B dependent variable vector $\vec{x}_t$ is assumed to be constituted by stationary variable. The components of the column vector (nx1) $\vec{\varepsilon}_t$ represent, respectively, the error terms for each variable of the system are uncorrelated white noise and form. These disorders represent the exogenous stochastic shocks or innovations that act on each variable in the SVAR model. The terms of disturbances have zero mean, constant variance and are individually uncorrelated, but may have correlated with each series of disturbing the components of the error term.

But, like the retro-feeders deterministic effects are probably this prevents the solution of the model. Moreover, the inter-

active equations of this system are not reduced to a single equation. Despite these problems, it is possible to transform a system of structural equations of this type in a useful and compact way, making use of matrix algebra to obtain a VAR model in standard form or unrestricted VAR model from equation (15), such that pre-multiplying the matrix equation (15) byB^{-1} is as follows:

$$\vec{x}_t = B^{-1}B_0 + B^{-1}\sum_{p=1}^{m}\left(B_p\vec{x}_{t-p}\right) + B^{-1}\vec{\varepsilon}_t \quad (16)$$

Making:

$A_0 = B^{-1}B_0$; $A_i = B^{-1}B_p$ with i=1,2,3,..., m

After rearranging, we have:

$$\vec{x}_t = A_0 + \sum_{t=1}^{m}(A_p x\vec{x}_{t-p}) + \vec{\xi}_t \quad (17)$$

Where the term p represents the number of lags in the model, is the column vector (nx1) of dependent variables;

$\vec{x}_{t-p}$ is the column vector (nx1) explanatory variables with p lags, with p=1, 2, 3,...m and t observations;

A_0 is the column vector (nx1) of the intercept;

A_p the coefficient matrix is the column vector (nx1) the explanatory variables, $\vec{x}_{t-p}$, and $\vec{\xi}_t$ is corresponds to the column vector (nx1) the terms of forecast errors for each dependent variable;

p represents the number of lags in the model; where $\vec{x}_t$ is a column vector (nx1) of the dependent variables, stationary set of variables;

A_0 is a column vector (nx1) of the parameters of the intercepts;

A_p represents the coefficients of the impacts column vector (nx1) $\vec{x}_{t-p}$, representing the explanatory variables with p lags, with p=1, 2, 3,...m;

$\vec{\xi}_t$ is the column vector (nx1) formed by the terms of forecast errors (stochastic term) for each dependent variable in the model.

In SVAR model, analysis of determination of shock innovations on each dependent variable included in the model, it is necessary to determine the B, B_i and parameters. Through a set of equations involving $(n^2 - n)/2$ more parameters to the equations to be identified. In the case of triangular Cholesky decomposition is what happens, because the B elements above the diagonal are equal to zero and add up the same level of restrictions.

Moreover, the imposition of restrictions is not sufficient for exact identification due to the presence of nonlinearity in the system of equations that can generate multiple solutions. Therefore it is appropriate that the identification process, restrict $(n^2 - n)/2$ elements of the matrix B with evidence of economic base, as Blanchard and Quah guide (1989).

Enders (1995, p.327-330) notes that "as to the identification of the function impulse-response (FIR) and variance decomposition (VD), these are held by the triangular Cholesky decomposition method." To do so, you must obtain the Vector Moving Average (VMA) which, after some mathematics, takes the following form:

$$\vec{x}_t = \vec{\bar{X}} + \sum_{i=0}^{\infty}(A_i X \vec{\xi}_{t-i}) \quad (18)$$

Making some substitutions, we obtain:

$$\vec{x}_t = \vec{\bar{X}} + \sum_{i=0}^{\infty}(A_i x \beta^{-1} x \vec{\xi}_{t-i}) \quad (19)$$

Where $\vec{\bar{X}}$ is the column vector (nx1) of average terms for each dependent variable included in the model and the second term of equation (19) is the response function of the VAR system whose multiplier impacts of shocks on innovations ($\vec{\xi}_{t-i}$), no lag i, characterized by the matrix $\phi(i)$ are determined by the following equation:

$$\sum_{i=0}^{\infty} \phi(i) x \vec{\varepsilon}_{t-i} = \sum_{i=0}^{\infty} A_i x \beta^{-1} X \vec{\varepsilon}_{t-i}, \text{ that is, } \phi(i) = A_i X \beta^{-1} \quad (20)$$

Indeed, the estimated function-response (FIR) and variance decomposition (VD) is, in principle, the establishment and solution of the system given by the relations (17) and (18), assuming $(n^2 - n)/2$ restriction of array elements βor β^{-1}. In this case, these restrictions should be made by means of economic evidence about the model variables SVAR.

However, in general, most studies that use the SVAR model, identification of system constraints is taken by the Choleski decomposition method. The indirect and lagged impacts will occur only if there is a causal relationship between variables. At this stage, it can sometimes be resorted to analysis of Granger causality doing exogeneity test to establish the order of impacts.

The extension of the number of lags is the main weakness of the SVAR model. In practice, to mitigate such a problem, it is necessary to limit the order of lags to a lesser amount than would be ideal, given the dynamic nature of this model. The result is that sometimes it is necessary to impose restrictions on the SVAR model (p) doing exactly what you

wanted to avoid. Anyway, this is kind of identification, adapted for the purpose of this study, which intends to use to estimate the total amount of credit granted in the face of rationing of banks arising from the risk of default and the basic interest rate of the Central Bank of Brazil.

