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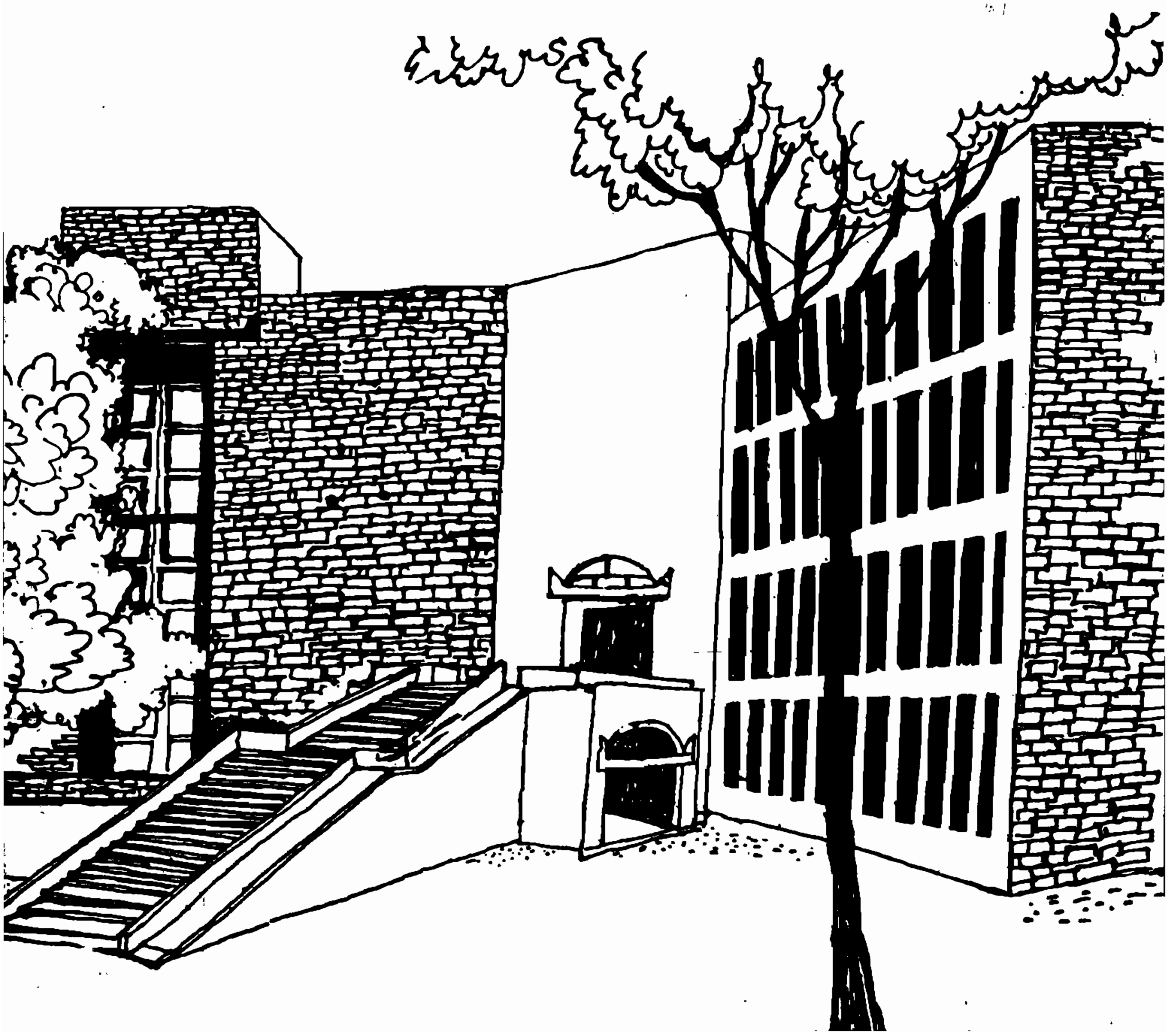

Examination of the Credit Channel of Monetary Transmission in India

Results from Response of Commercial banks' Balance Sheet to a Monetary Policy Shock

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Examination of the Credit Channel of Monetary Transmission in India:
Results from Response of Commercial Banks' Balance Sheet to a Monetary Policy Shock

