"What Happens After the Central Bank of Brazil Increases the Target Interbank Rate By 1%?"

RUBENS PENHA CYSNE

(EPGE/FGV)

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Coordenação:
Prof. Luis Henrique B. Braido
e-mail: lbraido@fgv.br
What Happens After the Central Bank of Brazil Increases the Target Interbank Rate By 1%?*

Rubens Penha Cysne†

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Abstract

In this paper I use Taylor’s (2001) model and Vector Auto Regressions to shed some light on the evolution of some key macroeconomic variables after the Central Bank of Brazil, through the COPOM, increases the target interest rate by 1%. From a quantitative perspective, the best estimate from the empirical analysis, obtained with a 1994 : 2 – 2004 : 2 subsample of the data, is that GDP goes through an accumulated decline, over the next four years, around 0.08%. Innovations to interest rates explain around 9.2% of the forecast error of GDP.

1 Introduction

The current approach to monetary policy in Brazil is characterized by the setting of two different targets: the inflation target and the targeting of the rate at which financial institutions lend each other reserves overnight (the interbank overnight interest rate target). Inflation targeting was introduced

*Work in progress, please do not quote. I am thankful to Lutz Kilian, for making available some of the computer codes used in this work. The usual disclaimer applies. Key Words: Inflation, Open-Mouth Operations, VAR, Vector Auto Regression, Bias-Corrected Bootstrap. CEL codes: C15, E40, E50.

†Professor at the Graduate School of Economics (EPGE/FGV) of the Getulio Vargas Foundation and a Visiting Scholar at the Department of Economics of the University of Chicago. Email: rpcysne@uchicago.edu.
in Brazil in July/1999. Once the policy of controlling the nominal exchange rate was abandoned by the Central Bank, at the beginning of 1999, a new forward-looking regime enhancing transparency and the control of expectations emerged as the right thing to do.

The interbank-rate targeting is the main operational tool by means of which inflation is kept equal or close to its target. It amounts in practice to two coordinated policies conducted by the Central Bank. The first policy regards the announcements of the interest-rate trends and/or targets for the near future. It is a responsibility of the COPOM¹, which holds monthly meetings with this purpose. The second policy, a responsibility of the Central Banks's Trading Desk, amounts to making daily open-market operations, in such a way that supply and demand for reserves intersect at an interest rate equal or close to the desired target. There is no direct interference of the Central Bank, through its Trading Desk, on the interbank rates.

Comparatively to the American experience in indirectly controlling the interbank rate, even though operationally the two systems are alike, there is at least one important technical difference. The relatively high statutory reserve requirements in Brazil generate a more predictable demand for bank reserves and facilitates the operations to be performed by the Trading Desk.

Other than the compulsory reserve requirements, the demand for reserves is generated by interbank payment flows. As pointed out by Furfine (2000), it is reasonable to assume that payment flows are positively correlated with the uncertainty in reserve balances. Therefore, by affecting the demand for reserves out of a precautionary motive, payment flows can be expected to be correlated with the level of the daily federal-funds rate.

Since the target interest rate is a crucial tool for the day-by-day policies of the Central Bank, it is very important to know how changes in this rate affect other relevant macroeconomic variables such as GDP, employment and inflation.

Several very elaborate econometric works have been produced by the Central Bank of Brazil since the introduction of the Inflation-Targeting regime, in order to provide a technical background for the forecasts to be announced. Among them, Bogdanski et al. (2000) concentrates on the dynamics involving interest rates, prices and output. These authors have concluded, using structural models, that interest rate changes affect aggregate demand in a period of 3 to 6 months, output gap having an impact on inflation after 3 months. This makes a total around nine months between a policy action based on the interest rate and curbing inflation. Tabak (2003) has found

¹"Comitê de Política Monetária" (Monetary Policy Committee).
that, to a certain extent, market participants have been able to anticipate some policy actions taken by the COPOM.