This paper uses the default of corporate loans borrowing and the basic interest rate of the Central Bank of Brazil between 2000 and 2009. It uses the techniques of cointegration and co-characterization to identify a system of structural vector autoregression and error correction, taking into account the existence of a structural break in the series.

Structural SVAR model with error correction

An alternative way of dealing with non-stationary time series is to find the appropriate linear combinations of stationary integrated variables called cointegrated variables. According to Enders (1995, p.359), the concept of cointegration states that there is at least one equilibrium relationship between a set of cointegrated variables that trend resulting equilibrium in the long run, must be so related that cointegrated variables cannot move in the long run independently of each other, so the dynamics of long-term trajectories of each variable must bear some relationship to the current shifts in the relations of short-run equilibrium.

These relationships, however, will only really make sense if the deviations in the series of variables that make the equilibrium relationships are temporary, or short-term. In this context, the VAR model involving cointegration equations, is also called a VAR Model with Error Correction or simply VECM model. The vector error correction model (VECM) is a restricted structural VAR model that has restrictions on the cointegrated specification built to work with non-stationary time series are cointegrated.

Accordingly, to Hamilton (1994, p.571-629), "the term cointegration is called error correction term because the deviation from long-run equilibrium is corrected gradually through a series of partial short-term adjustments". One of

the criticisms made to the restricted type VAR models is their eminently statistical nature, most of the time without any economic basis.

Moreover, the degenerate series with gaps, like a series explained only the first and fifth lags, are difficult to theoretical justifications. However, when time series of non-stationary and co-integrated time have a dynamic in common, they can be specified by a fuller SVAR model called a vector autoregressive error correction model or VECM.

An alternative way of dealing with non-stationary time series is to find the appropriate linear combinations of stationary integrated variables called co-integrated variables. According to Enders (1995, p.359), "the concept of co-integration states that there is at least one equilibrium relationship between a set of variables that trend co-integrated resulting equilibrium in the long run, must be so related that co-integrated variables not can move in the long run independently of each other".

Thus, the dynamics of long-term trajectories of each variable must bear some relationship to the current shifts in the relations of short-run equilibrium. Krätzig and Lütkepohl (2005, p.175-176) argue that "relations have practical sense only if the deviations in the series of variables that make such equilibrium relationships are short term." The term error correction means that the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

For authors such as Hamilton (1994, p.571-629), Johnston and Dinardo (2003, p.324), "when series are co-integrated of order one I (1), it is convenient calibrate the parameters again the SVAR model to turn it into a VECM, which can be

specified from the series in first differences - including the error term of the co-integral equation and excluding the difference in levels of the variables - so that the model error correction be so specified ":

$$\Delta Y_t = \varphi_0 + \varphi X_{t-1} + \sum_{t=1}^{p} A_i \Delta X_{t+p-1} + \varepsilon_t$$

e

$$\varepsilon_t \sim NID(0, \sigma_u^2) \qquad (21)$$

Where:

$A_t = \sum_{j=1+i}^{p} \emptyset_j, \qquad i = 1, 2, \ldots, p-1; \; \varepsilon_t = p\varepsilon_{t-1} + v_t$

If there is a unit root, then $\emptyset(I) = 0$, so that $\emptyset = \alpha\beta'$. With that, then, can be said that is the matrix having vectors of co-integration and α is the matrix of adjustment with r vectors.

The vector auto-regression correction model VECM errors is so named because it explains ΔY_t by two components: 1º) The short-term factors: $\sum_{t=t-1}^{p-1} A_i \, \Delta Y_{t+p-q}$ and 2º) A long-term relationship between the given coordinates vector of endogenous variables $\emptyset X_{t-1}$, considering that there is co-integration.

ESTIMATION AND ANALYSIS OF RESULTS: DATA AND VARIABLES USED

The econometric model that will be used for the development of this work will be the structural autoregressive model (SVAR) and the vector error correction model (VECM). The term autoregressive cointegration in structural models is called error correction term because the deviation term is

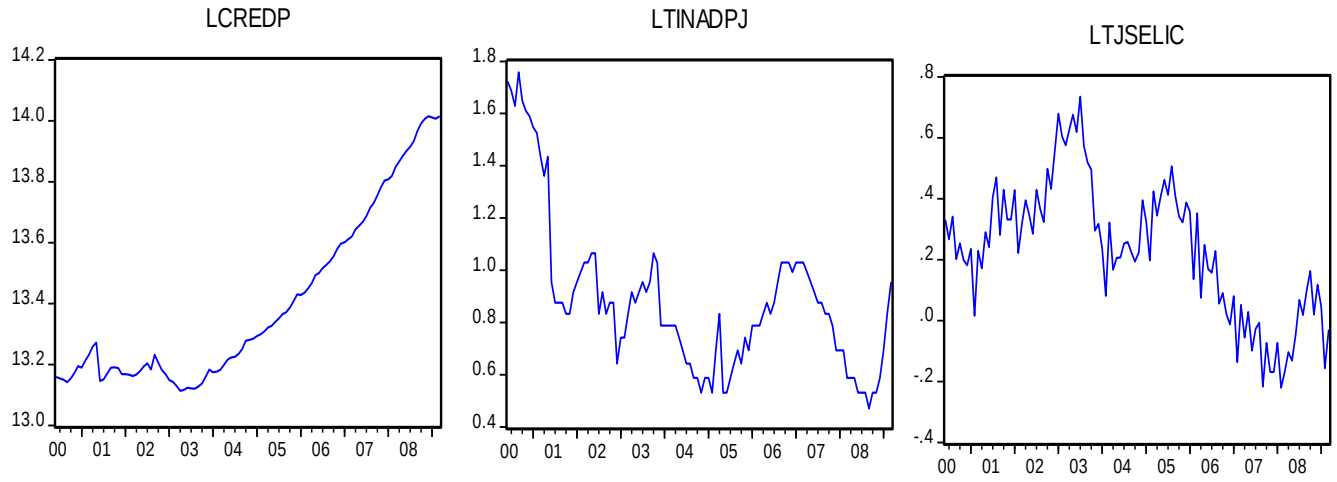
corrected gradually through a series of partial short-term adjustments.

