An econometric analysis of the effects of macroeconomic variables on interest rates in Brazil

Fernando Blumenschein[§]

ABSTRACT

This paper examines the importance of liquidity, credit, and Fisher effects on the interest rate in Brazil during the period 1975-1991, for five different segments of the financial market. The positive relationship between money and the interest rate prevailed in most of our results. This finding may represent a departure from both monetarism and rational expectation approaches. Price had a significant effect in the way money affected interest rate, especially under high rates of inflation. Some of our results confirmed the existence of segmentation among different segments of the financial market. Mainly the overnight market reacted differently. The implications of these results for the monetary transmission mechanism, and for the conduct of monetary policy in Brazil during the period 1975-1991, may have been substantial.

Key words: interest rate, money supply, credit, Fisher effect, Brazil.

RESUMO

Este artigo examina a importância do efeito liquidez, do efeito crédito e do efeito Fisher sobre a taxa de juro no Brasil durante o período 1975-1991 para cinco segmentos do mercado financeiro. Uma relação positiva entre a oferta de moeda e a taxa de juro prevaleceu na maioria das análises efetuadas. Este resultado pode representar uma modificação das previsões esperadas pelas correntes monetaristas e das expectativas racionais. O nível de preços teve um efeito significativo na maneira como a oferta monetária afetou a taxa de juro, especialmente quando prevaleceu altas taxas inflacionárias. Alguns resultados confirmaram a existência de segmentação entre diferentes segmentos do mercado financeiro. Principalmente o mercado overnight reagiu de forma diferenciada. As implicações destes resultados para o mecanismo de transmissão monetária e para a condução da política monetária no Brasil durante o período 1975-1991 podem ter sido substanciais.

Palavras-chave: taxa de juro, oferta de moeda, crédito, efeito Fisher, Brasil.

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§ Professor of economics at the Faculdade de Economia e Administração (FEA) of the University of São Paulo (USP), Brazil.

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1 Introduction

The price of money is perhaps the most important of all prices. Nevertheless, a historical view of the theories of the interest rate shows how controversial and continual the debate on interest rate determination has been.[1] Although the complexity of the theme is indisputable, some justifications have been given for the existence of that controversy. Most of the controversy arises from the lack of explicit recognition of three important factors that underlie both the empirical and the theoretical studies of the interest rate.

The first factor is methodological. It is related to the type of approach used in the analysis of the interest rate. The choices between partial equilibrium versus general equilibrium, or static versus dynamic model, involve some judgments that must be made explicitly. Each framework precludes some insights due to its limitations. The second factor is related to time. Innocuous dispute may stem from the conflict between variables that explain short-run phenomena and those that explain long-run relations. The third, and less explored factor, relates to the type of economic system being investigated. Some countries present distinct features on their economic system that usually is not taken into consideration. This is the case of many developing countries in which the characteristics of their financial markets are, in many ways, distinct from those of the more developed nations. These characteristic features may bear considerable influence on the behavior of the interest rate.

Investigation about the factors influencing the rate of interest in economies of the developing countries has been the subject of numerous studies.[2] These studies have shared a common concern with respect to the high market real rates of interest that prevailed in those countries during most of the 1980s. On the other hand, other studies have found that the government real rates of interest have been negative for most developing countries.[3] This asymmetric behavior between government rates and market rates seems to have been characteristic of many developing countries.

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1 For a historical and analytical view of theories and models of the interest rate determination, see Lutz (1968) as well as Conard (1959).

2 Sundararaja and Balino (1991) reviewed the studies on the interest rate for seven developing countries in Asia and South America. For a study of the interest rate in Mexico, see Khor and Rojas-Suarez (1991).

3 See Guidotti and Kumar (1991), for an analysis of the interest rate in fifteen developing countries. In their text, government rates include the deposit rate, the discount rate, and the interest rate on government securities.

For the case of Brazil, a study that implemented correlations and cointegration analyses has shown that the link between interest rates, in different segments of the market, has been very weak, both in the short run and in the long run.[4] For this reason, a thorough investigation of factors influencing the interest rates should consider each segment of the financial market separately. This fact contrasts with studies of interest rate determination in the developed countries, where a perfectly integrated financial market allows the impact of a given variable to have a roughly uniform effect in all segments. Moreover, the Brazilian financial market has some features which distinguishes it from the majority of the developing countries. On the one hand, it has some characteristic features, which are encountered in repressed financial markets. These characteristic features include curb market, capital controls, and currency substitution, among others. On the other hand, Brazil has a very developed banking system that manages the great majority of the financial intermediation, a sophisticated primary and secondary markets for government securities, and a fast growing stock market have been in place for more than two decades.[5]

Because of the degree of sophistication attained by its financial market, it is difficult to include Brazil in the category of financially repressed economies of the McKinnon-Shaw tradition. The study of the interest rate in Brazil has to be carried out within the context of the more traditional theoretical frameworks.[6] This traditional framework includes three theoretical approaches. First, the Keynesian/Monetarist approach of liquidity preference (Liquidity Effect). This approach allows us to measure the effect of changes in the money supply and income on the level of the interest rates. Second, the theory of loanable funds which gives emphasis to the supply and demand for credit as the determinants of the interest rate (Credit Effect). Third, the Fisher approach, which emphasizes the influence of changes in the price level on the interest rate (Fisher Effect).[7]

The main objective of this paper will be to evaluate how the three macroeconomic approaches we mentioned above relate to the behavior of the interest rate in Brazil during the period 1975-1991, for five different segments of the financial market. The paper intends to investigate the issue through the implementation of econometric analyses.

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4 See Blumenschein (1995), for an analysis of the interest rate in Brazil.

5 A detailed description of the sophistication of the Brazilian financial market was given in Lees, Boots and Cysne (1991).

6 In our text, the term "traditional" excludes, for example, the theories of term structure of interest rate, which do not apply to Brazil, and excludes real business cycle models.

7 See Friedman and Schwartz (1982) for a description of the theoretical background of both the liquidity effect and the credit effect. For the Fisher effect, see Fisher (1930).

Despite the fact that the effects of some other specific variables may help to explain short-run movements of the interest rate, a broader understanding of the behavior of the interest rate can be achieved only by considering the effect of those macroeconomic variables over the long run. The motivation to study the interest rate in Brazil derives from the unique features of its financial market that we have described, and from the lack of previous studies to investigate the issue.[8]

In the Brazilian case, the study has to take into consideration the various segments of the formal financial market, for reasons we outlined above. As a consequence of the asymmetric behavior of the interest rate among the various segments that comprise the formal financial market, our basic hypothesis is that the macroeconomic variables may influence different segments in different ways. Under these circumstances, the use of interest rate as an instrument of monetary policy in Brazil may be questioned. The paper will be structured as follows. The data we used and the features of the five different segments of the financial market will be briefly explained in section 2. Section 3 will outline the econometric techniques we applied, and the results we found. Some complementary discussion and interpretation of the results will be presented in section 4. The paper closes with concluding remarks in section 5.

2 Data and characteristics of the markets

The time series for both government and market interest rates have been constructed and made public only recently. This paper has taken advantage of these recent data, which allowed us to cover the period from 1975 to 1991.[9] We will investigate five segments of the financial market. These segments are the primary and the secondary market for government bonds, and three segments for short-term borrowing and lending in commercial banks.

For the primary market for government bonds we used the index of monthly quotations for national treasury bonds (TB), published by the Ministry of the Economy (see Apecão (1991)). This index is constructed by taking into consideration the yield of government bonds in the primary market. Since there are several different types of bonds and the

8 For one of the few studies about the interest rate in Brazil, see Garcia (1991).

9 The period 1975-1991 has been chosen because of the availability of the data at the time that this paper had been writen.

denomination of these bonds have changed over time, the use of the official index mentioned above seemed more appropriate. More importantly, this index is used as the basis for indexation of other segments of the financial market. This fact makes this index a representation not only of the interest rate paid in the primary market for government bonds, but also in some segments of the financial market that are subject to monetary correction (i. e. agricultural credit, household savings, and mortgages, among others).

For the secondary market, we used the interest rate paid on the overnight market (NG). This market is a repurchase contract market, which pays overnight interest rates. The holders of government securities use this market to obtain capital by using these securities as collateral.

The time series for market interest rates were the borrowing and the lending rates that prevailed in the banking system. The borrowing rate was the one the banking system paid on short-term certified deposits (CDB). Two lending rates were used to measure the cost of money for the private sector in the short term. One was the short-term rate for working capital (CG) and, the other, the rate used to discount private notes (DD), issued in short-term transactions. It is important to add that the interest rates in these segments are the result of market forces, since the levels of interest rate paid and charged are not subjected to governmental regulation. Moreover, these interest rates are good proxies for the curb market. The curb market was not included in our analysis because data for this market are not available in Brazil.

With exception of the quotations for national treasury bonds (TB), all the time series were obtained from the publication Análise Financeira (1991). They are monthly rates charged by and paid to the banking system, taken as an average for the whole country.