This work intends to add to the Brazilian monetary literature in two respects. First, a solution to Taylor's model is presented as a tool in the understanding of the link between the target interest rate and the overnight interest rate. The main conclusion of this analysis is that the convergence of interest rates to the target interest rate (which takes some days) can be assumed to be practically instantaneous, under the assumptions of a quarterly time period and a four-year horizon, for reasonable values of the underlying parameters. This allows for an interpretation of changes in the target interest rate as shocks to interest rates.2

In a second step, a Vector-Auto-Regression (VAR) analysis is carried out with the purpose of investigating the dynamics of some macroeconomic variables. More particularly, I will be interested in the qualitative effects of a one percent raise of interest rates on prices, output and reserves and, from a quantitative perspective, on the accumulated effects of such a measure on GDP, over a four-year horizon. As it is always the case in such analyses, all results are contingent on the assumption that the relevant sigma algebra on which economic agents base their expectations is the one generated solely by the series used in the econometric estimations.

2 Taylor’s Model and Its Solution

Taylor (2001) offers an easily readable model in which supply and demand for bank reserves are written, respectively, as3:

\[ b_t = b_{t-1} + \beta(r_{t-1} - \rho_{t-1}), \quad \beta > 0 \]  

\[ \text{(1)} \]

\[ 2\text{By defining the time of the shock as that in which the news are released.} \]

\[ 3\text{I am using the term "bank reserves" as a shortening to "bank reserves held as deposits in the Central Bank". This corresponds to what Taylor (2001) calls "fed balances".} \]
and
\[ b_t = -\alpha(r_t - \gamma E_t r_{t+1}) + \varepsilon_t, \quad \alpha > 0, \ 0 < \gamma < 1 \quad (2) \]

The first equation says that the supply of bank reserves \((b)\) is increased, at time (day) \(t\), by (indirect) actions of the Desk, when the interest rate in period \(t - 1\) is higher than the targeted interest rate \((\rho)\) at period \(t - 1\). The second equation translates the demand of reserves by the banks. This demand is positive when banks expect, conditionally on the information set available at date \(t\), that interest rates, corrected for the parameter \(\gamma\), will increase from one day to another.

In terms of the classification presented in Simonsen and Cysne (1995, p. 656), this is a mixed system of stochastic difference equations, since there are autoregressive and forward looking components. By assuming that information is not lost over time, (2) and the law of iterated expectations lead to:
\[ E_{t-1}r_t = -\frac{1}{\alpha} \sum_{j=0}^{\infty} \gamma^j E_{t-1} b_{t+j} + \lim_{n \to \infty} \gamma^n E_{t-1} r_{t+n} \]
which shows how the value interest rates expected to prevail in the future affect the present interest rate.

Taylor (2001) does not explicitly solve the system of equations given by (1) and (2).

This can be easily done, under perfect foresight, in the case of an autonomous system \((\rho_t = \rho \text{ for all } t)\). By writing:
\[ z_t = \begin{bmatrix} b_t \\ r_t \end{bmatrix}, \quad A = \begin{bmatrix} 1 & \beta \\ \frac{1}{\alpha \gamma} & \frac{1}{\gamma} \end{bmatrix}, \quad C = \begin{bmatrix} -\beta \\ 0 \end{bmatrix} \]

(7) and (8) read:
\[ z_{t+1} = Az_t + C \rho \quad (3) \]

The fixed point and the characteristic equation of (3) are, respectively,
\[ \bar{z} = (I - A)^{-1} C \rho = \begin{bmatrix} -\alpha(1 - \gamma) \rho \\ \rho \end{bmatrix} \quad (4) \]
and
\[ f(\lambda) = \lambda^2 - \frac{1 + \gamma}{\gamma} \lambda + \frac{\alpha - \beta}{\alpha \gamma} \]