The time period considered for the implementation of the model runs from June 2000 until March 2009. This definition covers the time corresponding to the high interest rates charged by the Central Bank of Brazil to control inflation, especially after the real plane to the current international financial crisis that has led to increased credit rationing policy period. These variables were selected based on the theory of credit rationing of Stiglitz.

The original values of the monthly supply private loans are expressed in units of million dollars and the explanatory variables are expressed in percentage terms. The nominal values of the time series of credit supply were deflated by the IGP-DI price of FGV March 2000. The data used in the application of the model were obtained from the following institutions: the Central Bank of Brazil (BCB) and the Institute for Applied Economic Research (IPEA). The time series of the variables included in the SVAR model are: the provision of private bank loans (LCREDP), the default rate of corporate borrowing loans (LTINADPJ) and the base interest rate (LTJSELIC) of the Central Bank of Brazil (BCB).

According Charemza and Deadman (2003, p.103) "private loans and other variables were converted to natural logarithms to avoid the problems resulting from the overlap of the operators “overdiffrencing difference". The Figure 1 below shows the level variables:

Figure 1: **Temporal Behavior Variables LNCREDP, LNTINADPJ and LTJSELIC.**



Source: Central Bank of Brazil.

The specification of the econometric model

Given the order of the lags of each variable, we can not reject the hypothesis that there may be bilateral causality between the variables of the system of equations. Taking this into account, for practical reasons, the estimation of SVAR (4) model of credit rationing will test the hypothesis that the credit granted in a given period of time depends on the lagged loans, the delinquency rate (the rate of risks) and the base interest rate that sets the monetary policy of the BC. Thus, the specification of the model can be represented:

$$LCREDP_{1t} = \alpha_{1t} + \sum_{t=1}^{4} \beta_4 LCREDP_{t-4} + \sum_{t=1}^{4} \lambda_4 \Delta\Delta LTINADPJ_{t-4} + \sum_{t=1}^{4} \delta_4 \Delta\Delta LTSELIC_{t-4} + \varepsilon_{1t}$$

(22)

$$LTINADPJ_{1t} = \alpha_{1t} + \sum_{t=1}^{4} \beta_4 LCREDP_{t-4} + \sum_{t=1}^{4} \lambda_4 \Delta\Delta LTINADPJ_{t-4} + \sum_{t=1}^{4} \delta_4 \Delta\Delta LTSELIC_{t-4} + \varepsilon_{1t}$$

(23)

$$LTJSELIC_{4t} = \alpha_{1t} + \sum_{t=1}^{4} \beta_4 LCREDP_{t-4} + \sum_{t=1}^{4} \lambda_4 \Delta\Delta LTINADPJ_{t-4} + \sum_{t=1}^{4} \delta_4 \Delta\Delta LTSELIC_{t-4} + \varepsilon_{1t}$$

(24)

In terms of the stochastic errors are the impulses or innovations.

The null hypothesis testable (H_0) that is testable parameters SVAR (4) models are zero. The alternative hypothesis (H_1) is that there is at least one of the coefficients of the SVAR (4) models is nonzero.

The unit root test

To place the unit root test is resorted to methods of Dickley-Fuller (ADF) and Phillips-Perron (PP), in which the testable null hypothesis is that the model variables are stationary at level1. The results of their tests indicated that they reject the presence of a unit root for any of the variables, or, in other words, the model variables are not stationary.

Since all variables in the model exhibited unit roots level goes up, then the definition of the order of integration of each variable. To do so, apply tests in the respective series in first difference. In this case, the null hypothesis is rejected, then the variable is integrated of order one, $x_t \sim I$ (1). Otherwise, differs again the series and applies the test until the null hypothesis is rejected. The results of both tests presented in Table 1 show that all variables are I (1).

In the previous unit root tests there was a formal concern in considering the possibility of sudden changes in the behavior of the analyzed series. One way to become more stringent tests for checking the stationarity of the series is to

[1] When the tests are insignificant trend is not necessary to repeat them. See Bueno (2008, p.104).

consider the existence of structural breaks. The presence of structural break in a series patterns can lead to erroneously conclude the presence of a root2.

In this context, we chose to conduct suggested by Zivot and Andrews (1992) test, in which a structural break is determined endogenously. In this test are considered three possible types of structural break, implying the use of three models in which the null hypothesis is that the series contains a unit root without structural break and the alternative hypotheses are possible versions of a stationary series with deterministic trend with a change in the intercept, or a change in slope, or both.

Table 1: Results of Unit Root Tests - DF and PP.