The maturity of the contracts for the market interest rates varied from one to six months. The average maturity of government securities varied during the period, but remained essentially small and never stayed greater than one year. All the interest rates we described above were nominal. We calculated the real interest rate by correcting the nominal interest rate for the official rate of inflation, for tax withholdings and, when pertinent, for other financial fees.[10]

10 For the average maturity of the primary market and of the overnight market during the eighties, see Jorgensen (1990). For the maturities of contracts and calculations of the market interest rate, see Análise Financeira (1991).

3 Econometric results

We will proceed in this section by investigating first the behavior of the nominal interest rates. This part will consist of regression analysis to investigate the effects of liquidity, credit, and inflation upon the rates of interest within the context in which the money supply is independent of the interest rate. Since most of the monetary policy stances in Brazil have not been constrained by concerns to promote stable interest rates, money-growth is likely to be uncorreleted with the error term.

Nevertheless, in the case of Brazil, the endogeneity of the money supply is related to the financing of the public deficit. Since part of the public deficit has been financed through monetary expansion, the money supply becomes an endogenous variable of the whole economy, through its direct link to the way the deficit is financed.[11] This form of endogeneity is an important point in the way the econometric analysis should be conducted. For this reason, we will inquire into the factors that may explain the behavior of the real interest rate in a scenario of endogenous money supply. In this inquiry, we will use the vector autoregression (VAR) technique, in which linear dynamic models allow us to analyze the issue with all the variables being endogenously determined. We expect that this combination of econometric approaches will permit us to check the robustness of our findings.

3A The nominal interest rate

3A1 The liquidity effect

The most traditional empirical approach to study the effects of monetary changes on the rate of interest was first proposed by Cagan and Gandolfi (1969). This approach consists of the OLS estimation of the following equation:

$$\Delta ir_t = \alpha + \sum_{i=0}^{k} \beta_i \Delta M_{t-i} + \varepsilon_t \,. \qquad (1)$$

where *ir* is the level of interest rate, M is a measure of money-growth, ε_t is the iid $(0, \sigma^2)$ random error, and Δ is the first difference operator.

11 Dornbusch, Sturzenegger and Wolf (1991) discussed the endogeneity of the money supply in the context of money financing.

Cagan and Gandolfi (1969) found that the cumulative coefficients in the regression above were negative for the short term. They asserted that this finding was the evidence of the liquidity effect. After the publication of the Cagan and Gandolfi's results, several studies followed and the controversy of the existence and nature of the liquidity effect became central in monetary economics.

The most important source of controversy lies in the fact that different methodologies and different econometric techniques have been employed to appraise the issue. Because of their complexity and scope, we will not comment on them. For the purpose of this paper, it is important to clarify the reasons why we selected the classical OLS Cagan-Gandolfi approach in our analysis. The motives for this choice were threefold. First, the issue of the interest rate in Brazil should be investigated by the more traditional methodology, which can serve as a benchmark for future studies. Second, data limitations for inflationary expectations for Brazil preclude the implementation of other methodologies. Third, given the conditions under which the monetary policy is conducted in Brazil, it may not justify the use of other econometric techniques.[12]

Figure 1 depicts the results for the twelve unconstrained cumulative lag effect[13] of monthly changes of monetary growth of M1, on changes of monthly interest rate, in five different segments of the financial market. The coefficients are expressed in terms of monthly percentage changes in the interest rate per one percentage point change in the monthly rate of money-growth. The analysis of Figure 1 shows very clearly that the presence of the liquidity effect, due to changes of growth rate of M1, was very strong for all segments of the financial market. It is important to add that the great majority of the coefficients was significant at the 5% level.[14] Nevertheless, the classical Cagan-Gandolfi curve response was not found for the five segments of the financial market. The upward sloped tail-end was absent in our results.

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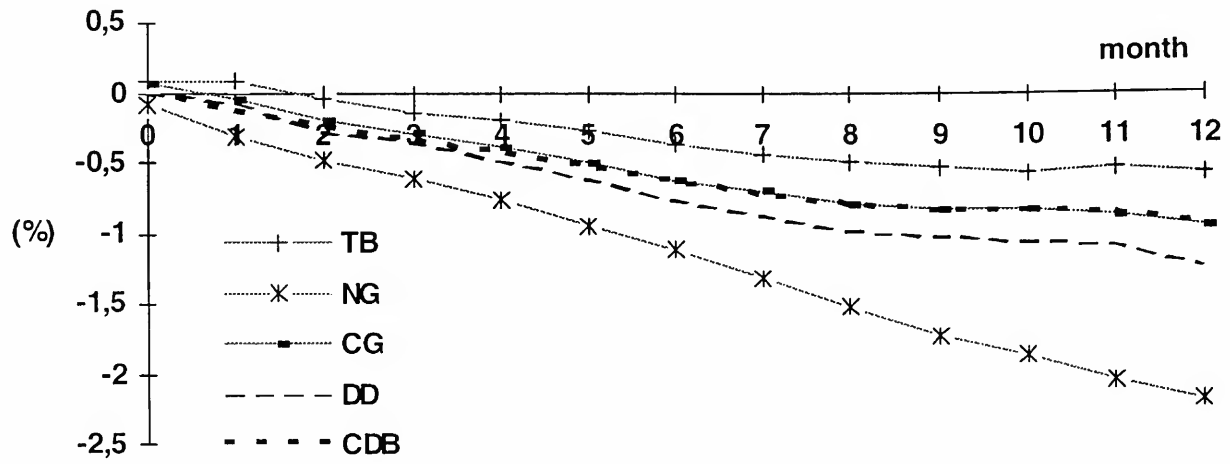
12 Besides the Cagan and Gandolfi approach, two other approaches have been used. They are the IS-LM-Aggregate Supply models and the Efficient Markets-Rational Expectation theory. See Mehra (1985), and Thornton (1988), for discussions of those approaches. For examples of different econometric techniques, see Stokes and Neuburger (1979), for a Box-Jenkins ARIMA analysis, Cochrane (1989), which used band-pass filters, and Mehra (1985), where instrumental variable for money-growth was employed.

13 The number of lags in the regression varied in different studies from twelve to thirty six. Although not reported here, the results for the twenty four lags were very similar to those of Figures 1-3, and most of the coefficients after the thirteenth lag were not significant. Also, the use of annualized data instead of monthly figures, did not change our results in any substantial way. The results for DW test and for multicoliarity can be found in Blumenschein (1994), Appendix F.

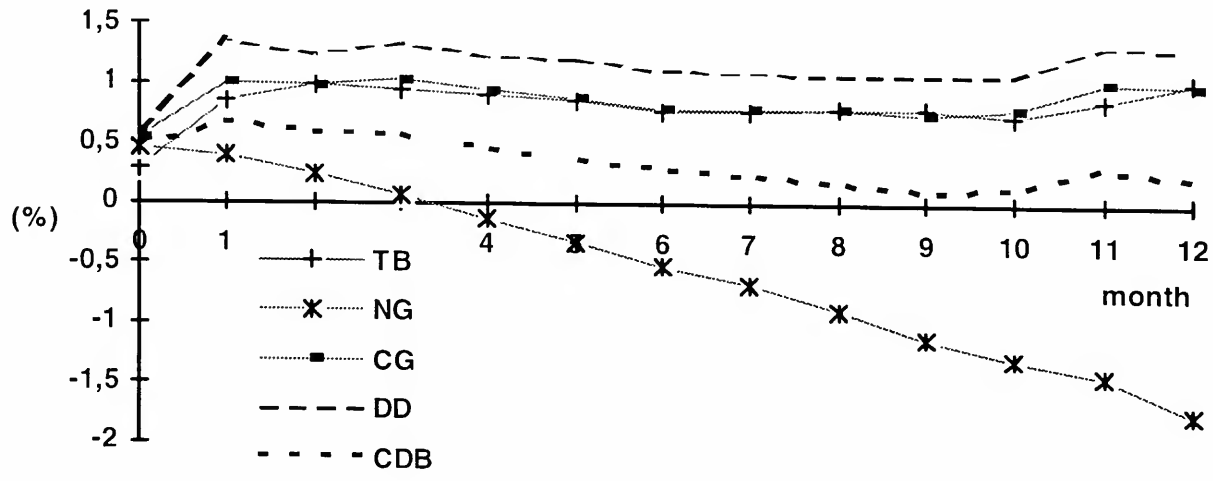
14 For the sake of brevity we will not report here the statistical significance of each coefficient.

Figure 1
Unconstrained Cumulative Lag Effects of Growth of M1 on Change of The Interest Rate. 1975-1991



Because it was never clear that the monetary authorities in Brazil were targeting a specific monetary aggregate, we examined for alternative measures of money in Equation (1). For this purpose, we used changes in the growth rate of M2.[15] Figure 2 presents the results for changes in the growth rate of M2. Approximately half of the coefficients were statistically significant at the 5% level. With the exception of the primary market for government bonds (TB), and in some degree for the overnight market, all the segments did not show the presence of the liquidity effect. On the contrary, the increase on the rate of growth of M2 was translated into positive cumulative lag coefficients for the whole period. The pattern of response for the overnight market clearly reflects a departure from the other segments.