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Examination of the Credit Channel of Monetary Transmission in India:
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In this study I present some evidence on the credit channel of monetary transmission in India. Using the set up of Bernanke and Blinder (1992) it is found that loans, investments and deposits of commercial banking system respond significantly to a monetary policy shock. Results to a positive shock to monetary base are as expected. Investments respond almost immediately and then taper whereas deposits permanently settle at a higher level. Loans respond more slowly and are seen to move contemporaneously with output after a lag of 8-12 months

I. Introduction

After in a series of studies Bernanke recorded empirical support for the credit channel of monetary transmission for the US[1] the 'credit view' has come to be accepted as key to explaining the transmission of monetary policy[2]. While Oliner and Rudebusch (1996) dismiss this role altogether, Bernanke (1993) and Kashyap and Stein (2000) show that in addition to affecting short term interest rates, monetary policy affects output by affecting the availability of new loans.

As a recent annual report of the Reserve Bank of India (RBI Annual Report, 1999-2000) notes, in India, the transmission channels of monetary policy have been influenced by gradual liberalization of the financial markets, steady diffusion of financial innovations, increasing exposure of corporate and financial sectors' balance sheets to market, and growing trade and financial integration between domestic and international markets. Using alternative frameworks, studies by the Reserve Bank of India (RBI)[3] suggest that credit channel is extremely relevant in analysing the transmission of monetary policy in India.

This study offers some additional evidence on the credit view in the Indian context following the methodology of Bernanke and Blinder (1992). In particular, VAR specifications are employed to model the response of balance sheet variables of the

[1] Bernanke (1983) and Bernanke and Blinder (1988, 1992) among others
[2] see Bernanke and Gertler (1995) and Kashyap and Stein (200)
[3] see Joshi and Bhattacharya (1999) and Mishra (2003)

commercial banks (bank credit, investments and loans) to exogenous shocks to policy variable.

All of this, of course, is contingent on the assumption that either monetary base or the call rate responds elastically to changes in the other. Or, in other words, if monetary base is indeed a measure of policy stance, it should be unresponsive to contemporaneous changes in the money market interest rates and vice versa, i.e. given its 'targeted' level (or growth rate) of reserve money, the central bank does not respond to short term interest rates[4].

Following Bernanke and Blinder (1992), exercise in VAR is an attempt to study the dynamic effects of monetary policy on the balance sheet of commercial banks. If the credit view is indeed 'true', commercial banks' balance sheet variables should respond to changes in policy variables, to the extent these changes are exogenous and do not react to contemporaneous changes in non-policy (economic) variables.

Although, RBI has declared that it is using base money as its operating target for monetary policy, it is important to check for the exogeneity (in the sense of Engle, Hendry and Richard, 1983) of monetary base to changes in short term interest rates (and vice versa) before the response of balance sheet variables to changes in the appropriate policy indicator can be assessed. The problem is essentially of identification. For either variable to be a good measure of policy stance, it must be unresponsive to contemporaneous changes in the other.

The plan of the study is as follows. After a brief discussion of the credit view in **Section II**, in **Section III** I perform exogeneity tests to determine the appropriate indicator of policy stance of monetary policy, which is uncorrelated with contemporaneous changes in non-policy variables. In **Section IV** I empirically assess the credit channel of monetary policy transmission by evaluating the response of commercial banks' balance sheet

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[4] In the Indian context the problem is complicated by sterilization in face of growing short term capital inflows - especially in the recent times (see D'Souza, 2003)

variables to changes in the policy variable. **Section V** concludes with a brief discussion of results.

II. The Credit View

The credit view rests on the assumption of asymmetric information and imperfect substitutability of loans and securities[5]. Expertise of financial institutions enable them to extend loans to agents who cannot get loans in open market – because of expensive screening and evaluation. Thus, in the words of Bernanke and Blinder (1992)

"*...when the Federal Reserve reduces the volume of reserves,* argue, *and therefore of loans, spending by customers who depend on bank credit must fall, and therefore so must aggregate demand.*[6]"

Also, because of lack of perfect substitutability between loans and securities, a fall in reserves leads to a decline in loans, and thereby aggregate demand, albeit with a lag. Infact, as Bofinger (2001) quotes Kashyap and Stein (2000),