I will concentrate here only in the generic case in which the eigenvalues are real and distinct. In this case the eigenvectors generate \(\mathbb{R}^2\) and we can consider the inverse of the matrix formed by the eigenvectors of \(A\). The eigenvectors \(e_1 = (e_{11}, e_{12}), e_2 = (e_{21}, e_{22})\) can be taken to be \(e_1 = (1, \frac{-1}{\alpha(1 - \gamma) \lambda_1})\).
and \( e_2 = \left(1, \frac{-1}{\alpha(1-\gamma \lambda_2)}\right) \). By making \( P = (e_1, e_2) \) and defining \( \hat{z} = P^{-1}z \), we have the system in diagonalized form:

\[
\hat{z}_{t+1} = D\hat{z}_t + P^{-1}C\rho
\]

where \( D \) is a diagonal matrix having in the diagonal the eigenvalues \( \lambda_1 \) and \( \lambda_2 \). The general solution reads \( \hat{b}_t = c_1 \lambda_1^t \) and \( \hat{r}_t = c_2 \lambda_2^t \), the hats over the variables having the obvious meaning.

Assuming that the parameters of the model generate \( |\lambda_1| < 1 \) and \( |\lambda_2| > 1 \), the transversality condition (saddle-path solution) implies \( c_2 = 0 \). Using (4) we have, in terms of the original variables of the system (since \( z = P\hat{z} \)):

\[
\begin{bmatrix}
  b_0 \\
  r_0 
\end{bmatrix} = \begin{bmatrix}
  \frac{1}{\alpha(1-\gamma \lambda_1)} & \frac{-1}{\alpha(1-\gamma \lambda_2)} \\
  \frac{1}{\alpha(1-\gamma \lambda_1)} & 0
\end{bmatrix} \begin{bmatrix}
  c_1 \\
  0
\end{bmatrix} + \begin{bmatrix}
  -\alpha(1-\gamma)\rho \\
  \rho
\end{bmatrix}
\]

which determines \( c_1 \) as a function of \( b_0 \). The general solution then reads:

\[
\begin{align*}
  b_t &= (b_0 - \alpha(\gamma - 1)\rho)\lambda_1^t + \alpha(\gamma - 1)\rho, & t \geq 0 \\
  r_t &= -(b_0 - \alpha(\gamma - 1)\rho)\lambda_1^t \alpha(1 - \gamma \lambda_1) + \rho, & t \geq 1
\end{align*}
\]

Equations (5) and (6) determine the evolution of the endogenous variables \( b \) and \( r \), under different values of the parameters \( \alpha, \beta \) and \( \gamma \), when there are changes of the target interest rate \( \rho \).

Taylor uses the parameter values \( \gamma = 0.9, \alpha = 0.3 \) and \( \beta = 0.1 \) to draw Figure 5 in his work. Figure 5 shows the evolution of interest rates when the target interest rate changes from 0 to 0.5. The economy is supposed, previously to period zero, and including period zero, to be in a steady state with \( \rho = r = 0 \) and \( b = b_0 = 0 \) (the fact that \( b_0 = 0 \) follows from equation (8), since in the steady state \( r_t = E_t r_{t+1} \)).

Note from (5) and (6) that when \( \gamma = 1, b_t = b_0 = 0 \) for all \( t \), even though the interest rate immediately adjusts to its new level. In other words, there is no need of open market operations to change interest rates. This is what Thornton (1999) and Guthrie and Wright (2000) referred to as "Open Mouth Operations".

Below I present some additional simulations of the solutions to (7) and (8) using parameter values other than those used by Taylor:

Insert Figure 1 Here

Note that the higher the value of gamma (see Furfine (2000) for empirical considerations regarding this parameter), the less time it takes for interest
rates and reserves to converge to the new steady states. Seeing the figures in Figure 1 as disposed like a 2x3 matrix, Figures 1x3 and 2x3 show the instantaneous adjustment of interest rates and the invariance of the total level of reserves when $\gamma = 1$, the case described above as the "open mouth" case. Figure 2x2 corresponds exactly to Figure 5 in Taylor (2001).

