

MONETARY PROGRAMMING, TURNOVER OF THE DIRECTORS OF CENTRAL BANK AND INTEREST RATE DETERMINATION: REACTION FUNCTION APPLICATIONS FOR BRAZIL

Área 4 - Macroeconomia, Economia Monetária e Finanças

by

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Abstract: The objective of this paper is to test empirically the question of Central Bank Independence (BCI) in Brazil. We estimated two reaction functions for the Brazil's Central Bank in order to identify whether the turnover of the Directors of the Monetary Policy Committee (COPOM), and whether the deviations of monetary aggregates interfered in the conduct of monetary policy. The results indicate that changes of directors did not result in changes in the conduct of monetary policy in short-run, but indicate changes in long-run of monetary policy. Besides, the results of reaction function show that it is necessary a closer monitoring of Brazil's monetary aggregates.

Keywords: Central bank independence, monetary policy, reaction function, Turnover COPOM's directors, monetary aggregates.

Resumo: O objetivo deste trabalho é testar empiricamente a questão da Independência do Banco Central no Brasil. Foram estimadas duas funções de reação para o Banco Central no Brasil, a fim de identificar se a taxa de rotatividade dos Diretores do Comitê de Política Monetária (COPOM), e se os desvios dos agregados monetários interferiram na condução da política monetária. Os resultados indicam que mudanças nos diretores do COPOM não resultaram em mudanças de curto prazo na política monetária, mas sinalizaram uma mudança de longo prazo na conduta do Banco Central. Além disso, dos resultados da função de reação, ficou demonstrado que é necessário um acompanhamento mais próximo dos agregados monetários no Brasil.

Palavras Chave: Independência do Banco Central, Política Monetária, Função de Reação, Rotatividade dos Diretores do COPOM, agregados monetários.

Classificação JEL: E02, E52, C32.

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1. INTRODUCTION

Throughout history, the level of inflation differs across countries. Some countries have managed to successfully achieve and maintain prices at a low level, while others have gone through serious crises of currency stability.

Kydland and Prescott (1977) address the problem of dynamic inconsistency of monetary policy. Accordingly, the form through which decisions about monetary policy are taking and the fact that policymakers are subject to an inflationary bias cause higher inflation for a particular country.

Once detected the problem of dynamic inconsistency, avoiding it would be the establishment of independent central banks, specifically committed to price stability, (ROGOFF, 1985). Following Rogoff (1985), Grilli, Masciandaro and Tabellini (1991), Cukierman, Webb and Neyapty (1992), Alesina and Summers (1993) agree that an independent central bank would be the institutional arrangement able to prevent policymakers to use the economic policy to obtain short-term gains in the unemployment and inflation rate tradeoff.

From this theoretical assumption, several indexes of central bank independence were created, such as, legal independence, actual independence, which were aimed to check whether there was any relationship between central bank independence and inflation levels.

Since 1999, prevails in Brazil an inflation targeting regime for price control, using the interest rate as main instrument, this study focus is the central bank independence indicators effects in the reaction function. Therefore, this study aims to estimate reaction functions modified to the Central Bank of Brazil from 2001 to 2011. In accordance with the methodology proposed by Cukierman, Webb and Neyapty (1992), two variables are included to calculate the degree of central bank independence: the turnover rate of central bank presidents and adherence in relation to monetary targets. To the first indicator of independence, this study innovates by including the turnover rate of the central bank directors (governors) from the Monetary Policy Committee (COPOM)⁵.

Thus, the first application estimates a modified version of the reaction function for Brazil, including as explanatory variables to the interest rate, the deviation of actual inflation from its target level, the deviation of inflation expectations from the target, the output gap relative to its potential level, and turnover rate of directors of the Monetary Policy Committee (COPOM).⁶

The purpose of this application is whether the rotation of directors of COPOM interfered in the conduct of monetary policy, causing further relaxation or tightening of monetary aggregates, for example. Accordingly, this analysis helps to understand how changes in the board of directors of COPOM could explain shifts in monetary policy and on the price levels, in light with the replacement of the president of the board appointed by the literature.

In the second econometric application, it is evaluated the adherence of monetary aggregates in relation to the monetary programming established by COPOM over central bank reaction function. In other words, it calculates the deviation of the actual growth of monetary aggregate (M1) from that announced by the monetary authorities.

Furthermore, it investigates the monetary authorities' reactions to deviations of preset targets. In that way, if monetary authorities pursue the monetary aggregates and if there is any reaction from the central bank because of a shift between the predicted values and those actually made, then it could alter the interest rate. We expected that, a systematic displacement between the predicted values and effective ones occurring for monetary aggregates combined with a lack of reaction to these events can cause damage to combat inflation and increase its volatility.

Along with this introduction, this paper has two main parts. The first part is a brief review on the theoretical discussion of central bank independence and also on empirical evidence. On the

⁵ Respective to Federal Open Market Committee (FOMC).

⁶ Following the econometric study of Dias, Teixeira, and Dias (2009).

second topic, the econometric methodology and the data set are presented. Then, the results of econometric applications are discussed. Following there is some overall considerations.

2. CENTRAL BANK INDEPENDENCE: A REVIEW

Along last decades, some countries were successful in maintaining price stability while others have gone through serious crises and periods of hyperinflation. The range of observed values for inflation in different countries has encouraged studies to explain the possible causes of these dispersions in prices.

The reasons for these differences are many and depend on each country's specificity. However, one of the possible reasons to understand why there are such differences between countries is attributed to the difference in the level of independence of Central Banks (ICB). Many authors have worked with the idea that countries with higher levels of independence could, over time, keeping prices in a more stable path than the countries in which the central bank was relatively more dependent or less autonomous.

One of the main empirical arguments in favor of delegating greater autonomy to central banks is due to the success of price stability obtained by central banks of Germany and Switzerland. These experiences led to a range of countries delegating greater sovereignty to their respective central banks during the decades of 80 and 90 (MENDONÇA, 1998).

Regarding the theoretical arguments, the first is related to the vision of public choice theory. The monetary authorities are exposed to strong political pressures so that they are forced to behave according to the preferences of the rulers. These pressures exerted by political authorities could be, for example, the explanation of political business cycles investigated by Allen (1986), and motivated by the study of pre-election periods cycles of Nordhaus's (1975). In such cases, from the point of view of public choice theory, it appears that the greater the degree of ICB, this will be subject to less political influence.

The second argument is presented by Sargent and Wallace (1981). For these authors, there is a clear distinction between monetary and fiscal authorities. According to the relationship between these authorities, there may be monetary instability. If fiscal policy is dominant, the monetary authorities can not control the money supply, because it ends up becoming endogenous to the system. In this case, the monetary authorities will be forced to finance the deficit by money creation. On the other hand, if monetary policy is dominant, the tax authorities will be required to reduce the deficit, or repudiate part of it. The higher the degree of ICB, the less monetary authorities would be coerced to finance government deficits through money creation.

However, the main theoretical argument used to support studies concerning central bank independence, is the problem of time inconsistency, which was developed primarily in Kydland and Prescott (1977), followed by Calvo (1978) and Barro and Gordon (1983). The problem of dynamic inconsistency starts when the best plan prepared in the present to some future period differs from the plan that would be optimal economically. In this situation, although the policy chosen by the policymaker is consistent, it is not socially optimal, leading to higher rates of inflation without consequent increase in the level of output. This is due to the agents' behavior under rational expectations. Thus, the institutional apparatus of an independent central bank would be able to reject the possibility of using inflation surprise in order to gain real variables improvement in the short run (MENDONÇA, 2001).