Dickley-Fuller **tests (**Raised in **First Difference**)					
Variables	Tests	VC τ_{PP}	Critical Values		
			1%	5%	10%
LNCREDP	CIST	-8.5793*	-3.4943	-2.8894	-2.5817
LNTINADPJ	CIST	-10.4964*	-3.4943	-2.8894	-2.5817
LNTSELIC	CIST	-4.9913*	-3.4943	-2.8894	-2.5817
Phillips-Perron tests **(**Raised in **First Difference**)					
Variables	Tests	VC τ_{PP}	Critical Values		
			1%	5%	10%
LNCREDP	CIST	-8.5693*	-3.4943	-2.8894	-2.5817
LNTINADPJ	CIST	-10.49928*	-3.4943	-2.8894	-2.5817
LNTSELIC	CIST	-18.7578*	-2.8894	-2.5817	-2.5817

Note: * significant at 1%, ** significant at 5%, *** Significant at 10%. The critical values were obtained from McKinnon (1996). VC = calculated value of the statistic, critical value = VCR • distribution; CIST = with intercept and without trend.

Source: Prepared by the authors.

The test results indicated that the titled one can reject the null hypothesis of a unit root only for LNCREDP variable and also that it is stationary with a break in October 2002, as can be seen in Table 2.

[2] The series used in the work are financial variables, as well as monthly and, as such, are more vulnerable to economic shocks arising from international and / or domestic crises.

Table 2: **Results of Unit Root Test with Structural Break**

Variables	Components Smash			t-Statistic Minimun	Date of Breaking	Critical Values	
	Intercept	Inclination	Intercept & Inclination			1%	5%
LNCREDP				-7.302*	2002:10	-5.57	-5.08
LNTINADPJ				-2.497		-4.93	-4.42
LNTSELIC				-3.469		-4.93	-4.42

Note: * significant at 1%, ** significant at 5%, *** Significant at 10%. Critical values Zivot and Andrews (1992) were obtained.

Source: Prepared by the authors.

A multivariate cointegration analysis

Unlike the traditional test of Johansen (1991), which presents critical values that take into account only terms deterministic - intercept and trend - the co-integration test used here is based on Johansen et. al (2000), since the results of unit root tests indicated the presence of a structural break in one of the analyzed series. In the latter test the critical values also take into account the presence of dummy variables, which reflect the presence of structural breaks.

The Table 3 presents the statistics of the dash indicates the existence of at least one co-integrating vector at a significance level of 1%. The occurrence of co-integration ensures the presence of a linear link between the stochastic trends of the variables, and therefore, they move together stochastically over time toward a long-term equilibrium. It should be clear, however, that this is the econometric definition of long-run equilibrium, which may or may not include a link to market forces or rules of behavior of individuals and firms, leaving the economic interpretation of the phenomenon depending on situation involved.

Table 3: **Johansen Co-integration Test with Structural Break**

Sample		Statistics Trace			
2000:06 – 2009:03	LR	Critical Values			*p*-value
		1%	5%	10%	
$r = 0$	152.04	54.25	47.78	44.55	0.000
$r \leq 1$	68.81	34.65	29.37	26.77	0.000
$r \leq 2$	11.44	18.52	14.50	12.61	0.124

NOTE$_1$: The test includes a structural break dummy relating to the supply of private bank loans (LNCREDP) the date of 2002:06 (r = number of co-integrating relations). **NOTE$_2$**: The number of lags was set according to the criterion of Hannan-Quinn and considered the presence of an intercept and a trend. **NOTE$_3$**: Critical values were obtained in Johansen et. al (2000).

Source: Prepared by the authors.

The test results identified a linear long-run relationship between the variables, where the variance decompositions indicate that the base interest rate explains most of the fluc-tuations in the short and long term supply of private bank loans.

RESULTS OF EMPIRICAL MODEL

A characteristic of Error Correction Models (VECM) is the inclusion of variables in differences in the specification of the model so as to allow both to investigate the effects of long-term correction of deviations as the short term. When there is co-integration relationships in the series of the variables considered, there are impacts of terms of stochastic disturbances (deviations from long-term) on the relationships of the variables co-integrated in the long run VECM models, support Hendry and Juselius (2000).

Test of the inverse roots of the characteristic polynomial of the VAR system - in this context, a stability test was performed3. The result of the stability test ensures the presence of roots between zero and one, as shown in Table 4, which indicates that the system is stable.

[3] If all roots of the polynomial fall within the unit circle the system should be stable, which means that all the roots must have modulus equal to or less than one if some roots lie outside the circle, then the system is unstable with explosive behavior; and get a root on the unit circle, then the system is non-stationary and may have stochastic trend or trajectory of the random walk. See Lütkepohl (2005).

Table 4: **Stability Test Model**

Roots	Modules
1.0000	1.0000
1.0000	1.0000
0.9291	0.9291
-0.449975 – 0.405271i	0.6055
-0.449975 + 0.405271i	0.6055
0.113483 - 0.270631i	0.2934
0.113483 + 0.270631i	0.2934
0.005127 - 0.285618i	0.2856
0.005127 + 0.285618i	0.2856

Source: Prepared by the authors.