3 Innovation Accounting

The previous section shows that, under reasonable assumptions regarding the parameters of the model, one can expect the overnight interest rate to converge to the new target announced by the monetary authorities in a period ranging from one to ten days. From this section onwards, our time period will be of one quarter and our horizon of analysis will take a total of four years. Since a ten-days period under this horizon is practically negligible, one can associate news of changes in the target rate with immediate shocks to interest rates.

Under this reasoning, from now on my purpose will be using impulse-response and variance-decomposition analysis to study what happens to output, price level, and bank reserves, once interest rates are increased by one percentile point (a hundred basis points)\(^4\).

Initially, I derive qualitative considerations working with the whole sample period in which the macroeconomic variables under consideration are available on a quarterly basis: 1980: 1 – 2004: 2. Later on in this section I will be interested on more accurate responses, from a quantitative perspective, regarding the present (after-Real) low-inflation experience, of how shocks in interest rates affect the evolution of GDP. In this case only the post-Real data sample (1994: 2 – 2004: 2) is used.

3.1 Confidence Bands: Bias-corrected Bootstrap

As in Cysne (2004), here I use the confidence bands for the impulse-response functions based on Kilian’s (1998) bias-corrected bootstrap method.

The application of the standard bootstrap procedures to auto-regressive models generates replicates which are necessarily biased, on account of the small-sample bias of the estimators of the parameters. In order to deal with this problem, specifically regarding the confidence intervals for impulse-

\(^4\)For the effect of changes in the target rate on the term structure of interest rates, in the Brazilian case, see Tabak (2003).
response functions constructed from VAR estimates, Kilian (1998) proposed correcting the bias prior to bootstrapping the estimate.

Monte Carlo studies carried out by this author (see p.222 in Kilian (1998)) show that the relative frequency at which the 95% confidence interval covers the true impulse response (in a model like the one used here) can be as low as 50% when standard bootstrap methods are employed. The bias-corrected bootstrap, on the other hand, presents a frequency around 90-95%5. In the formulation used here, I employ Pope's (1990) closed-form solution to the bias of the estimators of the VAR. The theorem reads:

**Theorem 1 (Pope (1990)):** Let \( \hat{A}_n \) be the least-squares estimator of \( A \) in the \( m \)-dimensional AR(1): \( X_t = AX_{t-1} + Z_t \), in which \( X_t \) and \( Z_t \) are \( mx1 \) and \( A \) is \( mxm \), based on a sample of size \( n \). Make:

\[
C_n(s) = \frac{1}{n-1} \sum_{i=1}^{n-1} U_{i-s} U_i^T
\]

where \( U_i = X_t - \bar{X}_n, \bar{X}_n \) the sample mean. Suppose that, for some \( \varepsilon > 0, E \| C_n(0)^{-1} \|^{1+\varepsilon} (\| \cdot \| \text{ states for the operator norm}) \) is bounded as \( n \to \infty \) and that the innovations \( Z_t \) are a martingale difference sequence such that all moments of \( Z_t \) up to and including the sixth, conditional on the past, are finite and have values independent of \( t \). Let \( G \) denote the conditional covariance of \( Z_t \), and suppose that \( \| A \| < 1 \). Then, as \( n \to \infty \), the bias \( B_n = E\hat{A}_n - A \) is of the form:

\[
B_n = -\frac{b}{n} + O(n^{-3/2}) \tag{7}
\]

where \( b \) is given by:

\[
b = G \left[ (I - A^T)^{-1} + A^T(I - (A^T)^2)^{-1} + \sum \lambda(I - \lambda A^T)^{-1} \right] \Gamma(0)^{-1} \tag{8}
\]

The sum is over eigenvalues of \( A \) weighted by their multiplicities, and \( \Gamma(j) = EX_tX_{t+j}^T \).

**Proof.** See Pope (1990).

The key point to note is that the bias for the bootstrap is re-estimated, and new coefficients are generated, in each re-sample of the bootstrap.