Figure 2
Unconstrained Cumulative Lag Effects of Growth of M2 on Change of The Interest Rate. 1975-1991



15 In our analysis, the stock of public debt is part of M3 but not of M2.

The differences in pattern of responses for the monetary aggregates M1 and M2 prompted us to test which specification best represents the cumulative lag effects of money on interest rate. With that objective, we implemented the J test developed by Davidson and MacKinnon (1981).[16] The results are presented in Table 1. These figures indicate that, for the period 1975-1985, the lag effects of money-growth on interest rates were best specified with the monetary aggregate M1, for three segments of the financial market (primary market, secondary market, and working capital). The results for the segments DD and CDB were inconclusive. For the period 1986-1991, the specification with M2 was favored for all three market interest rates (working capital, short-run credit, and certified deposits), but was inconclusive for the other segments (primary and secondary markets).

To examine for changes in the way the money-growth affected the interest rate, we conducted the F test for the constancy of the coefficients for successive break points. The results are presented in Table 2. These numbers corroborate that, after 1986, there was a statistically significant change in the relationship between money-growth of M2 and the interest rate in all segments of the financial market.[17] On the other hand, the results for M1 did not confirm any change in the pattern of the coefficients, except for the overnight market. Although not reported here, F tests for M1 in alternative break points before or after 1986 were not statistically significant.

Table 1
J Test for Specifications of Lag Effects of Monetary Variables

INT. RATE	1975-1985		1986-1991	
	M1/M2	M2/M1	M1/M2	M2/M1
TB	0.42	6.71**	5.81**	3.06**
NG	-0.11	6.71**	5.85**	2.88**
CG	1.06	6.90**	6.09**	1.68
DD	3.06**	4.08**	7.25**	2.16*
CDB	2.64**	5.78**	7.55**	1.88

Note: * means significance at the 5% level. ** significance at the 1% level. M1/M2 represents the truth of M1 specification against the falsity of the M2 specification.

16 Consider two alternative hypotheses: $H_0 : y_t = f_t(X_t, \beta) + \varepsilon_{0t}$, and $H_1 : y_t = g_t(Z_t, \gamma) + \varepsilon_{1t}$, where X_t and Z_t are the lagged values of M1 and M2, respectively, β and γ are the vector of parameters and ε is assumed to be NID$(0, \sigma^2)$. They assumed that H_0 and H_1 are not nested on each other. To test the truth of H_0 against the falsity of H_1, the following regression was estimated: $y = (1-\alpha) f_t(X_t, \beta) + \alpha \hat{g}_t + \varepsilon_t$, where $\hat{g}_t = g_t(Z_t, \hat{\gamma})$, and $\hat{\gamma}$ is the ML estimate of γ. If H_1 is true, then the true value of α is zero. The reverse holds for H_1 against H_0. The results in Table 1 are the t test for α.

17 Before 1986, the F tests for M2 were not statistically significant.

Table 2
F Tests for the Constancy of Coefficients for Two Measures of Money: Break-Point at 1986.01

INT RATE	M1		M2	
	F test	Prob.(%)	F test	Prob.(%)
TB	1.59	8.60	2.29	0.70
NG	1.91	2.93	2.87	0.07
CG	0.46	94.97	1.94	2.60
DD	0.82	63.70	3.48	0.00
CDB	0.41	96.90	1.93	2.60

In summary, the results for the F test and for the J test indicated that the specification with M2 more accurately represented the relationship between interest rate and money, especially during the second half of the 1980s. To more closely investigate the nature of the changes that occurred after 1986, we constructed the cumulative lag effects of M2 for two sub-periods, 1975-1985 and 1986-1991. The results are shown in Figures 3 and 4.

Figure 3
Unconstrained Cumulative Lag Effects of Growth of M2 on Change of the Interest Rate. 1975-1985

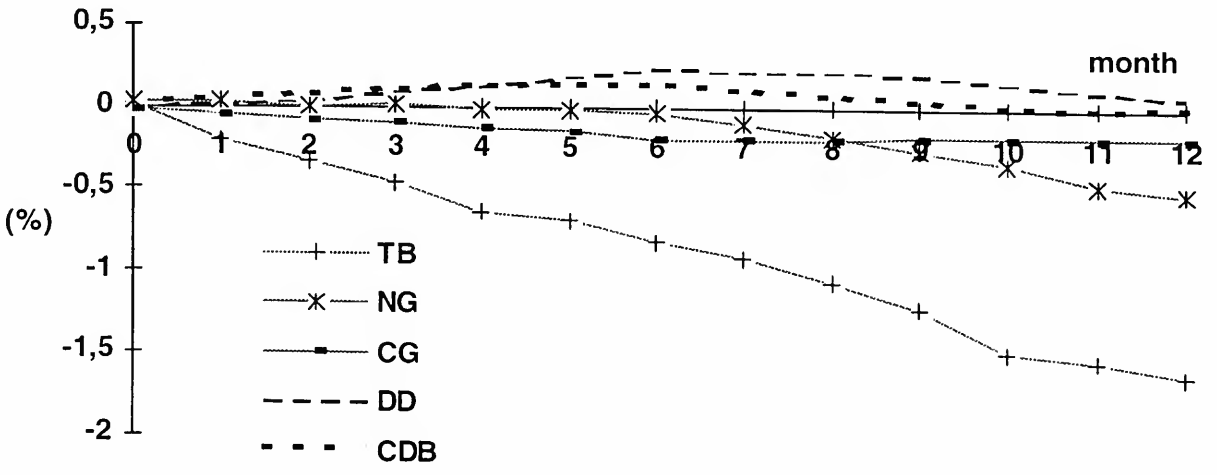
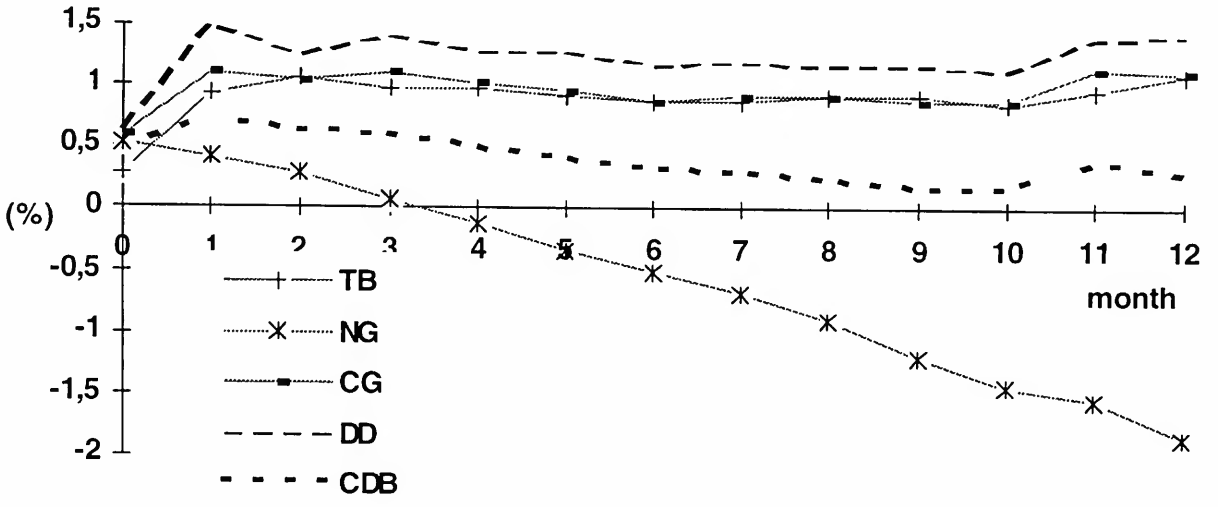


Figure 4
Unconstrained Cumulative Lag Effects of Growth of M2 on Change of the Interest Rate. 1986-1991



Before 1986, there was a liquidity effect for three segments of the financial market (primary market, overnight market, and working capital), and a positive, but not pronounced, cumulative lag pattern for the two other segments (short-run credit and certified deposits). The liquidity effect was particularly strong for the primary market. Since the quotations in this market were used to calculate the monetary correction, some liquidity effect may have spilled over to segments of the financial market subject to indexation. The extent of this effect would be determined, among other things, by the relative importance of these segments.

The analysis of these figures very clearly shows that there was a remarkable weakening of the liquidity effect after 1986. For the second half of the decade of the 1980s, and with exception of the overnight market, there was a pronounced positive cumulative lag pattern between M2 growth and nominal interest rate. This assertion is corroborated by the statistical significance of the coefficients for the two periods. For the period 1975-1985, almost all coefficients were not statistically significant at the 5% level, whereas for the period 1986-1991 nearly half of the coefficients were statistically significant. One possible reason for the presence of a direct positive relation between money growth and interest rate after 1986, may be related to the presence of the Fisher effect. The inflation rate, measured by the I2 (FGV), increased from an average of 6% per month during the period 1975-1985, to 19% for the period 1986-1991. Moreover, the volatility of the inflation rate, measured by the standard deviation, increased from 3.3 to 16.2 between those periods. These figures may indicate that the formation of higher expectation of the inflation rate was translated into higher interest rates even in the short run. It must be pointed out that the positive responses of the interest rates in the short term were an extreme version of the Fisher effect, in which

the expectation of higher inflation rates preceded money-growth itself.[18] It would be better named "anti-liquidity effect."