The importance of the ICB is related to two possible advantages arising from this institutional arrangement. First, with the ICB, the board of governors would be free of the political pressures to monetize budget deficits, in exploring the tradeoff between inflation and unemployment. The second advantage is associated with the objectives of central banks. The more independent the central bank is, the more prone it will be to pursue its "natural target" which should be the pursuit of price stability (MENDONÇA, 2001).

In general, Table 1 summarizes some studies that indicate mainly negative relationships between inflation and legal independence of the central bank for industrialized countries. However, in developing countries, this result does not hold. Thus, an alternative capturing the effect of ICB on inflation levels is using an index that represents the behavior of the monetary authority in fact. The most common indicator in this direction is the turnover rate of the presidents of central banks.

From Table 1, there is not yet a consensus regarding the negative relationship between inflation and ICB. Depending on the variable and the method used, the results differ substantially. In general, Central Bank Independence appears to be an important condition but not sufficient to ensure stability of prices.

However, although there is no consensus, some results seem to converge. The negative relationship between inflation and ICB is more explicit in the case of high income countries, or industrialized countries. Instead, the turnover rate of the presidents of central banks seems to be a better proxy for independence when analyzing developing countries. Also, in account with actual behavior of central banks it must be created some indicator that is capable of identifying whether or not the CB acts independently. The turnover rate of the presidents of CB is an interesting attempt in this direction. However, we must look for other variables that could be used as a proxy for independence in fact of the CB.

An even greater difficulty is the construction of a series monthly, quarterly or annually which represents the variation in the degree of ICB for a certain period of analysis. This difficulty implied the majority of studies using cross-sectional data in analysis of the importance of the relationship between the degree of ICB and inflation.

The turnover of presidents of CB is a variable that changes over time and is a way to analyze the temporal variation in the context of the degree of central bank independence. One obstacle to this variable is, in most cases, the turnover of the President of the Central Bank relatively low.

Avoiding these problems, the rotation of directors of the Monetary Policy Committee (COPOM) as a proxy to capture the degree of actual independence of CB in a time series can be a good option.

Table 1
ICB and Empirical Evidence

Authors	Sample	Type of Index	Results
Grilli, Masciandaro & Tabellini (1991)	Industrialized Countries	Political and Economic Independence	Negative relation between independence index (CBI) and inflation, with no relation to growth rate of product
Cukierman, Webb & Neyapty (1992)	Industrialized Countries and Developing Countries	Turnover Rate, Legal Independence, Survey, and Aggregate	CBI index and inflation are negative in industrialized countries. Turnover rate are significant in developing countries.
Alesina & Summers (1993)	Industrialized Countries	Legal Independence, Political and Economic Independence	CBI index shows negative relation with inflation but no relation to real economic variables.
Campillo & Miron (1997)	Industrialized Countries and Developing Countries	Turnover Rate, Legal Independence, Survey and Aggregate (CWN index)	The relation between CBI and inflation presented low significance.
Mangano (1998)	Industrialized Countries	Legal Independence, Political and Economic Independence	No significant relationship between CBI and inflation.
Mendonça (2001)	Brazil	Survey/Questionnaire	CBI index has no negative relationship with inflation

Mendonça (2006)	Brazil	Turnover Rate and Legal Independence	Neither significant relationship between CBI index and inflation, nor between inflation and turnover rate.
Anastasiou (2009)	39 countries of OCDE	Legal Independence	Negative significant relationship between CBI index and inflation.
Klomp & Haan (2010)	100 countries	Turnover Rate and Legal Independence	Negative relationship between CBI index and inflation only for some countries.

Another problem associated with most studies is disregarding some important features of the regressions in determining inflation. In this case, univariate regressions can lead to biased results, and then it is necessary performing a function that incorporates other possible explanatory variables for inflation.

Finally, there seems to be a gap in studies examining the effects of ICB in a particular country. Most studies reviewed use cross-section regressions, implying loss of important information from various countries. This information omitted probably help to better explain the dynamics of inflation in each country.

The following topic deals with the methodology that will be used for analysis of data referring to the Brazilian economy.

3. EMPIRICAL METHODOLOGY

Sims (1980) is a precursor regarding vector autoregressive models (VAR). This study spread the seminal analysis technique to the academy and became one of the most widely used techniques in macroeconomics. The widespread use of this model as a tool of analysis is partly due to the possibility of analyzing the interrelationships between multiple variables from a minimum set of constraints identification. Thus, it enables us to estimate the effect of a "shock" from some variable on all the variables in the equations (CAVALCANTI, 2010).

3.1. *Impulse Response Functions and Variance Decomposition Analyses*

The main results used here from VAR models are the analysis of variance decomposition of forecasted error and impulse response functions. Through the impulse-response functions, it is possible to observe the response of all variables in the system from a shock in one of them in a given time horizon. And variance decomposition represents how the variance of each variable is explained by their variance and by the variance of all other system variables (ENDERS, 1995).

3.2. *Specification of the Macroeconomic Variables*

Many authors have worked with the idea that countries with higher levels of central bank independence could keep prices in a more stable path than the countries in which the central bank was relatively more dependent.

The main theoretical inspiration that underlies the need for ICB is based on the hypothesis that the use of monetary policy can not affect real economic variables in the long run. There is no tradeoff between inflation and unemployment in the long run. If the Fed is independent, the possibility that monetary policy will lead to undesirable results in relation to price stability, becomes smaller.

So the economic variables used here are consistent with the proposal submitted, whose objective is to identify if somehow the degree of independence of the Central Bank in Brazil may be related to the way policymakers conduct monetary policy. For this measure will be estimated reaction functions for the Brazilian Central Bank (BCB), whose variables are displayed as follows.

Inflation Rate (CPI): National index of consumer prices - wide concept (IPCA)⁷. Percentage variation in 12 months provided by IBGE⁸.

Inflation Expectations (EXPCPI): Expected average Inflation (IPCA) - accumulated rate for the next 12 months, provided by the Central Bank of Brazil through the FOCUS Report.

DESVIO: Difference between CPI accumulated in 12 months and the target set by the National Monetary Council (CMN) in period "t".

EXPDESVIO: Difference between accumulated inflation expectations in the next 12 months available through the FOCUS Report and the inflation target set by (CMN) in period "t".

SELIC: Nominal interest rate set by the Monetary Policy Committee (COPOM). Since the Meeting on 04/Mar/1999, this rate was defined as the main monetary policy instrument.

GAPPRODUTO1: Difference between the current product and its potential level. As a proxy of the product was used Industrial Production Index (PIND) provided by IBGE. The number of potential output is determined by the trend of PIND, which in turn is obtained by applying the Hodrick-Prescott Filter technique. Therefore, the calculation of the gap of the product (GAPPRODUTO) can be performed as follows,

GAPPRODUTO = (Real Product) - (Potential Product), or

GAPPRODUTO = (PIND) - (Trend of the Industrial Production Index).

ROTATIPERCENT: Variable that represents the turnover rate of the directors (governors) of Monetary Policy Committee (COPOM). This series was constructed from the analysis of the minutes of the COPOM provided by BCB. The idea for the construction of this variable is that it can be used as an indicator of independence of BCB. The higher the turnover of representatives from COPOM, less independence would have the CB. As a high rate of change may indicate instability of the directors in office, which can make more political pressure on the director, for example.⁹

Therefore, this is an index actual independence of the monetary authority and would be an alternative to the turnover rate of the president of Central Bank used in Cukierman, Webb and Neyapty (1992), Campillo and Miron (1997), Mendoza (2006), and Klomp and Haan (2010).