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5The bias-corrected bootstrap detailed here has been primarily designed for stationary VARs. However, Kilian (1998, section VI) demonstrates that this technique may still be satisfactory, in practice, for nonstationary processes estimated in levels.
3.2 Impulse-Response Functions

Let $y$, $p$, $r$, $res$ and $m$ denote, respectively, the logarithm of real GDP, the logarithm of the price index, the short term (Selic\textsuperscript{6}) interest rate, the logarithm of total (bank) reserves and the logarithm of $M_1$ (means of payment). The primitive data on $p$, $m$ and $r$ used here are from IBRE-FGV's\textsuperscript{7} data bank. The quarterly GDP index and bank reserves are from IPEA\textsuperscript{8}.

In all estimations in this work, the benchmark specification used, regarding the ordering of the variables in the VAR, is the same as in Christiano et al. (2000). Under this ordering, the information set assumed to be available to the government at time $t$, when choosing the interest rate to target, includes the current and lagged values of $y$ and $p$, as well as lagged values of $r$, $res$ and $m$. As a consequence of the ordering of the variables in the VAR and of the Cholesky-orthogonalization assumption, neither the price level at time $t$ nor the GDP at time $t$ are supposed to change as a consequence of a contemporaneous interest-rate shock\textsuperscript{9}.

- Results For The Model in Log Levels

Since the main goal here is to determine the interrelationships among the variables, not the parameter estimates, in this subsection I follow Sims's (1980) and Doan's (1992) suggestions\textsuperscript{10} and estimate the VAR in log levels.

A preliminary analysis of this data set has been carried out by Cysne (2004). Using the Akaike and the Schwarz criteria\textsuperscript{11}, the model with 12 lags

\textsuperscript{6}Selic is a shortening for "Sistema Especial de Liquidação e Custódia."

\textsuperscript{7}Instituto Brasileiro de Economia da Fundação Getulio Vargas.

\textsuperscript{8}Instituto de Pesquisa Econômica Aplicada.

\textsuperscript{9}The fact that interest rates do not affect output contemporaneously can be justified by previous work of Bogdanski et al (2000), who found, using structural models, that interest rate changes affect aggregate demand only after a period of 3 to 6 months.

\textsuperscript{10}See also Enders (1995, p. 301).

\textsuperscript{11}The maximum estimated absolute value of the eigenvalues of the A.R. matrix for 4, 8 and 12 lags are, respectively, 0.9815, 0.9829 and 0.9930. Reestimations of the VAR over the same sample period lead to values of the Akaike Information Criterion, respectively, for the model with 4, 8 and 12 lags, of 1.0969, 1.1392 and -0.7527. This suggests the use of the model with 12 lags. Even though we are dealing with a small sample, I also performed a log-likelihood test under a null of 12 lags and an alternative of 8 lags. Asymptotically, $c = 2 \ast (L12 - L8)$ has a chi-square distribution with 100 (5\textsuperscript{2} 4 degrees of freedom. The value found was 367.2, confirming the Akaike-Criterion option for 12 lags. Sims' (1980) bias-corrected version of this test calls for multiplying this statistics by $(n_1 - n_2)/n_1$, where $n_1$ is the number of periods effectively used in the regressions and $n_2$ is the number of parameters estimated in the equation with the highest number of parameters. This leads to a new statistics $s = 367.2 \ast (86 - 61)/86 = 106.74$. The new p-value of 0.3049 does not point out so definitely in favor of 12 lags.
outperformed the models with 4 and 8 lags.