4.1. The specification of the VECM

With the purpose of analyzing the effects of private credit rationing associated with the provision of private credit, the default rate and the base interest rate of the BCB, the specification of the linear model VECM with two lags, was as follows:

$$\Delta LCREDP_{1t} = \alpha_{1t} + \sum_{t=1}^{2} \beta_2 \Delta\Delta LCREDP_{t-2} + \sum_{t=1}^{2} \lambda_2 \Delta\Delta LTINADPJ_{t-2} + \sum_{t=1}^{2} \delta_2 \Delta\Delta LTSELI_{t-2} + v_{1t}$$

(25)

The investigation of the relations of long-term equilibrium through the error correction model, requires that the series of variables are cointegrated, as in the previous case. The results of the VECM model can be presented as well as results in Table 5:

$$\Delta LCREDP_{1t} = 0{,}001 + 0{,}567\ \Delta LCREDP_{t-1} - 0{,}208\ \Delta LCREDP_{t-2} - 0{,}026\ \Delta LTINADPJ_{t-1} - 0{,}048\ \Delta LTINADPJ_{t-2} - 0{,}02\ \Delta LTSELIC_{t-1} - 0{,}01\ \Delta LTSELIC_{t-2} - 0{,}01 EC_{1t}$$

(26)

The coefficient of error correction term (EC1) of the VECM model is significant at 5% error probability. This shows that

the short-term imbalances between the time series of the variables should provide a path toward long-term equilibrium. In this case, the coefficient EC1 = 0.01 indicates that drifts (deviation) around the long term equilibrium variables will be adjusted to 0.01 parts per month.

This condition proves certain stiffness (viscosity) for the transmission of the effects of the supply of private credit, the default rate and the interest rate Selic monetary authority over the channels of bank lending to companies occurs.

4.2. Analysis of impulse response function

The function impulse response (IRF) instruments are illustrative of how the variables in the model over time to react to a change in the deviation of innovations. Accordingly, the IFR is an important analytical tool to assist in identifying the reaction of the endogenous variables on innovation chain4. The requirement of the impulse response function (IRF) and variance decomposition requires the establishment of restrictive $(n^2-n)/2$ elements of the matrix B.

This transmission mechanism of the IRF resulting from the reduction of the standard deviation of innovations of variables of the VECM model, can be seen in Figure 2. In the first figure, representing the IRF LNCREDP variable, we note that the dynamics of the mechanism begins with an increase of one standard deviation of 0.02 per month mainly caused by the reduction in default rate and the growth rate Jutes throughout the period .

Second, the level of IRF LNTINADPJ is decreasing throughout the period for the provision of credit, which despite showing an increase from the fourth quarter, this is small

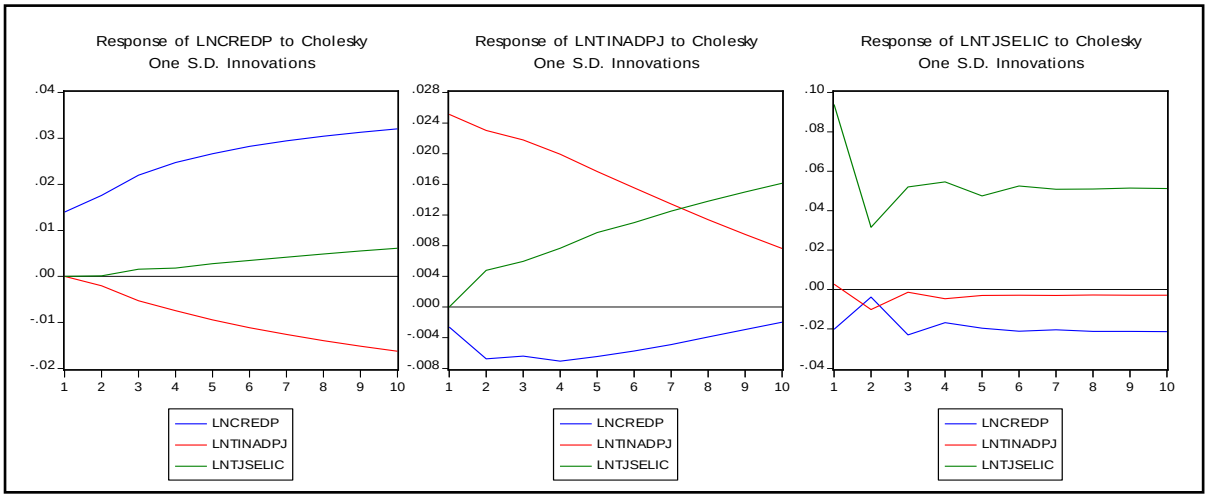
[4] The confidence intervals are calculated from the standard errors of the impulse response functions.

suggesting certain stiffness (viscosity) for reasons related to information asymmetries as risks of adverse and moral choice.

In the third figure the level of the IRF LNTJSELIC shows the relative influence of the high interest rate on the supply of credit, since banks do not pass on to their customers, full and immediate policy changes in the interest rate SELIC - which suggests evidence of practice credit rationing.

Finally, it remains to add that, in response to impulses (shocks), the series of variables can enter into long-term balance to a new level, above or below the short-run equilibrium position.

Figure 2: Impulse Response Functions to a Clash Level a Unit Standard Deviation Innovations in; confidence interval of 95%.



Source: Prepared by the authors.