Besides the Fisher effect, it is also important to assert that, during the 1980s, substantial changes occurred in the demand function for money itself, and in the arguments of the demand function. Financial market innovations and money substitutes had an important quantifiable effect on the demand for money and consequently on the relationship between inflation and the interest rate.[19]

The most important example of financial innovations was the payment of interest on money. Combined with high rates of inflation[20] that prevailed in the second half of the decade of the 1980s, this innovation dampened the desires to hold money. The collapse of the demand for money and the increase in the velocity of money sped up the process of formation of inflationary expectations, with a direct impact on interest rates. Money followed rather than led, and this behavior has a close association with the fact that the money supply was endogenously determined, and lacked the feature of anticipation. The Cagan-Gandolfi curve response of interest rate may hold for Brazil, but in an upside down form as revealed in Figure 4.

3A2 The credit effect

According to the loanable funds theory, variations on the total amount of credit allocated to the economy are the primary source of variations on the interest rate. A higher rate of monetary growth, through an increase of the supply of loanable funds by the banking system, would produce a single drop in the rate of interest.

Although, on the theoretical level, there is little controversy about the existence of the credit effect, some debate exists regarding the empirical difficulty in breaking down liquidity and credit effects. Hence, empirical analyses of the credit effect are scanty. We will present the results for the two empirical approaches encountered in the literature. These are Cagan's approach and an alternative method proposed by William Poole.[21]

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18 See Hanson (1980), for a confirmation that, in Brazil, changes in price can predict changes in money but the reverse is not true.

19 See Calomiris and Domowitz (1989), for a study of the money demand in Brazil, that takes into account financial innovations and money substitutes.

20 It is important to say that this combination is a direct cause of the financing of the public deficit under poor governmental credibility.

21 See Cagan (1972) and Poole (1974). The rationale behind the specification of equation 2 and 3 without lags was explained in details by Cagan (1972).

The analysis of the credit effect carried out by Cagan consists of investigating the following equation:

$$\Delta i = \alpha + \theta(\Delta gC) + \vartheta[\Delta(gC - gM)] \qquad (2)$$

In Equation (2), i is the interest rate, gC is the monthly growth rate of credit of the banking system, Δ is the growth rate of money stock, gM is a constant term, and α is the first difference operator.[22] The coefficient θ measures the effect attributed to credit expansion alone, or the loanable funds effect, while ϑ measures the effect of all other sources of monetary expansion. According to Cagan (1972), if the two coefficients have negative signs, the credit and the liquidity effects have the same outcome on the interest rate, and no separate role can be attributed to credit alone. For credit to have a specific role, (θ-ϑ) must be statistically significant and negative. To test this hypothesis, we estimated Equation (3):

$$\Delta i = \alpha + (\theta - \vartheta)(\Delta gC) + \vartheta(\Delta gM). \qquad (3)$$

The estimates of the coefficients of Equations (2) and (3), for five segments of the financial market, and for three periods, are presented in Table 3. The numbers in this table visibly reveal that the estimates varied considerably when we compare the numbers of the period 1975-1985 with those of the period 1986-1991. During the period 1975-1985, the credit effect had a significant influence only on one segment of the financial market, namely, working capital (CG). On the other hand, although small in values, the coefficient for non-credit sources (θ-ϑ) for the short-term credit (DD) was negative, whereas for the overnight market (NG) it was positive. Moreover, both were statistically significant. This piece of evidence shows that the non-credit sources had an impact on these segments of the financial market.

An overall analysis of these results reveals that statistical significance is lacking for the majority of the coefficients. This fact indicates the neutrality, *strictus sensus,*[23] of the credit and non-credit sources of monetary expansions in affecting the interest rate for most segments of the financial market.

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22 For the credit variable, we used the growth rate of total amount of credit to the private sector, and for the money variable, the growth rate of M2. All variables, including the interest rate, were expressed in percentage points. The credit variable excludes securities outside the government agencies. According to Cagan, this specification allows for more accurate estimates.

23 Neutrality, in this context, means the absence of either negative or positive effects.

Table 3
The Credit and Non-Credit Sources of Monetary Growth and Their Relationship to the Interest Rates

INT.RATE	Cte. (α)	Credit (θ)	Non-Credit (ϑ)	Non-Credit ($\theta - \vartheta$)	R^2	DW	F
			1975-1991				
TB	0.09 (0.2)	0.29 (4.6)**	0.01 (0.2)	0.28 (5.3)**	0.13	2.39	15.85**
NG	0.02 (0.1)	0.57 (13.9)**	0.42 (11.3)**	0.14 (4.0)**	0.50	2.05	93.91**
CG	0.07 (0.2)	0.61 (10.6)**	0.19 (3.8)**	0.43 (8.9)**	0.38	2.40	61.94**
DD	0.05 (0.1)	0.74 (9.1)**	0.08 (1.2)	0.65 (9.7)**	0.35	2.81	56.51**
CDB	0.05 (0.2)	0.51 (11.9)**	0.21 (5.7)**	0.30 (8.5)**	0.42	2.27	73.55**
			1975-1985				
TB	0.08 (0.3)	-0.08 (-1.1)	0.02 (0.3)	-0.11 (-2.2)*	0.01	2.91	2.16
NG	0.07 (1.0)	0.05 (2.1)*	0.02 (1.0)	0.03 (1.9)*	0.02	2.32	2.62
CG	0.05 (1.4)	-0.02 (-1.9)*	-0.01 (-1.5)	-0.008 (-1.1)	0.01	1.06	1.84
DD	0.09 (1.9)	-0.02 (-1.5)	0.002 (0.2)	-0.024 (-2.4)*	0.03	1.92	2.92*
CDB	0.06 (2.3)*	0.01 (1.5)	0.007 (1.1)	0.005 (1.0)	0.003	1.49	1.20
			1986-1991				
TB	0.13 (0.1)	0.40 (4.0)**	-0.03 (-0.3)	0.44 (4.9)**	0.25	2.28	13.0**
NG	0.06 (0.1)	0.69 (9.1)**	0.53 (7.8)**	0.16 (2.4)*	0.60	1.99	46.5**
CG	0.18 (0.2)	0.79 (8.0)**	0.19 (2.3)*	0.59 (6.8)**	0.49	2.55	35.6**
DD	0.04 (0.04)	0.96 (7.0)**	0.03 (0.28)	0.92 (7.7)**	0.48	3.02	34.5**
CDB	0.10 (0.2)	0.63 (8.8)**	0.23 (3.6)**	0.41 (6.4)**	0.52	2.43	40.3**

Note: * significance at the 5% level. ** significance at the 1% level.

The results for the period 1986-1991 present a different pattern from those for the period 1975-1985. The credit expansion had a strong, statistically significant, and positive effect on the interest rate for all segments. The coefficients for non-credit sources of monetary expansion, although smaller than those of credit, had a positive and statistically significant impact on the interest rate in the majority of the segments of the financial market. We can interpret these results as a valuable signal that credit has had a much stronger effect on rising the interest rates than the other sources of monetary expansion. Moreover, the size of these coefficients reveals also that the effect can be quite substantial and uniform across all segments.

According to Poole (1974), in the short term, the test of the credit effect would appear as a relationship between the rate of change of the interest rate and the rate of change of the money stock.[24] In Poole's point of view, the use of credit variables in the regression analysis

24 Poole's argument took the line that "*if money demand differs from money supply primarily because of changes in the later, then the credit effect should appear as a relationship between the level of interest rate and the rate of change of money.*" Friedman and Schwartz (1982) undertook their empirical analysis of the credit effect on these lines.

as proposed by Cagan was not fully satisfactory. Following Poole's method, we found that the correlation between the level of interest rate and the growth rate of money strongly confirmed the results of Table 3. Indeed, for growth of M1, the averaged correlation for the five segments increased from 0.20 during the period 1975-1985, to 0.60 for the period 1986-1991. For the monetary aggregate M2, the numbers were 0.70 and 0.86 for the two periods respectively.[25] These numbers confirm the nonexistence of the credit effect in both periods, and that the positive relationship between credit and interest rate was substantially higher after 1986. Nevertheless, they do not confirm the neutrality of credit, *strictus sensus*, before 1986.

Some rationale for the results of Table 3, and of the correlations suggested by Poole may be given by the factors we explored in analyzing the liquidity effect. Indeed, if prices preceded money-growth, a once-and-for-all increase of the interest rate in the short run would mask any credit effect. Moreover, an increase in the issuing of government securities that was required to finance the growing public deficit constituted a continuous drain on the availability of credit to the private sector. The fast growing repurchase contract in the secondary market may also have helped to offset the increase in any private holdings of new credit, by disposing of these assets.