For the calculation of the variable, divide the number of members of the board of governors with the right of voting that were replaced in a particular meeting to the number of members present. Thus, in some particular meeting, there were eight directors present and one of the eight was a replacement in comparison to the previous meeting, such as:

*Turnover Rate*¹⁰ = Quantity of directors replaced / Total directors present in the Meeting

Turnover Rate = 1/8 = 0.125 or 12.5%.

And so on for each meeting.

Monetary Aggregates Target (MAM): Difference between the quantity of money (M1) actually occurred and the programmed amount by the monetary authority in a given period. These data are provided by the Central Bank of Brazil (BCB). In Brazil, the monetary programming is announced quarterly. According to Cukierman, Webb and Neyapty (1992), the existence of targets for monetary aggregates shows that the central bank is more independent to focus on pursuing the goal of price stability. Therefore, the higher the grip in relation to the goal, it would classify a more independent monetary authority.

⁷ IPCA: *Índice de Preços ao Consumidor Amplo*.

⁸ IBGE: *Instituto Brasileiro de Geografia e Estatística*.

⁹ Although admitting that the higher the rotation of the president of Central Bank, the lower would be the degree of independence, Cukierman (1996) gives attention to for situations in which low substitutions may indicate high subservience from Central Bank representatives to government goals, characterizing high degree of dependence.

¹⁰ A study on the causes of the replacement of the directors of the Central Bank would be interesting; however, these factors are not available to the general public, so we will treat only the quantitative issue.

$$MAM_t = (Effective\ Variation)_t - (Predicted\ Change)_t$$

As higher the adherence of monetary aggregates to quantities predicted by authorities in relation to their target, more independent monetary authority would be.

Finally, concerning the periodicity of the variables, the observations are monthly from July 2001 to December 2011. The initial period is due to the number of expected inflation that is available only from that date. Moreover, the period beginning on that date excludes the period of transition goals for the currency inflation targeting regime, which was a period of adjustment to the new regime and relatively with higher volatility in the data.

4. REACTION FUNCTION AND TURNOVER OF DIRECTORS OF COPOM: VAR APPLICATIONS TO BCB

From late 80s to early 90s, along with Bade and Parkin (1988), Cukierman (1992), and Alesina and Summers (1993) arose that institutions, especially those who controlled monetary policy, could be crucial to explain the differences between the behavior of prices in various countries.

The main theoretical argument increased with the rational expectations revolution, first proposed by Muth (1961), further developed by Lucas (1972), and consolidated and systematized by Kydland and Prescott (1977) on the problem of dynamic inconsistency of monetary policy.

Kydland and Prescott (1977) argued that the way in which monetary policy was implemented implied the policymakers were tempted to follow a behavior that would cause an inflationary bias without any increase in real output. Thus, the establishment of an institution of independent monetary policy goals and unique stabilization of prices could be a possible solution to the problem of inflation bias.

Since then, empirical studies have tried creating or using some index of central bank independence and relating this information with the level of inflation in the countries. Among these, note Cukierman, Webb and Neyapti (1992), Alesina and Summers (1993), Campillo and Miron (1997), Mendonça (2006), and Haan and Klomp (2010). Because there is no consensus over the results about the effects of ICB on inflation in developing countries, the authors, except Alesina and Summers (1993), used the turnover rate of the president of central banks as a proxy to the independence in fact and tested it against inflation. In general, for developing countries the results showed a negative relationship between turnover rate and inflation.

Considering the Brazilian experience, in recent years, especially after the stabilization of prices in 1994, the turnover rate of the President of the Central Bank (BCB) has decreased significantly. Since the beginning of the Real Plan (*Plano Real*) were eight different presidents to occupy the head office. Specifically after the inflation targeting regime, the president of the BCB has only been replaced twice. However, although there has been a significant drop in turnover of the BCB's president, there were 29 replacements of directors of the board of governors with voting power decisions in the Monetary Policy Committee (COPOM) from 2001 to 2011. Then, on average, all members of the board were replaced four times during the period analyzed here.

The question to be examined is then: the rotation of directors of COPOM may have somehow influenced the conduct of monetary policy in the post-inflation targeting regime in Brazil. More specifically, turnover of directors may have influenced the determination of interest rates in the Brazilian Economy?

Dias, Teixeira, and Dias (2009), applied a VAR model to the reaction function Brazilian Central Bank, adding a *dummy* variable to account for rotation of directors of COPOM. The dummy had the value 1 for those occasions when there was a replacement of one or more directors and zero otherwise.

In this context, one aim of this paper is deepening the work of Dias, Teixeira and Dias (2009), innovating with respect to the estimation method, using a structural VAR model and treating the variable rotation of the directors of COPOM in percentage terms, rather than a dummy variable, considered a limitation by the literature, providing to obtain further interactions with other

variables in the system. Furthermore, the expanded sample period allows greater robustness to the results. Therefore, a reaction function for the Central Bank of Brazil is estimated, including the variable turnover among the explanatory variables of the model, whose results are reported in the following topics.

4.1. Empirical Modeling

Identifying and measuring the response of monetary authority to stabilize inflation and output around their predetermined values and demonstrating the effects of actual independence of BCB (ROTATIPERCENT) on the interest rate required estimations of reaction functions à la Taylor (1993), incorporating expectations, as in Clarida *et al.* (1998), Meyer (2001), Arestis and Sawyer (2002), among others. Accordingly, the first specification testing is:

$$i_t = a_{10} + a_{11}i_{t-1} + a_{12}(Dldesvio)_{t-1} + a_{13}(Dlexpdesvio)_{t-1} + a_{14}(Gapproduto1)_{t-1} + a_{15}(Rotatipercen)_{t-1} + e_{1t} \quad (01)$$

Where i_t is the difference of the logarithm of the interest rate (basic Selic rate); DLDESUDIO is the logarithm of the rate of inflation minus its target level in the first difference; DLEXPDESUDIO is the logarithm of expected inflation from the target in first difference; and ROTATIPERCENT represents the turnover of the Directors entitled to vote in the Monetary Policy Committee (COPOM) in percentage terms, in each given month. Including the latter variable aims identifying whether the changes of one or more directors of COPOM interfere in the decisions of the Committee over the instrument interest rate. If it does, in which magnitude it translates into positive or negative changes afterwards.

The hypothesis is that if the substitution of directors entitled voting took place through political pressure, the BCB would be less independent than ideal, then these changes would be negative to the interest rate, because is assumed that higher turnover implies a lower level of independence of BCB until certain threshold. Being less independent, the BCB would give less attention to the control of inflation, which would translate into more flexible policies regarding the interest rate.

The methodology used to estimate the reaction function specified in equation (01) is Vector Autoregressive (VAR). In order to define the best model specification, the first test was lag length criterion. The results indicated as properly three lags, depending on the chosen criterion. So it is reasonable considering that monetary policy decisions are based on solid information over a period, the estimated model used the first and third lags of information. It was also accomplished the lag exclusion tests. The results suggested that the lags one and three should not be excluded from the model.

Moreover, the estimation tested two Dummy variables. The first includes the period of June 2002 to June 2003 capturing the crisis of confidence over presidential election because some variables appears more volatile behavior compared with the total period. This first Dummy was significant. We tested also a Dummy for the crisis of subprime of 2008. This was not significant, and then was excluded from the model.

Regarding the explanatory power of the test, approximately 48% of the variation in DLSELIC can be explained by variations in the variable itself and as a result of other variables in the system.