"*...the effect of monetary policy on banks' loan supply schedules is on top of any increase in there in interest rate on open market securities such as Treasury Bills.*[7]"

Bofinger criticizes the credit view saying that it subsumes that the effect of increase in refinancing rate of the central bank has mutually exclusive effects on the interest rates and the availability and terms of new bank loans. However, this is because of the price theoretic model of money supply that Bofinger (2001) uses, in which

"*...the reduction of reserves goes hand-in-hand with an increase in the central bank refinancing rate.*[8]"

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[5] see Blinder and Stiglitz (1983) and Bernanke and Gertler (1995)

[6] B. Bernanke and A. Blinder "The Federal Funds Rate and Channels of Monetary Transmission," *American Economic Review*, 82, 4, p. 901

[7] P. Bofinger, *Monetary Policy: Goals, Institutions, Strategies and Instruments*, OUP, Chapter 4, p. 86

[8] Bofinger, *op cit* Chapter 4, p. 90

In the standard multiplier analysis of money supply, the 'macroeconomic market for money' is totally absent. By introducing a market for credit in which banks maximize return on their portfolio, the credit view is already incorporated. Thus, the value of price theoretic model of money supply of Bofinger (2001) is *because* of the credit channel and not despite it.

III. Which 'Policy Variable'?

To measure the response of the balance sheet variables of the commercial banks we need an indicator of policy stance which is uncorrelated with contemporaneous shocks to the money market.

We adopt three approaches, none of which perfect in their own right, but when seen together would give a clue as to the more acceptable policy variable of call rate and monetary base. Our sample, as in other models estimated in the study, is the period between April 1992 and March 2002, i.e. a 10 year data sampled at monthly frequency.

- *Simple Regression/Correlation Analysis*

As a first indicator we look at the contemporaneous correlation between adjusted monetary base and the call rate, i.e. we estimate the following regressions i.e. with call rata and monetary base in both levels and first differences after adjusting for serial correlation and heteroskedasticity in the residuals. Results are presented below. In all cases the coefficient of r is quantitatively zero with a negative sign. Thus, if we ignore endogeneity problem for the time being, simple contemporaneous correlation analysis tells us that monetary base does not respond to levels or innovations in the call rate.

Case 1: $b_t = \alpha + \beta r_t + \varepsilon_t$		
	Coefficient	Pr > |t|
Intercept	11.55	<0.0001
r (call rate)	**-0.000078**	**0.7462**
AR1	-1.0125	<.0001
ARCH0	0.0000472	0.0853
ARCH1	0.4026	0.0069
GARCH1	0.5093	0.0016
Case 2: $\Delta b_t = \alpha + \beta r_t + \varepsilon_t$		
	Coefficient	Pr > |t|
intercept	0.0154	<0.0001
Δr (call rate)	**-0.000318**	**0.0479**
AR1	0.2623	0.0128
AR2	0.2619	<.0001
ARCH0	0.0000923	0.0026
ARCH1	0.8903	0.0027
GARCH1	0.0328	0.7283
Case 3: $\Delta b_t = \alpha + \beta \Delta r_t + \varepsilon_t$		
	Coefficient	Pr > |t|
intercept	0.0126	<0.0001
Δr (call rate)	**-0.000139**	**0.5316**
AR1	0.2212	0.0243
AR2	0.2343	<.0001
ARCH0	0.0000776	0.0112
ARCH1	1.0664	0.0013
GARCH1	0.0320	0.7517

- *Weak Exogeneity Tests*

The second test we employ is to test for exogeneity (in the sense of Engle, Hendry and Richard, 1983) of monetary base to call rate. This we analyse in a VAR framework. Essentially we look for cointegration between monetary base and call rate and check for weak exogeneity by imposing restrictions on the vector of adjustment coefficient. The disadvantage of this approach is that although call rate is a unit root process going by the conventional Dickey Fuller type tests, as shown by Virmani (2004), using tests with better size adjusted power properties in small samples, call rate is stationary.