4.3. Decomposition analysis of variance

In order to fix the degree of transmission of innovations of different variables, use the effect of the variance decomposition to an unanticipated monetary policy shock will make itself. The variance decomposition allows to determine the

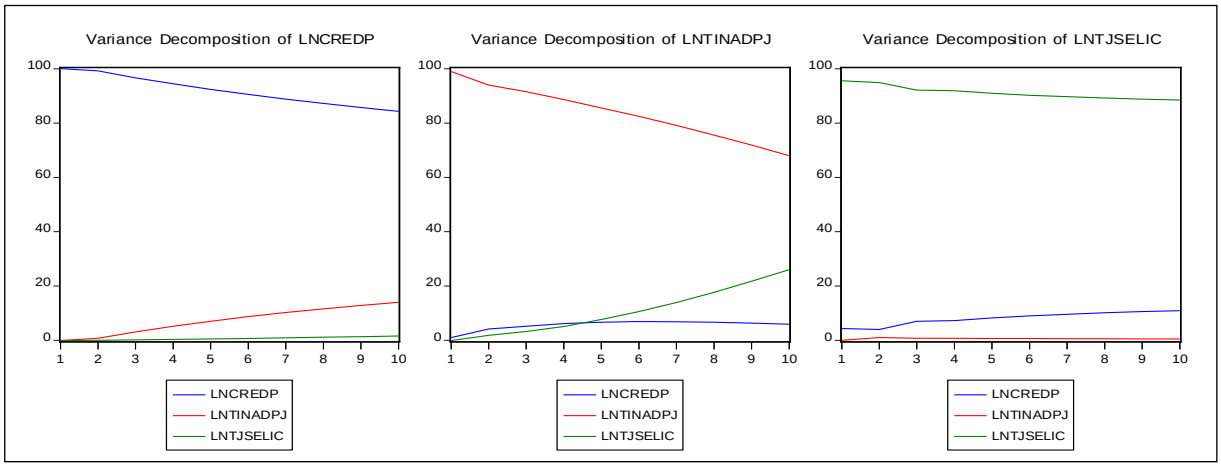
percentage of change driven by the introduction of an innovation.

A high percentage suggests a dominant position and, therefore, a strong presumption of causality. We chose to analyze the effects of variance decomposition (VD) of credit supply, the default rate and the prime rate.

The Figure 3 shows the results: the first of the three figures, it appears that the VD LCREDP variable is explained by 99.18% in the second month and declines until it reaches 84.34% in the tenth month, which reveals the importance of influence the actual variance of the supply of credit, in the second figure we note the influence of VD default rate on the supply of credit declined from 98.93% to 68% from the first to the tenth month, and the third figure, the VD SELIC interest rate declines from 95.52% to 88.49% from the first to tenth month.

Finally, we note a tendency of long-run equilibrium with the VD of credit supply (10.96%), the default rate (0.53%) and the interest rate SELIC (88.49%) explaining the credit rationing in Brazil.

Figure 3: **Decomposition of Variance of Credit Default Rate and Interest Rate Selic.**



Source: Prepared by the authors.

THE CASE OF CREDIT RATIONING IN THE AMERICAN SUBPRIME CRISIS

Although the origins of the U.S. financial crisis goes back to the U.S. consumer boom - covering the two administrations of President Bill Clinton of the Democratic Party and extending to the administration of President George Bush's Republican Party - the first clear signs of the mortgage crisis expressed, in June 2007, with falling property prices and the devaluation of mortgage securities. The Secretary of the Treasury of the George Bush, Paulson Junior (2010, p 1-18) anticipated the financial crisis that erupted in September 2008, just did not expect it to come of residential property and not to come cause deep and lasting damage to the U.S. economy and the rest of the world sector.

It's very strange this statement compared with others before the outbreak of the crisis. In fact, between August 2007 and August 2008, the real estate industry was already showing clear signs that something was wrong. At that time, Paulson Junior, the U.S. Treasury Secretary, ruled out any possibility of a subprime mortgage meltdown: "I do not believe that subprime mortgages represent a real threat to the economy as a whole." Even after the collapse of Bear Stearns, Paulson Junior continued not believing that a major crisis could erupt in real estate. The chairman of the Fed, economist Ben Bernanke at a conference in the U.S. Congress said: "At this juncture, it appears that the impact of problems in the subprime mortgage market in the U.S. economy and financial markets will be contained".

In the not too distant past, U.S. banks made loans, mainly to finance residential houses, operating model best known for originating and maintaining a portfolio mortgage securi-

ties pledged as collateral by borrowers of this loan type. This type of transaction was conducted strictly between the potential property owner and the bank. In the 1970s, a financial institution by the U.S. government was created, the Government National Mortgage, known as Ginnie Mae guaranteed mortgage.

In practice, the Ginnie Mae began to gather lots of mortgage securities it originated and then rather than keep in your wallet, began issuing securities backed him. As a result, instead of waiting twenty, thirty more years to recoup the funding provided, Ginnie Mae began receiving in advance the amount of funding the purchaser of savings bonds.

In turn, investors who purchase these securities or passed along the selling in the secondary market or received part of revenue from payments made by thousands of homeowners who write off their debts. This financial innovation spread rapidly to the banks originating the mortgage securitization process, illiquid assets until then transformed into marketable liquid assets on the open market.

These financial instruments were called mortgage-backed securities (MBSs), i.e., mortgage backed securities. Over time, other government agencies, such as Fannie Mae (Federal National Mortgage Association FNMA) and Freddie Mac (Federal Home Loan Mortgage Corporation, FHLMC), also began to issue securitized mortgages, mentioning Roubini and Mihm (2010).

The Commercial banks, investment, brokerage firms and even the builders they came to enjoy increased profits with large numbers of lots of securitized mortgages. Investors, banks, pension funds and investment funds from the rest of

the world also bought these titles, because after all the agencies risk suggested that house prices would never fall.