3A3 The Fisher effect

The evidence for the nonexistence of either the liquidity effect or the credit effect prompted us to focus attention on the analysis of the Fisher effect. For economies with high inflation rates, Friedman (1968) suggested that the monetary effects on the interest rate would be very weak or even absent, due to the speed at which the economic agents would adjust to expectations of higher rates of inflation that follow an increase in the money supply.[26] For the specific case of the Brazilian experience, recent work by Garcia (1991) has found that, after 1975, the Fisher equation is a good approximation of the behavior of CDB (indexed and non-indexed) interest rate in Brazil. Although this evidence was important, it was partial owing to the fact that it focused only on one segment of the financial market.

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25 The correlation differentials between segments were very small.

26 For studies in developing countries supporting the Friedman view, see Blejer (1978).

As a complementary analysis, we will investigate the hypothesis that the inflation rate influences the way money growth affects interest rates. To test this hypothesis, Equation (1) has to incorporate a variable for inflation. This will be achieved by implementing a weighted distributed lag. To this end, we will make the b coefficient of Equation (1) a function of the rate of inflation, i.e., $\beta_t = f(\mathrm{I})$ The function f will assume a first degree polynomial given by Equation (4).[27]

$$\beta_t = \rho_t + \varphi_t \mathrm{I}_{t-j} \qquad (4)$$

In Equation (4), the coefficient ρ_t corresponds to the fixed effect of money on the interest rate, and $\varphi_t \mathrm{I}_{t-j}$ corresponds to the variable effect, which depends on the inflation rate I.

A twelve-weighted lag was estimated for five segments of the financial market for the two periods, 1975-1985 and 1986-1991. For the sake of brevity, in Table 4 we present only the coefficients of the variable weights. It is important to point out that the cumulative lag for the weighted version showed a pattern very similar to those of Figures 3 and 4.

For the period 1975-1985, and with exception of the lending rates (CG and DD), the majority of the coefficients was negative. On the other hand, for the period 1986-1991, almost all the coefficients were positive. This pattern suggests that increasing prices attenuated the liquidity effect, and that this attenuation was more pronounced under higher rates of inflation.[28]

The tests for the joint significance of the coefficients in Table 4, reported in Table 5, indicate that, before 1985, the hypothesis that monetary policy was affected by inflation was confirmed only in the segments working capital (CG) and certified deposits (CDB).[29] After 1985, only the overnight market (NG) did not confirm this hypothesis. As it will be discussed in the next section, this non-uniform behavior should be taken into consideration in analyzing the effects of monetary expansion.

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27 This is a variation of the Almon lag scheme. In his scheme, @, and the polynomial, can take any degree. For examples of empirical works that used this methodology, see Tinsley (1967), Tanner (1979), and Melvin (1983). This methodology is distinct to the one used by Garcia (1991).

28 One of the difficulties in interpreting the results of Table 4 was that only the coefficients of the first two lags were significant at the 5% level. Nonetheless, the analysis of the coefficients of the first two lags confirms all the results of the paragraph above.

29 It was specified on page 16 and footnote 25 the rationale for this hypotesis.

Table 4
Variable Effect Captured by the Coefficients j in Weighted Distributed Lag

	TB	NG	CG	DD	CDB
lag			1975-1985		
0	0.013(0.56)	0.008(0.88)	-0.010(-2.24)	-0.0096(-1.67)	0.003(0.97)
1	-0.026(-1.02)	0.009(0.85)	-0.008(-1.71)	-0.007(-1.13)	0.006(1.60)
2	0.026(0.99)	-0.016(-1.50)	-0.002(-0.49)	-0.001(-0.17)	0.004(1.02)
3	0.011(0.40)	0.0015(0.13)	0.006(1.04)	0.007(1.02)	0.0005(0.14)
4	0.017(0.57)	0.011(0.90)	0.006(1.01)	0.008(1.08)	0.006(1.46)
5	0.023(.080)	0.006(0.50)	0.002(0.35)	0.014(1.97)	0.011(2.67)
6	0.037(1.25)	0.003(0.26)	-0.019(-0.33)	-0.001(-0.16)	0.009(2.38)
7	0.004(0.012)	0.0005(0.04)	-0.009(-1.58)	-0.004(-0.64)	0.005(1.15)
8	-0.002(-0.007)	-0.006(-0.54)	-0.001(-0.31)	0.004(0.58)	-0.007(-1.71)
9	0.031(1.04)	-0.017(-1.50)	0.016(2.75)	0.006(0.90)	-0.004(-1.02)
10	-0.129(-4.38)	0.021(1.76)	0.013(2.29)	-0.010(-1.45)	0.002(0.44)
11	0.075(2.52)	0.005(0.45)	0.005(0.85)	-0.013(-1.82)	0.005(1.11)
12	-0.010(-0.32)	-0..019(-1.50)	-0.002(-0.33)	0.006(0.78)	0.009(1.90)
			1986-1991		
0	-0.008(-2.39)	0.012(3.47)	0.011(2.77)	0.010(2.04)	0.012(3.47)
1	0.009(2.02)	0.017(4.10)	0.026(5.11)	0.030(5.70)	0.017(4.10)
2	0.013(3.16)	0.004(0.92)	0.005(1.04)	0.003(0.57)	0.004(0.92)
3	-0.003(-0.78)	0.000(0.00)	0.00(0.00)	-0.0015(-0.26)	0.00(0.01)
4	-0.0002(-0.05)	0.002(0.62)	0.002(0.36)	0.001(0.21)	0.003(0.62)
5	0.004(0.82)	0.004(1.06)	0.008(1.41)	0.003(0.59)	0.004(1.06)
6	0.006(1.28)	0.002(0.59)	0.003(0.58)	0.002(0.36)	0.003(0.59)
7	0.004(0.91)	0.002(0.44)	0.0001(0.02)	0.002(0.29)	0.002(0.44)
8	0.002(0.43)	0.003(0.64)	0.002(0.36)	0.003(0.49)	0.003(0.64)
9	0.004(0.81)	0.002(0.38)	0.003(0.46)	0.002(0.31)	0.002(0.38)
10	0.005(1.23)	0.004(0.93)	0.008(1.55)	0.006(1.09)	0.004(0.93)
11	0.006(1.35)	0.003(0.62)	0.004(0.73)	0.004(0.62)	0.002(0.62)
12	0.01(3.22)	0002(0.07)	0.00(0.02)	0.001(0.38)	0.0002(0.07)

Table 5
F Tests for the Joint Significance of the Coefficients

INT. RATE	1975-1985		1986-1991	
	F test	Prob. (%)	F test	Prob. (%)
TB	1.00	44.7	3.61	0.1
NG	0.90	53.5	1.55	16.8
CG	2.07	3.5	3.94	0.0
DD	1.21	29.0	6.04	0.0
CDB	1.94	4.9	2.28	2.9

In summary, two important qualifications should be emphasized regarding the power of the interaction between money and price in affecting the interest rate. First, the degree of the effect seems to be positively related to the level of inflation that prevailed in Brazil during two different periods. By international standards, although Brazil experienced high rates of inflation before 1985, monetary policy still had some bearing on moderating upward movements in the interest rate during this period, at least for some segments of the financial market. After 1986, with higher inflation rates prevailing, this moderating effect vanished. Second, during the second half of the 1980s, the overnight market seemed more immune to the effect of inflationary expectations than other segments. The increasing importance of this market in allocating savings to the public sector, at the end of the decade of the 1980s, may have reduced the cost of debt financing.[30]

3B The real interest rate: vector autoregression analysis

The real rates of interest, in all segments of the financial market, were very high and volatile, especially after 1985. The investigation of factors that may have affected the real portion of the nominal interest rates seems mandatory to understand the behavior of the interest rate in Brazil. The analysis of the real rates of interest will be conducted by using the Vector Autoregression (VAR) technique.

The seminal paper by Sims (1980) introduced the methodology of Vector Autoregression (VAR) in the study of macroeconomic problems. This sub-section will use the VAR approach to analyze the behavior of the real interest rates. We will maintain the same theoretical

30 For the importance of the overnight market, see Jorgensen (1991). The idea that the government could ameliorate the burden of debt financing by issuing nominal debt was rejected by Garcia (1991).

apparatus we employed in the study of the nominal rates. Our main purpose in this subsection is to investigate how the macroeconomic variables (liquidity, income, and price level) influenced the real component of the rate of interest in different segments of the financial market.[31]

In the vector autoregression approach all the variables are assumed to be endogenous. For each interest rate, consider the vector $\mathbf{Y}_t = (i2_t, m2r_t, y_t, ir_t)$ of four variables that comprise the system being investigated. In this vector, $i2$ is the rate of inflation, $m2r$ is the real level of the money supply, y is the real level of income, and ir is the real rate of interest.[32] With the ordering given by the vector above, we estimated the following system of equations which defines the unrestricted VAR approach.

$$Y_t = \sum_{k=1}^{4} B_t(k) Y_{t-k} + u_t \qquad u_t \sim N(0, \Sigma) \tag{5}$$

The linear dynamic system of equations above states that the model is joint modeled, and that the present value of a variable is determined by four lags of all the variables.[33] A variable for trend was not included because the variables did not present any trend pattern. Since the coefficient matrix $B_t(k)$ is difficult to interpret, the analysis of the VAR was conducted by looking at the variance decomposition of the system and at the impulse response functions.