At first, the estimates of ROTATIPERCENT coefficient from the unrestricted VAR were not significant, indicating that the turnover of the Directors of COPOM could not alter the conduct of monetary policy. One explanation for the lack of significance may be related to the fact that,

initially, as a way of signaling to the market consolidation policy of inflation targeting, the appointment of directors would be for agents more compromised to inflation targeting.

However, the structural VAR model investigation about the effect of rotation of BCB's directors of COPOM in the reaction function indicated a long run relationship between the variables of inflation target programming. Structural VAR allows us testing whether the effects of explanatory variables treated as exogenous remain in the long run.

Accordingly, the coefficients C51, C52, C53, C54 and C55 represented in the empirical model are long run effects over de interest rate instrument of the follows variables, respectively: ROTATIPERCENT, GAPPRODUTO, DLEXPDESUDIO, DLDESUDIO, DLSELIC.

Figure 1: Structural VAR Coefficients – Long Run Relations

$$Y_t = \begin{bmatrix} Rotatipercen \\ gaproduto \\ dlexpdesvio \\ dllesvio \\ dselic \end{bmatrix}; C \begin{bmatrix} C_{11} & 0 & 0 & 0 & 0 \\ C_{21} & C_{22} & 0 & 0 & 0 \\ C_{31} & C_{32} & C_{33} & 0 & 0 \\ C_{41} & C_{42} & C_{43} & C_{44} & 0 \\ C_{51} & C_{52} & C_{53} & C_{54} & C_{55} \end{bmatrix}; e_t = \begin{bmatrix} rot_t \\ g_t \\ ex_t \\ d_t \\ i_t \end{bmatrix}$$

$$Y_t = \begin{bmatrix} Rotatipercen \\ gaproduto \\ dlexpdesvio \\ dllesvio \\ dselic \end{bmatrix}; C \begin{bmatrix} 0.086747 & 0 & 0 & 0 & 0 \\ (0.0000) & & & & \\ 0.034188 & 0.078985 & 0 & 0 & 0 \\ (0.0000) & (0.0000) & & & \\ 0.010268 & 0.039998 & 0.089020 & 0 & 0 \\ (0.2465) & (0.0000) & (0.0000) & & \\ 0.078230 & 0.064781 & 0.105426 & 0.099841 & 0 \\ (0.0000) & (0.0000) & (0.0000) & (0.0000) & \\ \mathbf{0.034814} & \mathbf{0.052208} & \mathbf{0.022304} & \mathbf{0.017594} & \mathbf{0.033668} \\ (0.0000) & (0.0000) & (0.0000) & (0.0000) & (0.0000) \end{bmatrix}; e_t = \begin{bmatrix} rot_t \\ g_t \\ ex_t \\ d_t \\ i_t \end{bmatrix}$$

Note: Results from estimations.

The results indicate that there is a significant long-run relationship between the variables of the system and DLSELIC – the interest rate instrument of monetary policy. Accordingly, 11.5% of the growth rate of the interest is explained by changes in the system variables in the long run.

Regarding the variable ROTATIPERCENT, turnover of the directors of COPOM affects positively and is statistically significant in explaining the variations in DLSELIC in the long run.

This means that if the turnover of the Directors of COPOM maintain in the long run, then the Central Bank would be interpreted as less independent, making monetary policy less reliable. This lack of credibility contributes to inflation deviations from its target, which in turn forces the monetary authority to increase the growth rate of interest. Thus, higher turnover rate would increase interest rates in the long run. Hence, rotation of the directors of the Committee at a high frequency may be harmful to the conduct of monetary policy. Somehow, it may signal that the directors do not have sufficient autonomy or are subject to the pressures of political government for purposes other than price stability, which can generate mistrust to the market, affecting the credibility of the monetary authority.

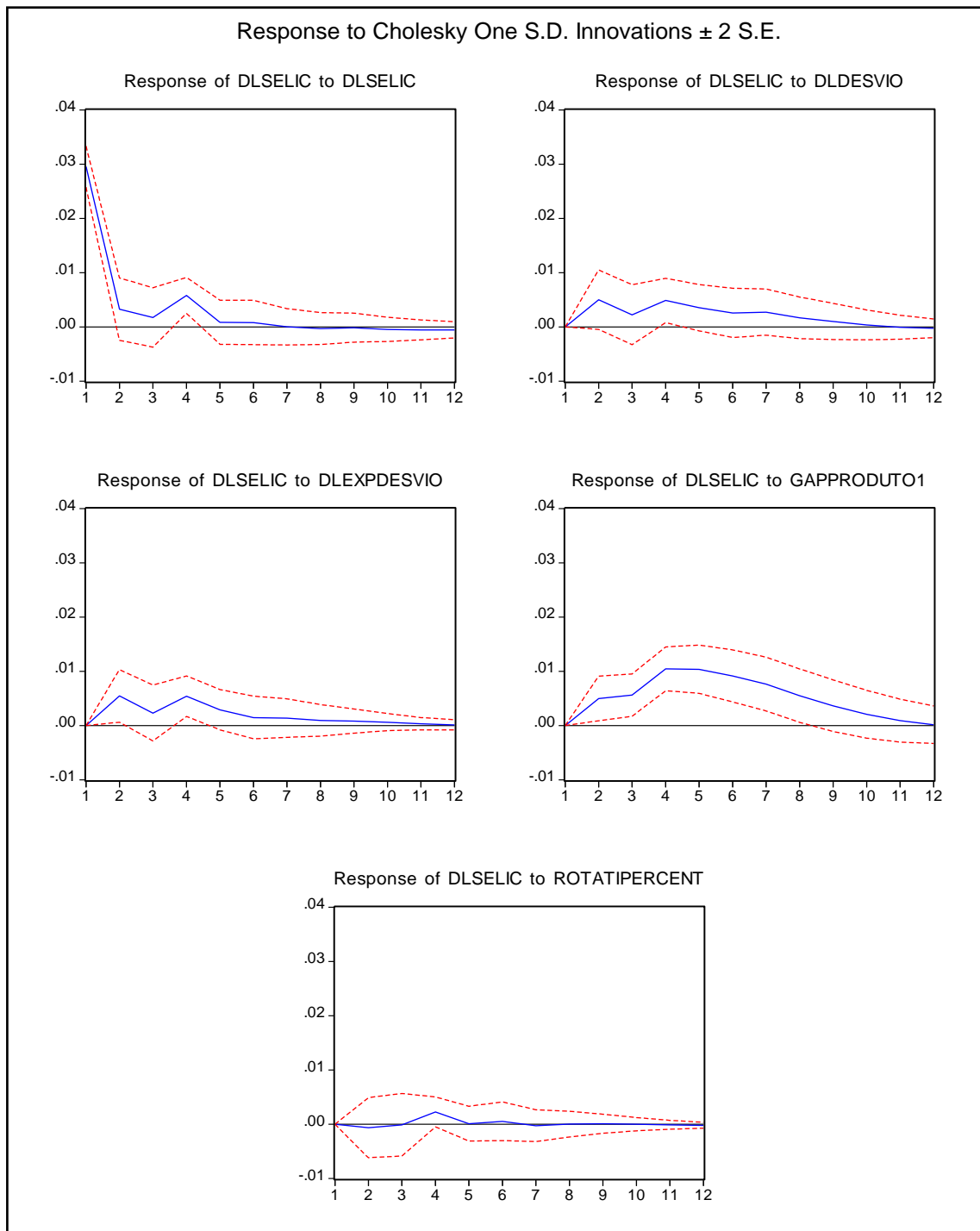
Ensuring robustness of the model implies to attend the stability conditions which were verified. Then, we tested for autocorrelation in the residuals, normality, and stationarity. Results of the impulse response functions, considering the shock of the system variables on the interest rate (DLSELIC) are also displayed.