The two publicly traded companies, "Fannie Mae and Freddie Mae, which had the support of the federal government, through Government Sponsored Enterprise (GSE) pioneered the granting of reckless lending and even participated in the scam mortgage securitization, but, he said, both played a secondary role. The deregulation of the financial system was also another serious mistake committed by the government, but Krugman (2009, p. 170-182) believes that the financial crisis, in part not involved problems with deregulated institutions that took new risks. Rather, the current crisis revolved around risks taken by institutions that were never regulated.

5.1. Structural deficit in the American economy and its impact on the world

The financial crisis in the U.S. economy is, significantly, a macroeconomic crisis because its trade and fiscal deficits are eventually produced the financial markets and then transmitted to the real economy. Meanwhile, the international financial system is dependent on the deficit of the current account to the U.S. dollar liquidity can feed commodities markets, monetary and financial.

The financial instability hypothesis, in the sense of Minsky, caused by the current account deficit of U.S. attempts to show how the link between the macroeconomic imbalances and inflation of asset prices is transmitting instability to the world. "This approach matter because, really, there is a structural imbalance in the U.S. economy, but few theories have emphasized the effects of the U.S. twin deficits on the global financial system," argues Perelstein (2009, p.3).

In an attempt to sensitize members of the Senate, so the plan of Paulson Junior was approved, the cost of this plan increased from $ 150 billion because the federal government was forced to grant tax relief for the medium and small businesses tax incentives class. Anyway at this point the financial crisis and credit braking had caused an economic crisis with the reduction in consumer spending and investment, rising unemployment and deflation.

Even with the drop in interest rates, from 2008 onwards, yet the loss of confidence in banks because credit rationing by increasing the conditions for the granting of credit, and this complicates the process of economic recovery U.S.A. Indeed, macroeconomic indicators show the beginning of the Great Recession starting in 2006.

The effect of the U.S. economic recession was characterized by a fall in the growth rate of U.S. GDP of 3.07% (2006) to -3.52 (2010) and the sharp rise in the unemployment rate of 4.61% (2006) to 9.63% (2010). The interest rate that had remained relatively low, between 2000-2004, shall rise between 2005-2007 and it brings serious difficulties for borrowers of high risk (subprime).

In 2011, the political impasse between the executive and legislative American increased the risk of a worldwide depression. The Republican Party, the majority in Congress, left the government hostage Barak Obama of "radical Republicans" when the executive had difficulty approving the increase of budget allocations. This fact has created a political impasse high risk which, if not resolved, could further exacerbate systemic international financial crisis.

The impacts of the great recession on economy of Brazil

The financial crisis that began in the U.S., and spread around the world, hit the countries of Latin America, but some of them are in their strongest financial systems than in other seasons. The effects of the financial crisis on the stock markets and domestic currencies in terms of dollars of Latin America (LA) were differentiated, with Brazil being in a better position than other global crises.

The Macroeconomic policies adopted by Brazil, after the intense fighting inflation and speculative attacks against surprising in the 1990s, as well as improvement in the levels of international reserves, left the country more resilient to external shocks. Brazil is an example of those countries that have invested housing. In fact, the total budget to housing value was $ 8 billion between 2009 to 2010, aiming to build one million homes, despite covering only 12% of the housing deficit.

The Brazilian government has also been using fiscal policy to avoid the possibility of a recession in Brazil. The investments of the Program Accelerated Growth and the pre-salt are important as complementary actions. Even so, the risk of being affected by Brazil great recession in the developed world is real. The adoption of countercyclical macroeconomic policies, which is being conducted by the Brazilian government may facilitate the recovery of the Brazilian economy in a shorter time than you might assume. The data in Table 5 show that, despite the actions of the federal government, the Brazilian economy is not immune from the effects of a global economic depression.

Table 5: Macroeconomic data from the Brazilian Economy: 2007-2012

Macroeconomic Data	Units	2007	2008	2009	2010	2011	2012
Growth Rate	%	6,09	5,16	-0.64	7,49	3,02	4,25
Investment	% GNP	18,32	20,68	16,50	19,25	19,82	20,55
Inflation	%	3,64	5,67	4,90	5,04	6,58	4.55
Unemployment Rate	%	9,28	7,90	8,10	6,70	6,70	7,50
Revenue From Government	% GNP	35,65	36,32	35,58	37,51	36,73	36,38
Government expenditure	% GNP	38,34	37,72	38,70	40,40	39,21	39,18
Current Transactions	US$ Billions	1.551	-28.192	-24.302	-47.365	-58.408	-66.580

Source: Central Bank of Brazil.

Given the difficulty of a political action coordinated between the governments of rich countries, to overcome the ongoing recession since 2008, cannot be ruled out the possibility of recession turning into a depression worldwide. Although at the time I write this essay does not glimpse a great depression, the political deadlock in both the U.S. and the Eurozone could lead the global economy into a depression. This possibility cannot be ruled out if the crisis of confidence worsen with braking or credit rationing.

CONCLUSION

The result highlights the influence of the base rate of interest on loan volume. Besides contributing to government decisions, this finding is relevant to the planning activity of institutions and businesses that extend credit or depend on it for carry out its sales activities.

The realization of this work was able to achieve the objective of demonstrating the influence of credit rationing in Brazil 's economic policies, ie when credit demand is greater than the supply of credit to the interest rate market, so that the demand credit, by some economic agents, is not fully satisfied.