The decomposition of variance quantifies the relative importance of the variables in explaining the forecast error variance. The results for decomposition of variance were presented in Table 6. The following observations are worth noting. First, among the macroeconomic variables, the inflation rate was the most important factor in explaining monthly forecast variance in the real interest rate in all segments.[34] Second, the importance

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31 Simulations with the inclusion of a variable for credit resulted in lack of explanatory power for the decomposition of the variance, and for that reason credit was not included in the system.

32 In the vector $\mathbf{Y}_t = (i2_t, m2r_t, y_t, ir_t)$ $i2_t$ = rate of inflation measured by I2 (FGV), $m2r_t$ = real level of M2, y_t = index of industrial electrical consumption (IIEC), and ir_t = real rate of interest. The index of industrial production (IIP) in Brazil is poorly surveyed. Also, unlike IIEC, IIP does not capture the informal economy, which is substantial in Brazil. Nonetheless, either choice gave very similar results.

33 Results for a 4 legs and an 8 lags VAR were very analogous. The orthogonalization of the error covariance matrix was made by the Cholesky method. The results we found were very robust for various different ordering of the variables. For some authors, the fact that the results are insensitive to the ordering of the variables does not justify causal interpretations among these variables. See Cooley and LeRoy (1985). See also Sachs (1982) and Sims (1982), for further discussion of this point.

34 With exception of the overnight market for the period 1986-1991, when real M2 was the main factor.

of inflation as an explanatory factor was considerably smaller after 1985. Third, the importance of changes in real M2, as a variable that explains decomposition of forecast error variance, increased after 1985 for all segments. Fourth, the overnight market shows a pattern in the decomposition of the variance that was substantially different from the other segments.

Table 6
Variance Decomposition of the Real Interest Rates

PERIOD		1975-1985					1986-1991				
		S.E.	I2	M2R	Y	I.R.	S.E.	I2	M2R	Y	I.R.
1		2.72	26.24	5.10	0.01	68.65	4.25	7.93	2.00	2.07	87.97
2		3.61	21.97	4.77	0.01	73.25	5.19	5.97	1.41	1.52	91.09
3	TB	3.67	22.18	4.63	0.04	73.14	5.46	5.79	10.06	1.64	82.49
4		3.74	23.90	4.65	0.90	70.55	5.61	6.61	10.20	1.99	81.19
5		3.79	23.34	4.55	2.96	69.16	5.69	7.42	11.26	1.99	79.31
6		3.99	24.55	4.45	4.40	66.59	5.79	7.38	11.59	2.08	78.93
1		1.36	71.20	0.64	0.30	27.85	5.34	4.11	26.72	0.04	69.11
2		1.45	73.81	0.71	0.62	24.84	7.33	2.40	38.95	4.49	54.14
3	NG	1.52	72.43	0.82	0.58	26.17	8.42	2.82	33.73	14.66	48.77
4		1.56	71.77	2.48	0.63	25.11	8.75	2.82	33.27	14.44	49.45
5		1.60	69.39	4.60	0.62	25.37	8.85	2.77	33.85	15.04	48.32
6		1.61	68.20	4.55	0.77	26.47	8.88	2.76	33.62	15.59	48.01
1		0.25	0.93	0.21	4.46	94.39	3.32	12.62	0.73	4.06	82.56
2		0.32	21.84	0.17	4.57	73.41	3.56	16.13	3.75	3.58	76.54
3	CG	0.33	22.29	0.16	4.20	73.35	4.25	12.85	9.96	3.58	73.59
4		0.34	22.31	0.17	4.25	73.27	4.34	12.38	9.73	3.65	74.22
5		0.34	22.35	0.32	4.41	72.91	4.37	12.41	9.75	3.77	74.06
6		0.34	22.70	0.36	4.41	72.54	4.48	13.52	10.52	4.29	71.64
1		0.67	0.63	0.00	0.40	98.97	4.48	1.75	1.67	3.36	93.20
2		0.75	8.86	1.67	0.91	88.54	5.23	4.85	1.37	2.73	91.03
3	DD	0.76	10.45	1.71	1.59	86.23	5.48	9.23	2.40	4.23	84.12
4		0.77	11.14	2.27	1.57	85.00	5.48	10.82	2.64	4.93	81.59
5		0.78	11.72	2.21	2.89	83.17	5.70	10.97	3.37	5.66	79.97
6		0.79	12.07	2.55	2.90	82.46	5.95	12.19	3.12	5.69	78.98
1		0.36	3.89	0.01	1.67	94.42	2.74	12.87	0.72	3.57	82.82
2		0.47	30.19	0.01	1.14	68.65	2.99	11.50	4.69	3.03	80.77
3	CDB	0.49	34.45	1.16	1.43	62.96	3.48	8.82	6.35	7.06	77.74
4		0.49	35.62	1.26	1.40	61.72	3.61	8.58	5.92	6.85	78.64
5		0.50	35.15	1.26	1.91	61.67	3.66	8.52	5.75	7.04	78.67
6		0.50	35.16	1.38	1.91	61.54	3.71	8.93	5.91	6.85	78.28

Note: S.E.=standard error, I2=inflation, M2R=money supply, Y=income, and IR=interest rate.

The impulse response function traces the response (current and future) of a variable of separated one standard deviation shock of each variable that comprises the system. Figure 5 depicts the impulse response functions for six months ahead, of separated shocks on inflation, growth of real money stock of M2, and real income. The response patterns following a shock were as follows. First, the responses for the first month after the shock had been implemented were as expected. A shock in prices and income increased the real interest rates while a shock in real M2 decreased the real interest rates. Second, although the volatility of the response was common to all five segments, the responses after the first month varied considerably in intensity and direction depending on the segment. Third, by looking at the y-axis, it is clear that the intensity of the response was substantially higher after 1985. Some interpretations of these results and of the results for the nominal interest rate will be given in the next section.

4 Interpretations and implications

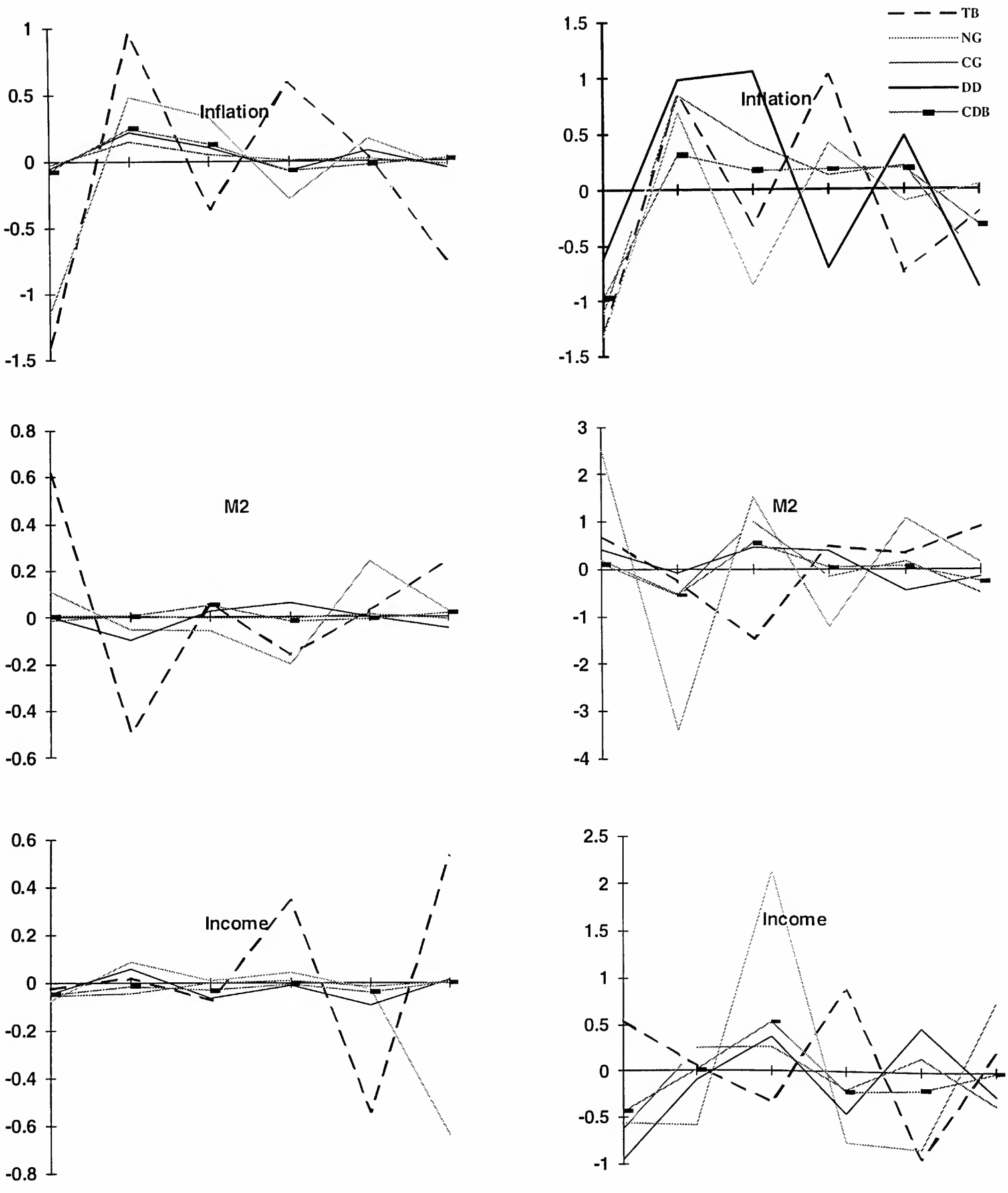
This section will elaborate on three different issues. Firstly, there is an attempt to compare the results we obtained in Section 3 with the prediction of the monetarists and views of the rational expectation school. Secondly, the section pursues the interpretation of those results in the light of two 'ad hoc' factors. It brings the role played by risk and segmentation in explaining some of the main findings. These two issues are presented in sub-section 4A. Thirdly, we elaborate on the implications of these results for the efficacy of the monetary policy in general, and for the functioning of the monetary mechanism in particular. This is briefly stated in sub-section 4B.