Selecting lag length using AIC and BIC, a VAR with three lag of each was specified. Both Trace test and maximum Eigen value tests pointed towards one cointegration vector. Results are given in table below:

Determination of Reduced Rank

	H0: r = 0	H0: r <= 1
Trace Statistic	**23.97 (15.34)***	0.54 (3.84)
Maximum Eigen Value[9]	**23.43 (14.07)***	0.54 (3.76)

** - Significant at 5% (Critical values given in parentheses)*

Given that there exists one cointegration vector we can test for weak exogeneity of the two variables with respect to other. Estimation using Johansen's procedure allows for a Chi-square test of restriction on the row of the adjustment coefficient vector

Weak Exogeneity Test

Variable	Chi-square Probability
r	**<0.0001***
b	0.1135

Thus, while adjusted monetary base is weakly exogenous to call rate, vice versa is not true. Though, results from this test also are only indicative and cannot be relied upon outright, they still point towards a plausible exogenous policy variable in monetary base.

The above VECM (3) can be given the following VAR representation:

$$\begin{bmatrix} b_t \\ r_t \end{bmatrix} = \begin{bmatrix} 0.55 & -0.0042 \\ -20.88 & 0.47 \end{bmatrix} \begin{bmatrix} b_{t-1} \\ r_{t-1} \end{bmatrix} + \begin{bmatrix} 0.07 & 0.00012 \\ -0.29 & 0.017 \end{bmatrix} \begin{bmatrix} b_{t-2} \\ r_{t-2} \end{bmatrix} + \begin{bmatrix} 0.37 & -0.0002 \\ 20.39 & 0.098 \end{bmatrix} \begin{bmatrix} b_{t-3} \\ r_{t-3} \end{bmatrix} + \varepsilon_t$$

Note that coefficient of all lagged *r* terms in the above equation are quantitatively not any different from zero.

[9] Alternative in case of Maximum Eigen Value test is closed-ended; i.e. H1: rank = r + 1

➢ *The Supply/Demand of Bank Reserves: The Monetary Base/Call Rate Schedule*

The final test we employ is similar to the one performed by Bernanke and Blinder (1992). They argue that for monetary base/funds rate to be an indicator of monetary policy actions, changes in monetary base/short rate should be unresponsive to contemporaneous changes in short-term liquidity conditions/reserve demand. Econometrically, the problem is of identification of the monetary base/call - rate schedule

They look at the correlation in innovations between the funds rate and monetary base from a five variable VAR comprising three macroeconomic indicators each, reserves and funds rate, i.e. they look for information in leading macro indicators as an instrument to provide 'identify' the slope of the reserves/funds rate schedule. In this study we employ a VAR comprising IIP, adjusted monetary base, call rate and the price level with lag length of four, selected using Sims' (1980) Likelihood Ratio test criterion.

Although, true, as Bernanke and Blinder argue, typically a central bank will have much more information than just on IIP (in the Indian case), so that may effect RBI's decision on monetary base, leading to possible endogeneity problem. However, we are constrained for lack of availability of high frequency data on leading economic indicators in the Indian context, and must content ourselves with only partial evidence on contemporaneous correlations in innovations in call rate and monetary base.

Below we report results from innovations in call rate and monetary base from the four variable VAR. We look at the correlation in innovations and estimate the slope of innovations in monetary base on innovations in call rate using the Generalized Method of Moments with innovations in IIP and innovations in call rate as instruments.

➢ *Correlation in Innovations: Simple Regression*

$$\Delta e_b = \alpha + \beta \Delta e_r + \varepsilon_t$$

	Coefficient	Pr > |t|
intercept	-0.000019	0.9850
Δe_r (call rate innovations)	**-0.000862**	**-2.35**
AR1	0.0433	0.7277
AR2	0.0499	0.4389
ARCH0	0.000113	<.0001
ARCH1	0.5375	0.0059

➢ *Correlation in Innovations: Instrument Variable Estimation (GMM)*

$$\Delta e_b = \alpha + \beta \Delta e_r + \varepsilon_t$$

	Coefficient	Pr > |t|
intercept	0.000169	0.8988
Δe_r (call rate innovations)	**-0.00078**	**-2.21**

It is clear from all estimations above, notwithstanding their limitations, that (change in) monetary base is not contemporaneously correlated with call rate or its innovations. Thus, monetary base presents itself as an appropriate policy variable to measure the stance of the central bank.