For these reasons, regarding the whole data sample, I shall work here only with 12 lags. The figures below show the response of output and prices to an increase of one standard deviation in interest rates, using a VAR in log levels with a nonzero intercept and 12 lags:

Insert Figure 2 Here

The four sub-figures in Figure 2 show the response of $y$, $p$, $r$ and $res$ to a one percent increase in interest rates. As one can observe from the "$r \rightarrow y$" figure, the product declines in the first quarter to a maximum around 0.3% but recovers before the end of the year\textsuperscript{12}. There is a rebound after the end of the first year and a subsequent decline one quarter afterwards, which last for two years. A new rebound after the third year is then followed by a further decline. By aggregating the effects over the GDP over the whole four-year horizon one finds an accumulated product decline around 0.44\%\textsuperscript{13}.

As shown by Cysne (2004), there is a subtle price puzzle in the first quarter after interest rates are increased. As of this date, though, the effect of interests on prices is of a four-year persistent decline.

Regarding the interest rate itself, the shock lasts around one quarter. Finally, with respect to bank reserves, the contemporaneous effect is negative, with a rebound at the end of the first quarter that lasts for three quarters. After the end of the first year, the negative effect of interest rates on reserves lasts for the next three years.

- Trends and Unit Roots

It is a valid exercise checking how the results obtained by running the VAR in log levels, without a trend, could change by using first differences of the nonstationary variables, or by the introduction of a time trend for the regressions run in log levels. The respective impulse-response functions are shown in Figures . The results in differences were obtained with four lags. To avoid clustering the analysis, I do not include confidence bands here.

\textsuperscript{12}Considering only the initial cycle shown by GDP, this is in agreement with Lisboa (2004), who has argued that the short-run effect, on output and employment, of an increase of the target interest rate by the COPOM is temporary and lasts less than a year.

\textsuperscript{13}Aggregation using the 95\% confidence bands leads to lower and upper bounds of 1.47\% (GDP loss) and 1.31\% (GDP gain). This range, as we shall see, contains the accumulated product decline of all alternative estimations with the inclusion of a trend, with the regressions run in first differences and within the subsample 1994 : 2 – 2004 : 2 as well.
Regarding the estimation in log levels with a trend (the nonzero intercept is assumed in all cases), the overall shape of the responses of all variables is practically the same as in the case without trend. This could be expected, given the large number of regressors in each equation. A quantitative difference is that now the overall decline of product along the four years is found to be 0.29%, a bit lower than the previous 0.44%.

Qualitatively, imposing unit root to the nonstationary variables leads to some changes in the shape of the responses, but not significant ones (Figure 4). GDP still declines just after the interest-rate shock and recovers by the end of the first year. The three-peak format of figure 1 in now sharper, with a positive response by the second year.

The value of the accumulated decline in GDP over the four years now amounts to 1.23%, much higher than the previous 0.44%, but still in the range delimited by the same type of calculation using the confidence bands (see footnote 13).

The price puzzle is a bit longer, lasting around six to nine months. But the overall response of prices is negative, repeating the previous result. Regarding interest rates, the shock lasts for around six months, as opposed to the previous three months. As before, bank reserves increase just after the shock, but fall around one year and a half afterwards.

3.3 Variance Decomposition

The purpose of this subsection is to measure the proportion of movements in each of the sequences considered that can be attributed to its own shocks, or to shocks to other variables. The same assumptions regarding the ordering of the variables in the VAR used to obtain the impulse-response functions apply here. The horizon considered is of four years. I provide variance decomposition for the model in log levels only.

The results displayed in Figure 5 show that interest rates explain a relatively small share of the conditional variance of GDP (4.9%). Regarding prices, interest rates, bank reserves and money, though, the effect of shocks to interest rates in explaining forecast errors is usually very relevant. Unexpected movements in interest rates account for around 39% of the variance of prices, 35% of the variance of bank reserves and 36% of the variance of $M_1$. Except for the effect on GDP, shocks to interest rates play a more important
role in explaining forecast errors than shocks to money. Price and interest-rate shocks, alone, explain around 80% of the forecast errors in reserves and money.