4A Interpretations

The understanding of the relationship between the interest rate and macroeconomic variables in the long run, in an environment of a closed economy, was the main concern of the preceding sections. Although the money supply implicitly incorporates external capital movements, the effective roles that these movements and the exchange rate policy may have played on the determination of the interest rate, have not been addressed in this paper. They were excluded not because they were considered secondary, but for methodological reasons.[35]

35 A positive net capital inflow would exert a downward pressure on the interest rates by increasing the supply of credit. The exchange rate policy would determine the return of foreign exchange denominated assets, and would serve as a benchmark for the interest rate in other segments of the financial market.

Figure 5
Impulse Response Functions of the Real Interest Rates to Shock on Inflation, Real M2, and Real Income



The understanding of the timing pattern of money and the interest rate in an environment of changing inflationary regimes was considered one of the central themes of our analysis. Moreover, we emphasized that the interpretations of our findings should take into consideration some features of the financial market in Brazil.

A positive relationship between money supply and the interest rate prevailed in most of the segments of the financial market. It is worth noting that this upside down Cagan-Gandolfi curve without a tail end cannot be fully explained by the monetarist view. If there is a positive relationship between money growth and the interest rate, the notion that monetary policy is non-neutral in the short run should not be accepted. This non-neutrality comes from the fact that higher market interest rates following monetary expansion, either from credit and non-credit sources, cannot have a positive effect on income.

On the other hand, the rational expectation amendment that only unexpected money-growth is non-neutral has its pitfalls in interpreting our results. First, the concept of anticipation of money supply is difficult to hold in the Brazilian financial system. If the money supply is endogenous, as we have described, it may not have any characteristic of anticipation, in the way anticipation is defined in a setting with an independent central bank. For this reason, the characterization of monetary policy as anticipated or not, in the context of the Brazilian economy, may be inappropriate. Second, it is also difficult to accept that the economic agents, including the banking system, have the sophistication (technical and informational) to monitor the behavior of the money supply. Third, and more importantly, the positive pattern curve response does not allow room for non-neutrality even for the unexpected money growth.

Some understanding of the interest rate puzzle was achieved by our partial results regarding the effects of inflation on the relationship between money and the rate of interest. Although monetarism has emphasized that the liquidity effect would be weakened, or even irrelevant, in an economy with high rates of inflation, the positive pattern we found is an overshooting of this view. Prices were moving faster than money.[36] Under these conditions, the economic agents will consider inflation rather than money growth as the relevant information. Besides, in economies of the developing world, information regarding prices is more credible and easier to obtain and to interpret. The banking system will not raise interest rates if they expect forthcoming monetary tightness. Instead, they will look at the expected inflation. This pattern would be more prevalent if the money supply adjusted passively, like in Ultra-Keynesian models. In Brazil, the passivity of the money supply has been recognized in several studies.[37]

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36 For an empirical analysis of this point see Rossi (1991).

37 See Tobin (1970), for an elaboration on Ultra-Keynesian models. For the studies about the passivity of the money supply see Footnote 10.

The effect of prices on the relationship between money and the interest rate became more acute after 1986, when the inflation rates were higher and more volatile. Hence, the money supply was even more ineffective in influencing the interest rate, thereby causing the real rates to become remarkably higher. One channel in which increasing prices may undermine liquidity stances is through the risk associated with macroeconomic conditions.[38] Under the scenario of high and accelerating prices, expectation of higher prices would increase not only the nominal rate, but the real rate as well. An explanation for higher real rates could be found in the concept of risk premium, which is closely associated with the studies of the term-structure of interest rates. High and accelerating inflation would increase the overall risk of the economy, forcing the financial system to incorporate it in the form of higher risk premium and, consequently, higher real rates.[39] This component of risk would be incorporated mostly because of higher prices, but with a loose connection to the tightness of the money supply. Nevertheless, the results for the primary and secondary markets did not give total support for this argument. After 1986, on average, the real rates of interest were lower and the correlation between inflation and the real rates smaller. The market interest rates were much higher after 1986, but only the segment of short-run credit showed a considerable increase in the correlation between inflation and the real interest rate. The incorporation of a risk premium associated with inflation into the real rates varied considerably among different segments. In general, the market lending rates were more prone to this process.[40]

The existence of weak linkages between government interest rates and market rates in the Brazilian financial market was confirmed in many of our results. One important result was the asymmetric response of the secondary market for government securities or the overnight repurchase market. We found substantial liquidity effect in the overnight market which somehow resulted from the fact that this market was shielded from the Fisher effect. The reasons for this unique behavior seem complex. Some light was shed by our analysis of the real rates of interest where we showed that, after 1986, a large part of the variance

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38 Irving Fisher explored the effect of risk on the interest rate in what he called "Third Approximation" of the interest rate theory. He also recognized the difficulty in measuring economic risks.

39 Borrower's creditworthiness collapses owing to deteriorated macroeconomic conditions, which will set a wedge between cost of funds for the banks and the collateral. See Gertler (1991), which cited Irving Fisher on this line of thought.

40 For the period of moderate rates of inflation (1975-1985), the contemporary correlations between real rates of interest and inflation were the following: TB = -0.176, NG = - 0.299, CG = 0.299, DD = 0.254, and CDB = -0.145. For the period of high and volatile inflation rates (1986-1991), the correlations switched to the following values: TB = -0.498, NG = -0.259, CG = 0.105, DD = 0.440, and CDB = -0.119. Some scholars argue that we should not accept timing evidence as an empirical proof of propositions about causation. See Tobin (1970), and Friedman (1970). Moreover, any empirical test linking risk premium with higher real rates has to come up with a comprehensive measure of risk associated with various macroeconomic conditions. Here we have just considered inflation rates.

decomposition was explained by the real growth of the money supply. With a fast growing money supply, and higher inflation rates, lending to the overnight market would produce the best combination for reduced risk with higher liquidity, which can be translated into lower real rates.[41] A sharper impulse response function of the overnight market, for changes in real money, also confirmed the findings for the variance decomposition. The belief that the targeting of the real interest rate in the overnight market would constitute an adequate instrument of monetary policy may be misleading under these circumstances.[42]

4B Implications

The set of results we have encountered may have some bearing on the monetary transmission mechanism. By linking the monetary and the real side of the economy, the interest rate is considered a key variable in the monetary transmission mechanism. The effectiveness and nature of the transmission mechanism should be taken into account for the optimal conduct of monetary policy. The implications of our findings for the monetary transmission mechanism may be sizable. First, the overnight repurchase market represents a close substitute for money. As Tobin and Brainard (1963) argued, "*the possibility of substituting intermediary liabilities for currencies offers a partial escape from monetary restriction. But so long as the intermediary liability is an imperfect substitute for currency, the escape is only partial.*" In the case of Brazil, the overnight market is almost a perfect substitute. The presence of this quasi-perfect money substitute dampens the liquidity effect considerably. Second, the process of investment in the private sector is distorted by the existence of segmentation. Portfolio decisions will reflect concerns only with the short term and capital formation is discouraged. Third, the adjustment of interest rate structure among all segments, which constitutes the core of the monetary transmission mechanism, will also affect wealth allocations between real and financial assets. As we mentioned before, the shrinking pool of loans to the economy due to disintermediation for the overnight market may allocate resources to real assets sub-optimally. Moreover, the variability of results for impulse response functions for different segments may suggest that the adjustment of the interest rate structure is slow and perhaps imperfect, especially if the economy is experiencing high inflation rates.

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41 For a discussion of the argument that lower rates in those markets were due to a premium for higher liquidity, see Guidotti and Kumar (1991).