IV. Examination of Credit Channel of Monetary Transmission

The balance Sheet data for our VAR analysis for credit route of monetary transmission is obtained from Schedule 3 of the monthly RBI Bulletin. We use the item called *Aggregate Deposits* (item no. 5 in the Schedule) for deposits, the item called *Bank Credit* for loans, and the item *Investment* for securities. In particular, we estimate the following VARs (with exogenous variable, adjusted monetary base coming *first* in the autoregression):

- A 5-variable VAR comprising *real* adjusted monetary base, deposits, investments, loans and output (i.e. all deflated by price level, in this case WPI)
- A 6-variable VAR comprising *nominal* adjusted monetary base, deposits, investments, loans, output and the price level

Instead of using IIP to proxy income we use monthly output series created by Virmani and Kapoor (2003). The series in that study is provided till March 2000. We extend the series till Mar 2002 using regression based extrapolation. In particular we specify a regression function for each month as a function of the quarter to which it belongs and time. From the same study we have roughly 17 years of monthly and quarterly data. Then, given the quarterly estimates from CSO for the period from April 2000 to March 2002, we can get the estimates of monthly output for the entire sample period. All variables enter in their natural logarithm.

The results of interest from this VAR analysis is the dynamic effect of a shock to monetary base on deposits, investments, loans, and output. This can be best seen by looking at the impulse response function of the variables to a shock to monetary base.

Results are reported for lag lengths 1, 2, 4, and 6. See **Exhibit 1**. For lack of degrees of freedom, results from higher order VARs would be unreliable, although we did notice that results from higher order VAR followed the pattern of the corresponding lower order VARs with the difference that impulse response from the former were more erratic.

All estimations in the study were carried out using MATLAB using 'vare' and related procedures available in Prof. LeSage's econometric toolbox.

The plots represents a standard (Cholskey) decomposition based impulse response functions (IRFs) to a positive one standard deviation shock to monetary base over a horizon of 24 months.

From the IRFs it is apparent that easy money policy does cause the level of deposits to go up whether we consider in 'real' or 'nominal' terms. The effect to shock in deposits is almost instantaneous with saturation levels reaching around the 12 month mark, and from there on appears to be permanent.

Now for increase in liabilities of the commercial banking sector, the asset side too must get affected. While rise in investments (in G-Secs and other approved securities) is more steep compare to rise in loans, with time (around the 5 – 8 month mark) investments taper off and in some cases note that they 'return' to their normal level while loans settle at a higher level.

Thus, the first effect of increase in deposits is higher level of investment in securities, and a gradual rise in loans over time. This should be expected because changing the portfolio at the long end, especially as regards to claims, involves screening and entering into long-term contracts, and thus loans take a longer time to show effect.

The effect on output is quite surprising. Unlike what one would expect, easy money causes the output in nominal terms to increase almost instantaneously, while in real terms response from VARs does not present any clear cut picture. Though, the fall around 2-3 months after is seen in all cases. Except for VAR(1) in real terms, when it is seen to rise monotonically – though this is unlikely to be the case because output is seen to settle permanently at a higher level. In most other cases, output rises initially, adjusts, and in around 8 – 12 months settle to the normal levels. The instantaneous effect is a sign that monetary policy does have quite a strong effect on the real sector in the short-run.

The other thing that one finds – which is similar to what Bernanke and Blinder (1992) notice for the U.S. in their study – is the co-movement in loans and output after around 8 – 11 months to a monetary base shock.

V. Conclusion

We find strong evidence in favour of credit channel of monetary transmission. First we note that monetary base is contemporaneously uncorrelated with call rate using alternative tests, and thus we chose monetary base as an indicator of policy stance of the central bank. Then analysing the balance sheet of the commercial banking system as a whole we find that claims and output move together after economy has adjusted to the 'first-round' effects of policy induced. shocks. This is significant as it shows that claims form an important channel of monetary policy transmission and that as also shown by Joshi and Bhattacharya (1999) and Mitra (2003) credit channel is quite potent in the Indian context.