4.2. Impulse Response Functions and Variance Decomposition Analyses

Initially, the impulse response functions are shown in Figure 2. As expected, there is an inertial component in the interest rate captured over its growth rate. A shock from DSELIC of the size of its standard deviation causes a positive reaction to itself of 0.03, changing its growth rate.

In addition, a shock in the deviation of inflation from its target level causes increases in the interest rate growth that are dissipated only 11 months later, which is in accordance with a central bank behavior committed to price stability.

Figure 2
Impulse Response Functions - DLSELIC



Note: Results from estimations.

In relation to the output gap, the results indicate that the monetary authority in the Brazilian economy behaved in a manner sensitive to changes in the product relative to potential output. The impulse response function shows that a one standard deviation shock on the output gap is accompanied by a rise in the interest rates. This implies that the monetary authority has taken into account the current state of the economy in its monetary policy decisions.

Regarding the percentage turnover of the directors of COPOM (ROTATIPERCENT), observed through impulse response functions, the variable DLSELIC reacts to turnover of directors following a positive increase. That can be seen especially between third and fifth months. Despite the small reduction in the interest rate in the first two months, that indicates changing of the directors of COPOM may not be followed by monetary easing, causing the interest rate growth to increase in the long run, but with a smaller effect in the long run in comparison to the other variables of the SVAR system.

In any case, the impact of shocks from rotations of BCB's directors can be positive in Brazil because recent experience of hyperinflation. Since changes in the rotation of directors of COPOM could configure monetary easing, then interest rate growth should increase to offset that interpretation.

Even though a high turnover rate of these directors might somehow indicate that the monetary authority has less independence than it should, the changes in the directors of COPOM does not seem having influenced the conduct of monetary policy, and in fact, the behavior of the monetary authority might been consistent with price stability.

Another tool from VAR models is the analysis of variance decomposition of the forecast error, displayed in Table 2. The variance decomposition estimates the relative participation of innovations to each endogenous variable in the VAR (ENDERS, 1995).

Table 2
Variance Decomposition of Predicted Error

Period	S.E.	DLSELIC	DLDESVIO	DLEXPDESVIO	GAPPRODUTO	ROTATIPERCENT
1	0.02958	100.0000	0.0000	0.0000	0.0000	0.0000
3	0.03180	87.8789	2.9990	3.4887	5.5928	0.0406
6	0.03790	64.3215	5.1182	5.2443	24.9078	0.4082
9	0.03941	59.4678	5.4624	5.0756	29.6116	0.3827
12	0.03950	59.2588	5.4515	5.0880	29.8171	0.3846

Cholesky Ordering: DLSELIC DLDESVIO DLEXPDESVIO GAPPRODUTO ROTATIPERCENT

Note: Results from estimations.

According to the variance decomposition results from Table 2, the analysis of impulse response functions are confirmed. First, note the inertial characteristic of the interest rate variation (DLSELIC). That is, most of the variance of the interest rate is explained by shocks on itself. The second highest influence on DLSELIC is the output gap. Furthermore, the change of directors of COPOM showed relatively low magnitude over the conduct of monetary policy with respect to interest rates determination, confirming results from the impulse response functions.

5. MONETARY PROGRAMMING AND INTEREST RATE DETERMINATION IN BRAZIL: APPLICATION TO BCB'S REACTION FUNCTION

The index created by Cukierman, Webb and Neyapty (1992) has been replicated by many studies on central bank independence. Accordingly, countries with targets to monetary aggregates have gains from central bank independence against those who have not. The greater the grip in

relation to pre-established goals, central bank would be more committed, having a higher independence index.

In general, good adherence occurs when the value of the monetary aggregate for a given period is inside the predicted one by the monetary authority.

In Brazil, although there is no commitment to monetary targets explicitly, there is monetary programming in which the predicted values are set in advance to monetary aggregate variation. Monitoring monetary aggregates has long run relationships to average price levels. Deviations from expected future values of money may affect inflation desired values. In this respect, the European Central Bank is known as the example of a committed monetary authority to monetary programming.

Thus, this topic has the following objectives: to investigate what is the adherence of the Central Bank monetary program; to identify possible causal relationships between adherence in relation to goals and other variables such as interest rates, inflation and inflationary expectations; and lastly, to investigate whether the monetary authorities manage the interest rate when there is a deviation of the expected values and occurred ones during the period of monetary program.

Here, the monetary aggregate used for analyses is the M1 concept (demand deposits plus currency held by the public) and the variable defined to represent adherence is called Monetary Aggregate Target (MAM).

Given its role to the efficiency of the inflation targeting regime, this study about the monetary programming adherence in Brazil contributes, especially, by the empirical methodology employed. The time series analysis applied with structural VAR model can identify precedence and relations for the long run, making use of Granger causality tests, impulse response functions, and variance decomposition.

5.1. Inflation Targeting and Monetary Aggregates

The behavior of monetary aggregates in Brazil is summarized in Figure 3. The variable (MAM) represents the difference in percentage terms between occurred variation of M1 and its predicted variation reported by policymakers in the monetary program, quarterly. The variable DESVIO is the difference in percentage terms between the price index accumulated in 12 months (IPCA) and the inflation target pursued by the government during 2000 through 2011, quarterly.

Figure 3
Adherence of Monetary Aggregates vs. Inflation Deviations

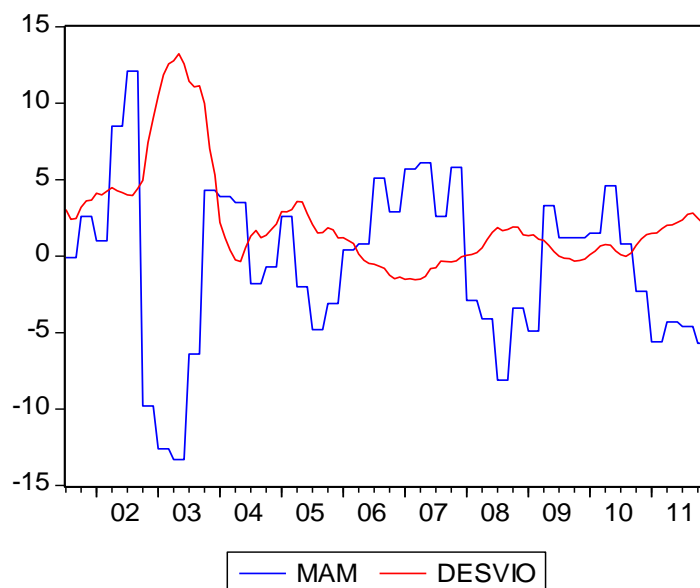


Figure 3 indicates there is a relative volatility in MAM, the difference of the actual value of the means of payments from its predicted one by policymakers. Note the relation between these deviations and the deviations of inflation from target, on an inverse basis. The bias in MAM coincides with a deviation of the inflation from its target level with lags.

Also, there is a sharp volatility in the period from 2001 to 2003, in which the difference between the predicted values and actual ones exceeded 10% in some quarters. However, for latter periods, the series show lower volatility compared to the initial one. In general, it is clear that in many periods, the actual values exceeded or were below predicted one over several periods, showing a low grip to the monetary aggregates.

5.2. Granger Causality Tests

In order to identify the relationship between the variable (MAM) and the other system variables, Granger causality tests are performed. Table 3 display relationships of precedence among the variable system.