4 Subsampling: Results For The Post-Real Economy

The results obtained so far are satisfactory from a qualitative perspective but are not ideal for a description of the economy after the Real Plan. The main reason is that as of 1994:2, macroeconomic variables evolved under a very different pattern. For instance, considering the whole sample, from 1980:1 to 2004:2, the standard deviation of the residuals in the estimation of y, p, r, res and m, conditional on a sigma algebra generated by the last four lags of each variable, were equal to around, respectively\footnote{Note that the results concerning the interest rate are multiplied by a hundred.}, 2\%, 12\%, 31.45\%, 17\% and 8\%. For the period 1994:2 - 2004:2, these values decline to, respectively, 0.68\%, 1.14\%, 0.35\%, 11.48\% and 3.26\%.

The high variance of the residuals of the equation determining interest rates, for instance, explain the intercept around 6.6\% in the contemporaneous effect in interest rates of a 1\% increase in r in Figure 2. This is very far, quantitatively, from what one would expect in the after-Real period.

This suggest that, if we want a reasonable quantitative answer regarding the accumulated GDP loss after the Central Bank of Brazil raises the target rate, we should resample the data to include only the 1994:2 - 2004:2 period. Since we are using quarterly data (there are no monthly estimates of GDP in Brazil), this leaves us with too little degrees of freedom to consider more than four lags. The product and interest-rate response are as expected, and are shown below:

**Insert Figure 6 Here**

The new estimations lead to a contemporaneous effect on interest rates of only around 0.34\% and to an accumulated interest rate increase, over the four-year horizon, of 0.16\%. Regarding the GDP, the new accumulated product loss is 0.08\%. Using the lower and upper bands lead to a GDP variation of \(-1.24\%\) and \(1.31\%). Note that this interval is contained in the
[-1.47%, 1.31%] previously calculated for the whole sample. The new estimate of 0.08% accumulated GDP loss, though, as opposed to the old one of 0.44%, fits better the Post-Real economy.

The new variance decomposition for the subsample 1994:2-2004:2 is presented in Figure 7.

Insert Figure 7 Here

The results displayed in Figure 7 show that interest rates in the more recent period explain a larger share of the conditional variance of GDP (9.2%, as opposed to the previous 4.9%). Unexpected movements in interest rates now account for 2.14% of the variance of prices, 20% of the variance of bank reserves and 6% of the variance of $M_1$. Shocks to money are now more important than shocks to interest rates in explaining errors in the forecast of all variables, except interest rates themselves.

5 Conclusions

In this work we have started with a short description of the two-target mechanism that characterizes the present state of monetary policy in Brazil. Next, we solved and simulated Taylor’s model for the determination of interbank interest rates. We have also seen that some parameter values of Taylor’s model lead to what is generally called "open-mouth" operations, as opposed to "open-market" operations.

In the second part of the paper, we have provided a VAR analysis of the effects of increases in the target interest rate in the dynamic evolution of GDP, prices, interest rates and bank reserves. Our main findings have been that, qualitatively, prices and GDP fall after interest rates are increased, and that this behavior is robust to imposing unit roots on some variables and to including a trend in the regressions run in log levels.

From a quantitative perspective, we have found that in the Post-Real economy a one percent increase in interest rates lead to a accumulated product decline over the next four years around 0.08%, and that interest-rate shocks explain around 9.2% of the conditional variance of GDP.

References


Figure 1: Response of Reserves and Interest Rates to a Unanticipated 0.5% Increase in the Target Rate
Figure 2: Impulse-Response Functions, VAR in Levels Without a Trend

Figure 3: Impulse-Response Functions, VAR in Levels With a Trend
Figure 4: Impulse-Response Functions, VAR in First Differences

Percentages of Forecast Error Variances in Rows Explained by Columns =

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Figure 5: Variance Decomposition, Model in Log Levels
Figure 6: Response GDP and Interest-Rate Response to a 1% Increase of the Target Interest Rate, Subsample 1994:2-2004:2

Figure 7: Variance Decomposition, Model in Log Levels, Subsample 1994:2-2004:2
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