References

Bernanke, B. (1983) Non-monetary aspects of the Financial Crisis in the Propagation of Great Depression," *American Economic Review,* June, 73, 257-76

Bernanke, B. and Blinder, A. (1988), "Credit, Money And Aggregate Demand," *American Economic Review,* May (Papers and Proceedings), 78, 435-39

Bernanke B.S. and Blinder, A.S. (1992), "The Federal Funds Rate and the Channels of Monetary Transmission", *American Economic Review,* 82, 4, pp. 901-927

Bernanke, B. S. and Gertler, M. (1995) "Inside the Black Box: The Credit Channel of Monetary Transmission", *Journal of Economic Perspectives,* 9, vol. 9, 1995, Issue 4, pp. 27-50

Blinder, A. and Stiglitz, J. (1983) Money, Credit Constraints and Economic Activity, *American Economic Review,* May (Papers and Proceedings), 73, 297-302

Bofinger, P. (2001), *Monetary Policy - Goals, Institutions, Strategies, and Instruments*, OUP

D'Souza, E. (2003) "What is Monetary Policy Doing," *Economic and Political Weekly,* February, 22, 821-823

Engle, Robert F & Hendry, David F & Richard, Jean-Francois, 1983. "Exogeneity," *Econometrica*, vol. 51(2), pages 277-304, March

Johansen, S. (1988), "Statistical Analysis of Cointegrating Vectors," *Journal of Economic Dynamics and Control,* 12, 231-254

Joshi and Bhattacharyya (1999), "The Dynamics of Money Supply process in India: An Analytical Framework", *RBI Occasional Papers*, 20, 2, Monsoon, pp. 223

Kashyap, Anil K., and Jeremy C. Stein (2000), "What Do a Million Observations on Banks Say about the Transmission of Monetary Policy", *American Economic Review*, 90 (3), 407-28

Mishra, S. B (2003), "Analytics of Credit-Output Nexus in India," *RBI Occasional Papers,* 24, Summer and Monsoon, 145-171

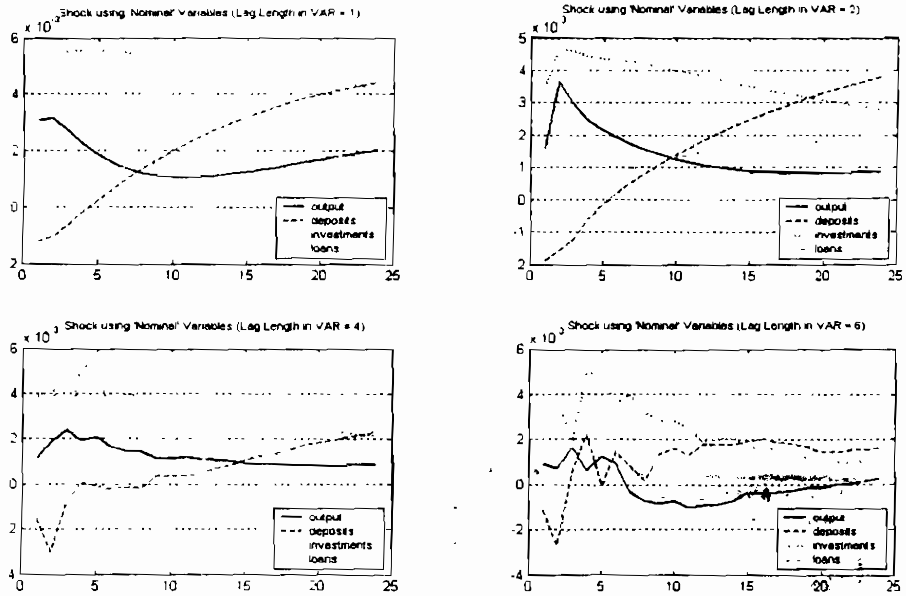
Oliner, S. and Rudebusch, G. (1996), "Is there a Broad Credit Channel for Monetary Policy", *Federal Reserve Bank of San Francisco Economic Review, pp.* 3-13

Virmani, V. and R. Kapoor (2003), "Developing a Back Series of Monthly and Quarterly Income Estimates for India: 1983Q1 – 1999Q4," *Indian Institute of Management, Ahmedabad* WP 2003-10-02

Virmani, V. (2004), "Unit Root Tests: Results from some recent tests applied to select Indian macroeconomic variables," *Indian Institute of Management, Ahmedabad* WP 2004-02-04

Exhibit 1

- *Impulse Response Function from VAR with variables in 'Nominal' terms*



- *Impulse Response Function from VAR with variables in 'Real' terms*