Table 3
Granger Causality Tests

Null Hypothesis	F statistics	Probability
MAM does not Granger Cause DLSELIC	7.85383	8.20E-05
DLSELIC does not Granger Cause MAM	3.31906	0.02239
MAM does not Granger Cause DLDESVIO	4.64192	0.00422
DLDESVIO does not Granger Cause MAM	1.23742	0.29945
MAM does not Granger Cause DLEXPDESIVO	6.87636	0.00027
DLEXPDESIVO does not Granger Cause MAM	2.29582	0.08145
MAM does not Granger Cause GAPPRODUTO	2.67544	0.05047
GAPPRODUTO does not Granger Cause MAM	2.32577	0.07840

Note: 03 lags, 122 observations, monthly observations.

Table 3 implies temporal precedence from MAM to the variable system at the significance level of 5%, including DLSELIC, DLDESVIO, DLEXPDESIVO, GAPPRODUTO. On the other side, DLSELIC can Granger cause MAM, at 5% significance, while DLEXPDESIVO, GAPPRODUTO could precede MAM at 10% level of significance. These results indicate some feedback relationship among the variables.

One interpretation is that deviations from the value of the monetary aggregate M1 in relation to its predicted values may be an important leader indicator to anticipate changes in inflation and agents' expectations.

5.3. Empirical Modeling

In order to identify the reaction of the interest rate due to actual deviations of money from its values announced by policymakers, the variable MAM, a reaction function is estimated here. Then, the variables of equation (01) remain, except the variable ROTATIPERCENT, including the variable MAM in determining the interest rate in Brazil.

This variable refers to the deviation from the target monetary aggregate to the value provided by the monetary authorities to a particular period. It is therefore a measure of the adherence to the monetary intermediary targets. This accounts for the degree of independence of BCB, according to the methodology proposed in Cukierman, Webb and Neyapty (1992). The higher the adherence of the goals to monetary aggregates, BCB would be more independent.

Regarding the results, it is expected that the more independent the central bank is, more the monetary authority will react to stabilize inflation. Thus, it is expected that a positive deviation from the target aggregates would translate into a positive movement in interest rates.

The methodology used to estimate the reaction function will be the Vector Autoregressive (VAR). In order to define the best model specification, the first test was the selection lag criterion whose results are reported here.

The results indicate the model contains one or three lags depending on the chosen criterion. Considering that monetary policy decisions are based on information from more than one period (month), the estimated model used the first and third lags of information. In order to confirm that the choice of lags is adequate, the test of lag exclusion was implemented. The results suggest that the lags 01 (one) and 03 (three) should not be excluded from the model.

After determining stationary conditions and normality of the variables of the system, to analyze Granger causality tests, to identify the appropriate number of lags, the VAR model was estimated. After estimating the model the stability conditions of residuals, autocorrelation, normality and stationary conditions were tested to accept the results.

From using this model, one can obtain significant results for analysis of the relationships among system variables. Analysis of variance decomposition and impulse response functions, for example, are important instruments to understand the behavior of the variables.

Furthermore, we tested dummy variables to the period of June 2002 to June 2003, to account for political instability during presidential elections in Brazil, and to the international crisis of 2008 period. Only the first was significant and thus retained in the final model.

Note that approximately 52% of the variation in the interest rate variations can be explained by variations in the variable itself.

5.4. Impulse Response Functions and Variance Decomposition Analyses

From the impulse response functions, it is possible to dynamically analyze the effect of a one standard deviation shock to one of the system variables and the resulting response on the variable selected. Here, we concentrate in the effects over the interest rate determination, in logarithm terms and first difference, from the shocks over DLSELIC, DLDESPIO, DLEXPDESPIO, GAPPRODUTO, and our new variable MAM.

Mainly, the objective is to observe the reaction of the Brazilian economy interest rate (DLSELIC) to deviations of intermediary targets programmed by central bank, such as the monetary aggregate representing the means of payments (MAM).

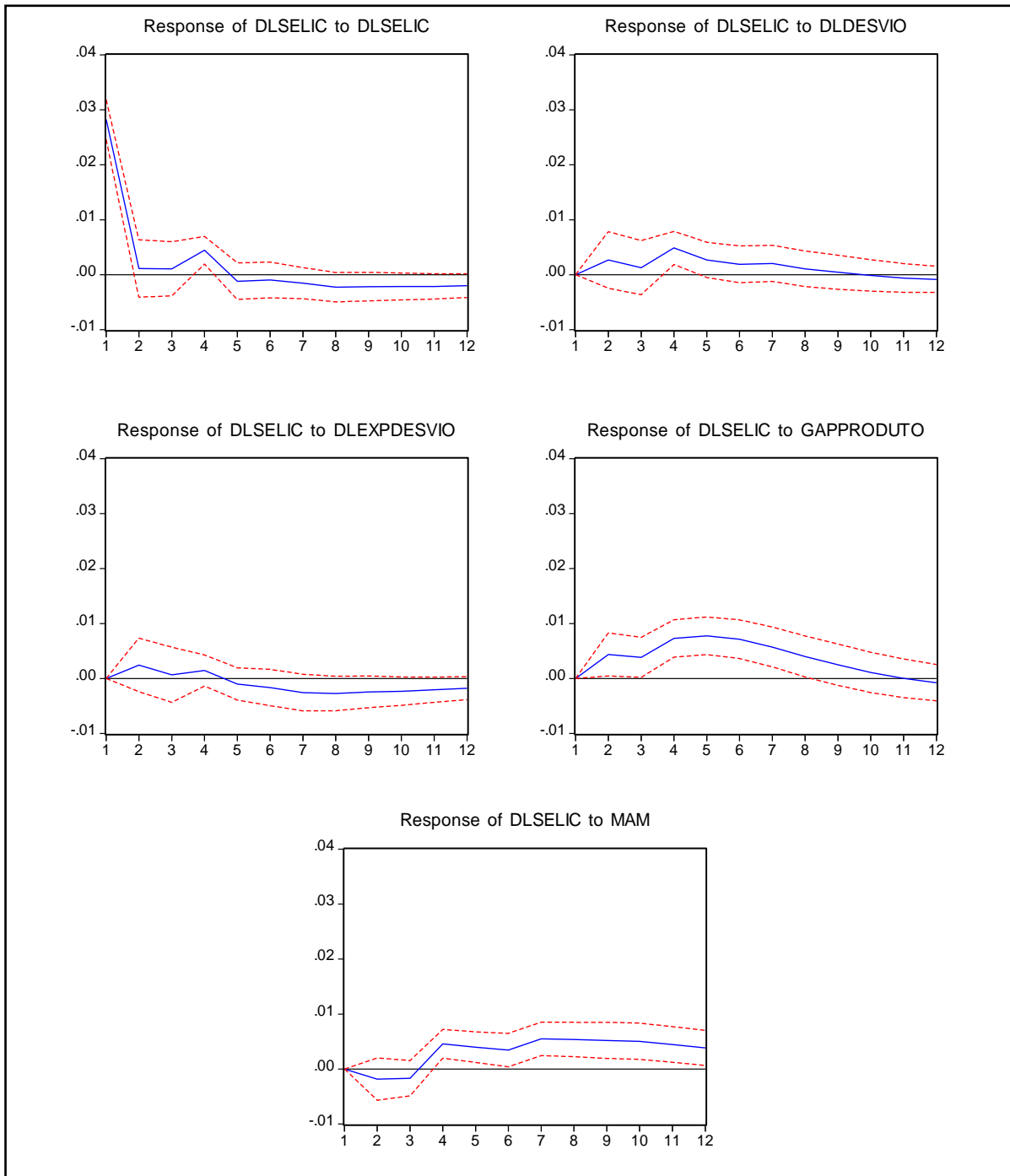
The results are similar to those found before about the degree of inertia in the interest rates, with a positive change in the DLSELIC functions from a shock to DLSELIC itself, from a shock to the output gap, and by a positive deviation of inflation from its target.