The current monetary survey reveals that bank concentration, for example, has been an important aspect in the Brazilian economic debate, because, basically, the stabilization of prices, the entry of foreign banks in the country, the privatization of state banks, the restructuring of banks with solvency problems and the country's accession to the Basel

Accords, among other reasons. This debate must be understood in the context of the restructuring process, which has led to the expansion of some financial conglomerates.

As to the Basel Accord by permitting the combination of the high risk of lending to offer federal bonds will induce financial intermediaries to replace the resources that would be allocated to the loans that investment bonds with high returns and virtually no risk.

If this will occur, the increase of credit rationing will preclude the increase in consumption and investment, since the lack of funding causes a decrease in output with a decrease in income hampering the resumption of economic growth. Moreover, monetary policy continues this high interest rates of the Central Bank; micro, small and medium enterprises will be part of the group of potential borrowers who are denied access to credit, and this will reduce your chances of keeping or even to grow in their markets for goods and services due to lack of financing the purchase of their basic inputs.

Therefore, credit rationing is considered an inhibiting factor in economic growth, causing concern among governments and economists, and serves as a source of inspiration for academic papers for economists of all theoretical frameworks, not focusing on just one, which shows its such diversity.

This article proved to be important to demonstrate monetary policy has a major influence on economic trajectory of a country. His conduct reflected in the behavior of domestic credit operations. Besides interest rates, credit policies encourage and interfere in these financial market operations. Indeed, the theory of credit rationing, the behavior of banks,

as credit supply increases on a restrictive monetary policy, which involves increases in base interest rate. In this context, banks, due to the problems of asymmetric information, credit rationing react as a result of adverse selection and moral hazard. Moreover, the transmission mechanism of the effects of monetary policy through the credit and interest channels are hard because the cost of "menu" observed by banks.

Furthermore, this research involving the theory of credit rationing found that although the rate of interest to be an important factor in the lending operations, banks' willingness to lend depends crucially on the perception of banks as the adverse selection and moral hazard of debts settlement unlikely, because in the absence of reliable information banks increasing the degree of caution in the supply of credit.

In Brazil, for example, even if interest rates are high, the credit will decline, regardless of demand, since the market does not have all the information needed to work efficiently. The asymmetry problem cannot be corrected by increasing the interest rate, even though the rise in demand balance in the market, encourage adverse selection, good clients and decrease emergence of riskier and less possibility of return projects. The aversion to risk is reduced when an increase in the firm basis of wealth, as the aversion and the cost of bankruptcy is connected directly with the scale of production and there is need to finance increased production through debt and can case an economic shock occurs the firm decree bankruptcies.

The threat of no return that intermediaries of credit in the medium and short term (Commercial and Development Banks) deposits with work not only sees, but also the long term liquidity needs is performed by the interbank market

for reserves, they invest their assets in business financing for working capital is usually guaranteed by inventories acquired by borrowing firms. Therefore, the risks depend on economic cycles, since the recession increase and decrease in an economic stabilization thereby choosing to bank operation depends on the expectations that agents observe.

The Inflation targets set by the Central Bank of Brazil are monitored by a monetary policy based on the establishment of the basic interest rate. Any threat of rising inflation is to answer a high interest rate. In recent years, the high interest rate Selic has transmitted its effects through the channels of interest and repayment of loans (loans) by banks. However, despite the high interest rate, the borrower companies continue making loans from the banks. Nevertheless, the high interest rates of loans as a result of monetary policy and the fear of default by borrowers, have induced banks to be cautious credit rationing. In fact, the effects of monetary policy of the Central Bank does not propagate quickly through transmission mechanisms - through the interest rate channel - as expected by the formulators of this policy.

Indeed, there is some rigidity in the transmission process due to the "menu costs". The theory of credit rationing of Stiglitz has a good analytical explanation for this behavior of the banking sector. The problem of asymmetric information by banks, leading to a process of adverse selection and moral hazard. In consequence, banks react by adopting a cautious stance for the rationing of credit to borrowers either due to high interest rate or by reducing the amount of available credit by increasing the bureaucratic requirements and reducing the "ceiling" of loans and time for payment of interest and principal.

Employed in the structural SVAR and VECM models in order to estimate the values of the parameters of the analytical model formulated based on the theory of credit rationing of Stiglitz. In particular, we adopted an econometric structure with three selected based on the theory of credit rationing variables. The results of analysis of model parameters VECM not only confirmed the theory fit them. The parameters of the models were used to test the predictive capability.

The advantage of the SVAR model type is because it allows you to use economic theory to recover the structural innovation of waste and uses it to identify the triangular Cholesky decomposition suggested by Sims (1986). For the purpose of the work, moreover, proceeded to the two important tests of the SVAR: the analysis of the results of the impulse response function and variance decomposition analysis to verify the behavior of the percentage rate of change of the explanatory variables with respect to the dependent variable.

In addition, the unit root test by methods Dickley-Fuller (DF) and Phillips-Perron (PP) was applied to test the null hypothesis that the model variables are stationary in level. The results of both tests rejected the presence of unit root, ie, the model variables are not stationary. Once the tests identified the presence of unit roots level and the order of integration we replicate the test in the series in first difference with integrated unit In order that allowed opportunity variables was done the traditional Johansen cointegration test with structural breaks as is the most suitable to the objectives of Article.

We conclude that, notwithstanding the stiffness (viscosity) of the rate of interest on loans, rationing of bank credit in

Brazil is due, in part, the policy of high interest rate and, in part, the cautious behavior of banks fear of default marked by excessive prudence (Basel Accord) and the basic high interest rate.

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