42 See Clifton (1990), for a macro model of interest targeting for Brazil. His model concluded that although the targeting of the real interest rate in the overnight market would allow the economic agents to calculate the conditional expectation of the next period price level, it would not permit the monetary authority to exercise control over the price level over the long run. Our results indicated that this short-run effectiveness has not influenced the real interest rates in other segments of the financial market.

One important point not yet investigated in the Brazilian economy relates to the role that the overnight repurchase market for government securities has played in the liquidity of the economy in the short term, and in absorbing private savings, and consequently reducing credit to the private sector in the long term. It seems that the total amount transacted in this market has been growing exponentially and may have constrained lending in other segments of the market.[43] The reduced quantity of credit available in the banking system, due to the increased role played by the repurchase overnight market, may have raised the market interest rates relative to the overnight rate. The gap would prevail due to the process of segmentation, which we analyzed in previous studies.[44]

Our approach did not investigate the demand side of the economy and its possible impact on the real rates. Basic tastes and technology may have changed considerably during the 1980s. This would exert an upward pressure on the demand side, which may have had considerable effect on the interest rates beyond those determined by money and prices alone. Our own evidence has pointed in the direction that change in real income was a trivial proportion of the real interest rate variance decomposition in all segments of the financial market. Nevertheless, these findings do not discharge the importance of changes in preferences and production conditions.

5 Concluding remarks

The high levels of market interest rates that prevailed in Brazil during the 1980s had a positive relationship with lagged values of monetary expansion. This was documented by an inverted Cagan-Gandolfi curve. This occurrence represents a departure from the rational expectation approach and an overshooting of the monetarist view. We found that this behavior was more prevalent under higher inflationary regimes, which is an indication of the presence of the Fisher effect. It is important to assert that although the directions of the responses were uniform among the segments of the private financial market, they varied quantitatively.

43 See Jorgensen (1990), for some figures about the size of this market.

44 See Blumenschein (1995).

On the other hand, the responses of the overnight repurchase contract market have confirmed the presence of the liquidity effect. Moreover, inflation had little or no influence on the timing pattern of money and the interest rate in this segment. These results indicate that the linkages between the overnight market and other segments are far from perfect. The market rates of interest can react differently and consequently behave differently at least in the short term.

It is important to notice that, besides the existence, as well as the strength, of each type of effect we investigated, the speed of the response may determine the neutrality of a monetary shock. In this regard, some considerations have to be given to factors, or scenarios, that affect the pace of the response. Some theories give emphasis to the formation of rational expectation as a factor accelerating the response. Nonetheless, little emphasis has been given to high rates of inflation, or to the structure of the financial market, as important causes of overreaction. These factors may contribute substantially to the neutrality of money, especially for economies of the developing countries.

One implication of our investigation is that the government lost one important policy tool. Monetary policy stances, either by monitoring monetary aggregates or by targeting the interest rate in the overnight market, have low effectiveness in affecting market interest rates. Hence, stabilization programs cannot count on monetary policy, at least in the short term.

Another important implication is related to the monetary transmission mechanism and, consequently, capital formation and economic growth. Imperfect and slow adjustment in the structure of the interest rate coupled with flight from productive real assets may have had substantial effect in diminishing investment in the long term.

References

Análise Financeira. *A taxa de juros no Brasil.* Edição Especial. São Paulo: Nova Análise Editora Ltda, 1991.

Apecão. *A economia brasileira e suas perspectivas*. Rio de Janeiro: Edições Apec No. XXX, 1991.

Blejer, Mario. Money and the nominal interest rate in an inflationary economy. *Journal of Political Economy* 86, p. 529-34, June 1978.

Blumenschein, Fernando. *Essays on macroeconomic policy and the institutional framework of the financial market in Brazil.* Ph.D. Dissertation, Cornell University, 1994.

_____. A integração do mercado financeiro brasileiro durante o período 1978/90. *Pesquisa e Planejamento Econômico* 25, p. 449-78, dezembro 1995.

Cagan, Phillip. *The channels of monetary effects on interest rate.* New York: Columbia University Press, 1972.

Cagan, Phillip and Gandolfi, Arthur. The lag in monetary policy as implied by the time pattern of monetary effects on interest rate. *American Economic Review, Paper and Proceedings* 59, p. 277-84, May 1969).

Clifton, Eric V. Real interest rate targeting: an example from Brazil. *International Monetary Fund, Working Paper No. 111*, 1990.

Cochrane, John H. The return of the liquidity effect: a study of the short-run relation between money growth and interest rates. *Journal of Business and Economic Statistics* 7, p. 75-83, January 1989.

Colomiris, Charles W. and Domowitz, Ian. Asset substitution, money demand, and the inflation process.*Journal of Money, Credit, and Banking* 21, p. 79-89, February 1989.

Conard, Joseph W. *An introduction to the theory of interest rate.* Los Angeles: University of California Press, 1959.

Cooley, Thomas F and LeRoy, Stephen F. Atheorectical macroeconomics. A critique. *Journal of Monetary Economics* 16, p. 283-308, November 1985.

Davidson, Russell and MacKinnon, James G. Several tests for model specification in the presence of alternative hypothesis. *Econometrica* 49, p. 781-93, May 1981.

Dornbusch, Rudiger, Sturzenegger, Federico and Wolf, Holger. Extreme inflation: dynamics and stabilization. *Brookings Papers on Economic Activity,* p. 2-84, 1991

Fisher, Irving. *The theory of interest rate*. New York: The Macmillan Company, 1930.

Friedman, Milton. The role of monetary policy. *The American Economic Review* 58, p. 1-17, March 1968.

_____ Comments on Friedman. *Quarterly Journal of Economics* 84, p. 318-27. May 1970.

Friedman, Milton and Schwartz, Anna J. *Monetary trends in the United States and the United Kingdom. Their relations to income, prices, and interest rates, 1867-1975*. Chicago and London: The Chicago University Press, 1982.

Garcia, Marcio G. P. *The formation of inflation expectation in Brazil*. Ph.D. Dissertation. Stanford University, 1991.

Gertler, Mark. Financial structure and aggregate economic activity: an overview. *Journal of Money, Credit, and Banking,* 20, p. 559-88, August 1988, Part 2.

Guidotti, Pablo E. and Kumar, Manmohan S. Domestic public debt of externally indebted countries. International Monetary Fund, *Occasional Papers* N° 80, June 1991.

Hanson, James A. The short-run relation between growth and inflation in Latin America: a quasi-rational or consistent expectation approach. *American Economic Review* 70, p. 972-89, December 1980.

Jorgensen, Erika. Domestic public debt in Brazil: a descriptive analysis with policy implications. The World Bank, May 1990, *mimeo*.

Khor, Hoe E. and Rojas-Soarez, Liliana. Interest rate in Mexico. The role of exchange rate expectations and international creditworthiness. International Monetary Fund, *Staff Papers* 38, p. 850-71, December 1991

Lees, Francis A., Botts, James M. and Cysne, Rubens P. *Banking and financial deepening in Brazil*. New York: St. Martin's Press, 1990.

Lutz, Friedrich A. *The theory of interest rate*. Chicago: Aldine Publishing Company, 1968.

Mehra, Yash. Inflationary expectations, money growth, and the vanishing liquidity effect of money on interest: a further investigation. Federal Reserve Bank of Richmond, *Economic Review* 71, p. 23-35, March/April 1985.

Melvin, Michael. The vanishing liquidity effect of money on interest: analysis and implications for policy. *Economic Inquiry* 21, p. 188-202, April 1983.

Poole, William. Book Review. *Journal of Political Economy* 80, p. 665-68, May/June 1974.

Rossi, J. W. Oferta monetária, nível de atividade econômica e inflação. *Revista Brasileira de Economia* 45, p. 91-103, janeiro/março 1991.

Sachs, Jeffrey D. Comments. *Brookings Papers on Economic Activity,* p. 157-62, 1982.

Sims, Christopher A. Macroeconomics and reality. *Econometrica* 48, p. 1-48, January 1980.

_____ Policy analysis with econometric models. *Brookings Papers on Economic Activity,* p. 107-67, 1982.

Stokes, Houston H. and Neuburger, Hugh. The effect of monetary changes on interest rates: a Box-Jenkins approach. *Review of Economic and Statistics* 61, p. 534-48, November 1979.

Sundararajan, Vasudevan, and Balino, Tomas J. T. *Banking crises: cases and issues*. Washington D.C.: International Monetary Fund, 1991.

Tanner, J. Ernest. Are the lags in the effect of monetary policy variable? *Journal of Monetary Economics* 5, p. 105-21, January 1979.

Thornton, Daniel L. The effect of monetary policy on short-term interest rate. Federal Reserve Bank of St. Louis, *Review* 70, p. 53-72, May/June 1988.

Tinsley, P. A. An application of variable weight distributed lags. *Journal of the American Statistical Association* 62, p. 1277-89, December 1967

Tobin, James. Money and income: post hoc ergo propter hoc? *Quarterly Journal of Economics* 84, p. 310-17, May 1970.

Tobin, James and Brainard, Willian. Financial intermediaries and the effectiveness of monetary controls. *American Economic Review, Papers and Proceedings* 53, p. 383-400, 1963.