Regarding the deviations of the expectation of inflation from the target, the graph shows the interest rate increases with two picks until the fourth month due to deviations in inflationary expectations, after this period the changes in DLSELIC are negative.

On the other hand, a shock coming from the variable MAM affects negatively the growth of the interest rate, reducing DLSELIC till the third month. After that, the changes in the interest rate become positive, indicating that central bank reduces the growth of the SELIC initially, probably to identify the sources of the shock and the reaction of the market. One quarter later, a time equivalent to two meetings of the Central Bank Committee for monetary policy, policymakers increase the interest rate, which remains higher than average for at least 08 months.

Figure 4
Impulse Response Functions: DLSELIC

Response to Cholesky One S.D. Innovations ± 2 S.E.



Note: Results from estimations.

The following will consider the results obtained by decomposition of the variance of the interest rate (DLSELIC). By Enders (1995), the variance decomposition analysis determines the quantitative participation of exogenous shocks to each variables of the system on the forecast error variance of each variable in the VAR.

Table 4
Variance Decomposition of DLSELIC

Period	S.E.	DLSELIC	DLDESPIO	DLEXPDESPIO	GAPPRODUTO	MAM
1	0.028256	100	0	0	0	0
2	0.028902	95.73575	0.862138	0.722895	2.27708	0.402134
3	0.02926	93.54266	1.033597	0.759027	3.945913	0.718807
6	0.033641	72.71977	3.842925	1.088991	17.51509	4.833224
9	0.036201	63.72488	3.744163	2.453607	19.32947	10.74788
12	0.037405	60.62117	3.585245	3.197346	18.23319	14.36305
Cholesky Ordering: DLSELIC DLDESPIO DLEXPDESPIO GAPPRODUTO MAM						

Note: Results from estimations.

Again, this model indicates a high degree of inertia in DSELIC, most of the variance of that variable was caused by variation in the variable itself. Second, much of the variance of DLSELIC was caused by shocks coming from the output gap, showing a concern of the monetary authorities to the economic activity and the variable representing unemployment. Also, the forecast error of DLSELIC responds to changes in the monetary aggregates (MAM).

Specifically on the variable (MAM), its significance to the forecast error of the interest rate shows a relative share monetary grip (MAM) in 12 months of variance decomposition analyses of 14.36%, smaller only than the value of output gap and the interest rate itself.

6. CONCLUSIONS

Here we examine macroeconomic monetary policy issues related to interest rate and inflation. In particular, two economic themes are treated in the literature review, Central Bank Independence (CBI) and programming on the monetary target regime. From the empirical analysis of Vector Autoregressive models applied for the Brazilian economy, the turnover of the Directors of the Monetary Policy Committee (COPOM) and deviations from the predicted actual value of money affects interest rate variations in Brazil.

Some advantages from central bank independence (CBI) can be emphasized. An institutional arrangement of CBI would be able to reject political pressures seeking to exploit short-term tradeoff between inflation and unemployment. Also, because the more independent the central bank, more compromise price stability, it would provide some solution to the problem of dynamic inconsistency of monetary policy by Kydland and Prescott (1997).

Most studies appoint a direct relationship between CBI and inflation, suggesting that the higher the degree of central bank independence, the lowest level of inflation would result in a given country. Overall, there is no consensus on the econometric results. Depending on the method and the variable used, the results differ substantially. The results seem to converge is that a negative relationship between inflation and CBI is more explicit in the case of high-income countries, or industrialized economies. On the other hand, the turnover rate of the presidents of CB seems to be a better proxy for independence when analyzing developing countries.

Regarding monetary target regimes, the literature reveals that staying under a target system helps coordinating anti-inflationary policies. Because permits greater transparency of monetary authorities objectives to the general public. Moreover, becomes more costly for the central bank credibility to deviate from pre-established goals. Concerning the type of goal being pursued, all have advantages and disadvantages. In general, one presenting more advantageous features has been the inflation targeting regime, as longevity, transparency, monitoring capacity and ability to deal with supply shocks.

Empirical applications to the Brazilian case estimate two reaction functions. The first estimation proves that directors' turnover in and out of the monetary policy committee (COPOM)

affects interest rate growth in Brazil, but less than the other variables in the system. That is, there was small easing or tightening in interest rates due to these changes. However, it is worth noting that the number of directors that were exchanged in COPOM was relatively high (twenty nine) during the period of analysis.

Although the consequences on the conduct of monetary policy from the frequency of replacement of directors are relatively small, it may generate some degree of uncertainty in the market and even reducing credibility, influencing agents' expectations, making it harder to fight the inflationary pressures.

The second application and analysis of the Brazilian economy refers to the behavior of the monetary aggregate (M1) or means of payments. The variable MAM represents the adherence of the aggregate money programming of the Central Bank of Brazil, accounting for the effects of deviations between actual and announced values over the interest rate.

Analyzing the behavior of MAM, in some periods, its values are above or below the values established for several consecutive periods. Moreover, there is a relatively sharp volatility in the variable that represents this deviation, indicating a low adherence of MAM to the predetermined values.

From the estimation of the reaction function of interest rate determination, the monetary authority reacts to deviations of the monetary aggregate from its preset values. However, the results indicate that the response of the monetary authorities differs in time, lowering interest growth in the first quarter and increasing it afterwards. This reaction could be a prudential one or a lagged one, depending on the point of view.

The low adhesion of monetary aggregates plus the relatively lengthy responses of the monetary authority may be factors that cause volatility of inflation. Brazilian economy may need a closer monitoring of monetary aggregates. This monitoring could reduce inflation rate deviations over values and periods, through the interest rate reaction function.

7. REFERENCES

- ALESINA, A.; SUMMERS, L. "Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence". *Journal of Money, Credit and Banking*, May 1993.
- ALLEN, S. D. "The Federal Reserve and the Electoral Cycle," *Journal of Money, Credit and Banking*, 18 (1) February, 88-94, 1986.
- ANASTASIOU, A. *Central Bank Independence and Economic Performance, Cyprus Economic Policy Review*, Vol. 3, No. 1, 123-156, 2009.
- ARESTIS, P.; SAWYER, M. *Can Monetary Policy Affect The Real Economy? Working Paper Series*, Annandale-on-Hudson, Nova York: The Levy Economics Institute, n. 355, 2002.
- ARESTIS, P.; SAWYER, M. *New consensus macroeconomics and inflation targeting: Keynesian critique. Economia e Sociedade*. Campinas, v.17. Número especial, p. 629-653, dez. 2008.
- BADE, R.; PARKIN, M.. "Central Bank Laws and Monetary Policy," *University of Western Ontário*, October 1988, processed.
- BANCO CENTRAL DO BRASIL. **Relatórios de Programação monetária**, Vários anos.
- BANCO CENTRAL DO BRASIL. **Atas das Reuniões do Copom**. Many issues.
- BARRO, R.; GORDON, D. "Rules, Discretion, and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics* 12, July, 101-22, 1983.
- CALVO, G. A. *On the Time Consistency of Optimal Policy in a Monetary Economy. Econometrica*, Vol. 46, No. 6, Nov., p. 1411-1428, 1978.
- CAMPILLO, M.; MIRON, J. A. *Why does inflation differ across countries? In: Romer, C.D. and D.H. Romer (eds.), Reducing Inflation: Motivation and Strategy (Chicago: University of Chicago Press), 1997.*

- CAVALCANTI, M. A. F. H. *Identificação de modelos VAR e causalidade de Granger: uma nota de advertência.* **Economia Aplicada**, Ribeirão Preto, Vol. 14, no. 2, June, 2010. Access on Jan 15, 2012. <http://dx.doi.org/10.1590/S1413-80502010000200008>
- CLARIDA, R.; GALÍ, J.; GERTLER, M. *Monetary policy rules in practice: some international evidence.* **European Economic Review**, no. 42, p. 1033-1067, 1998.
- CLARIDA, R.; GALÍ, J.; GERTLER, M. *Monetary policy rules and macroeconomic stability: Evidence and some theory.* **NBER Working Paper** no. 6442. Cambridge, Mass.: National Bureau of Economic Research, 1998a.
- CUKIERMAN, A.; WEBB, S. B.; NEYAPTY, B. *Measuring the Independence of Central Banks and Its Effect on Policy Outcomes.* **World Bank Economic Review**, 6, 353-398, 1992.
- CUKIERMAN, A. C. *Targeting Monetary aggregates and inflation in Europe.* In: **Conference on Future European Monetary Policy**. Frankfurt, 1995.
- CUKIERMAN, A. A economia do Banco Central. **Revista Brasileira de Economia**, 50, 389-426, 1996.
- DIAS, M. H. A.; TEIXEIRA, A. M.; DIAS, J. (2009) *Novo Consenso Macroeconômico e Regras de Conduta: O Papel da Rotatividade dos Diretores do COPOM no Brasil.* **XXXVII Encontro Nacional de Economia Annuals**, vol. 1, 1-20, Foz do Iguaçu, Brazil.
- DICKEY, D.A.; FULLER, W.A. "Distribution of the estimator for auto-regressive time series with a unit root." **Journal of the American Statistical Association**, 74:427-31, 1979.
- DICKEY, D.A.; FULLER, W.A. *Likelihood ratio statistics for autoregressive time series with a unit root.* **Econometrica**, 49:1057-1072, 1981.
- ENDERS, W. "Applied Econometric Time Series", 1a Ed., John Wiley & Sons, 1995.
- ENGLE, R. F., GRANGER, C.W.J. "Co-integration and error-correction: representation, estimation, and testing." **Econometrica**, v.55, p. 251-76, 1987.
- GRANGER, C. W. J. "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," **Econometrica**, 37, 424-438, 1969.
- GRILLI, V., MASCIANDARO, D.; TABELLINI, G. "Political and Monetary Institutions and Public Finance Policies in the Industrial Countries." **Economic Policy**, 13, October, 341-92, 1991.
- KLOMP, J.; HAAN, J. *Central bank independence and inflation revisited* **Public Choice**, Springer Netherlands, 144, 445-457, 2010.
- KYDLAND, F. E.; PRESCOTT, E. C. *Rules Rather Than Discretion: The Inconsistency of Optimal Plans.* **Journal of Political Economy**, 85, 473-91, 1977.
- LUCAS, R. E., Jr., "Expectations and the Neutrality of Money". **Journal of Economic Theory**, 4, Abril, 103-24, 1972.
- MANGANO, G. *Measuring central bank independence: a tale of subjectivity and of its consequences.* **Oxford Economic Papers**, 50, 468-492, 1998.
- MENDONÇA, H. F. Aspectos Teóricos e Empíricos sobre Bancos Centrais Independentes: Implicações para o Caso Brasileiro. **Economia Aplicada**, FIPE/FEA-USP, Jan.-Mar., V. 2, N. 1, p. 83-111, 1998.
- MENDONÇA, H. F. "A mensuração do grau de independência do Banco Central: uma análise de suas fragilidades." **Análise Econômica**. Faculdade de Ciências Econômicas, UFRGS, Ano 19, N. 36, setembro, p. 47-67, 2001.
- MENDONÇA, H. F. *Efeitos da independência do banco central e da taxa de rotatividade sobre a inflação brasileira.* **Revista de Economia Política**, vol. 26, No. 4 (104), p. 552-563, outubro-dezembro/2006.
- MEYER, L. H. *Does money matter?* **Federal Reserve Bank of St. Louis Review**, p. 01-15, set./out. 2001.
- MUTH, J. F. "Rational Expectations and the Theory of Price Movements," **Econometrica**, v. 29, p. 315-335, 1961.
- NORDHAUS, W. D. "The Political Business Cycle." **Review of Economic Studies**, 42, April, 169-90, 1975.
- PHILLIPS, P.C.B; PERRON P. "Testing for a Unit Root in Time Series Regressions." **Biometrika** 75, 335-346, 1988.
- ROGOFF, K. "The Optimal Degree of Commitment to an Intermediate Monetary Target." **Quarterly Journal of Economic**, 1, 10, Nov., 1169-90, 1985.
- SARGENT, T. J.; WALLACE, N. "Some unpleasant monetarist arithmetic." **Quarterly Review**, Federal Reserve Bank of Minneapolis, Fall, 1981.
- SVENSSON, L. E. O. *Price level targeting vs. Inflation targeting: a free lunch?* **Working Paper 5719 NBER**. 1050 Massachusetts Avenue, Cambridge, MA 02138 August, 1996.

- SVENSSON, L. E. O. *Inflation targeting as a monetary policy rule. **Journal of Monetary Economics**, 43, 607–654, 1999.*
- SVENSSON, L. E. O. *Inflation targeting: Should it be modeled as an instrument rule or a targeting rule? **European Economic Review**, 46, 771 – 780, 2002.*
- TAYLOR, J. *Discretion versus policy rules in practice. **Carnegie-Rochester Conference Series on Public Policy**, 39, 195-214, 1993.*

Appendix

Methodology to Estimate the Degree of the Central Bank Independence

Variables and Definition Codes	Abbreviation	Codes
1. Turnover	rot	
a) Low		1,00
b) Medium		0,50
c) High		0,00
2. Limitations on Lending in Practice	rfsp	
a) Tight		1,00
b) Moderately Tight		0,66
c) Moderately Loose		0,33
d) Loose or Nonexistent		0,00
3. Resolution of Conflicts	rc	
a) Absence of Accommodation in some Cases		1,00
b) All, Except Items a and b		0,50
c) Accommodations in All Cases		0,00
4. Who elaborate the Budget of the Central Bank	obc	
a) The Central Bank		1,00
b) Central Bank and Executive/Legislative		0,50
c) Executive/Legislative		0,00
5. Who defines Wages and Profit Distribution of the Central Bank?	sl	
a) Central Bank or Law		1,00
b) Central Bank and Executive/Legislative		0,50
c) Executive/Legislative		0,00
6. Quantitative Monetary Stock Targets	mam	
a) Such targets exist; Good Adherence		1,00
b) Such targets exist; Mixed Adherence		0,66
c) Such targets exist; Poor Adherence		0,33
d) No stocks targets		0,00
7. Formal or informal interest rates targets	mtj	
a) No		1,00
b) Yes		0,00
8. Actual Priority Given to Price Stability	pep	
a) First Priority		1,00
b) First Priority assigned to a fixed exchange rate		0,66
c) Price or Exchange Rate stability are among the bank's objectives, but not first priority		0,33 0,00
d) No mention of prices or exchange rate objectives		
9. Function as a development bank, granting credit at subsidy rates?	fqf	
a) No		1,00
b) To some extent		0,66
c) Yes		0,33
d) Yes, heavily		0,00

Note: Cukierman, Webb, and Neyapty (1992).