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The effects of a monetary policy shock: Evidence from India

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Abstract

This paper empirically investigates the transmission of the Reserve Bank of India (RBI)'s monetary policy at a time when multiple indicator approaches are popular, using a structural VAR approach. We find that non-recursive zero restrictions must be imposed on the contemporaneous structural parameters to identify a monetary policy shock and that the RBI regards the current value of money as the centered information variable of the monetary policy, though exercising leverage over the real interest rate.

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1. Introduction

Typically, most central banks affect short-term interest rates by means of various monetary policy instruments in order to influence interest rates set by commercial banks; they, then try to control private investment and consumption in order to achieve price stability and sustainable economic growth. In particular, the transmission mechanism through which the central bank affects the behavior of households and firms via changes in interest rates appears to be consistent with the theoretical prediction for the balance sheet channel (e.g., Bernanke and Gertler 1995). Nevertheless, such policies may not be meaningful unless the effects of monetary policy on the various interest rates are complete, especially in the case of developing countries where financial markets appear to be comparatively less mature.[1]

In the recent Indian context, the Reserve Bank of India (RBI) is interested in monitoring the behavior of various interest rates in financial markets rather than that of monetary growth, so as to be able to intervene and neutralize volatility (Jadhav 2003); this may imply that, increasingly, the RBI has come to regard the interest rate channel as a more important transmission of monetary policy. Bhattacharyya and Sensarma (2008) examine the effects of the monetary policy on the financial markets recently, and suggest that the reverse repo rate plays a relatively important role. Joshi (2004), on the other hand, argues that controlling the interest rate, as its operational target is not effective under the present circumstances in India, because its repos market remains immature. These studies, however, appear to be unconcerned with the effects of monetary policy on the Indian economy as a typical macro economy.

The aim of this paper is to empirically investigate the dynamic responses of the Indian typical macroeconomic variables to a monetary policy shock and to explore the monetary transmission mechanism through changes in interest rates. We estimate the impulse response functions to identify a monetary policy shock and to determine if and to what extent the RBI is able to affect output and inflation, using a structural vector autoregression (SVAR) approach. The main findings of this paper are that monetary aggregates adjustment—and not the interest rate adjustment—has still played a significant role in India, and that the RBI can exercise leverage over the real interest rate over relatively short time horizons owing to the inertia in domestic price adjustments.

The remainder of this paper is organized as follows. Section 2 describes the monetary policy operating procedure in India. Section 3 discusses the effects of a monetary policy shock on macroeconomic variables, using an SVAR approach. Finally, Section 4 provides concluding remarks.

[1] There are few empirical studies concerning effects of monetary policy on financial markets and typical macroeconomic variables in developing countries. In one such study, Charoenseang and Manakit (2007) find that Thai monetary policy and financial market behavior co-move in the long run. In another, Kubo (2008), who examines the effects of a monetary policy shock on typical macroeconomic variables in Thailand, concludes that the lending channel is more effective as a transmission mechanism for achieving price stability.

2. Background of the Indian monetary policy

According to the trilemma faced by macroeconomic policy regimes, it is impossible for a country to simultaneously have the three items: a fixed exchange rate, freedom of international capital movements, and monetary policy oriented toward domestic goals (e.g., Krugman and Obstfeld 2006). Prior to the Asian currency crisis, for example, most developing countries in the region—through their macroeconomic policies—had fixed their respective currency exchange rates and allowed international capital movements, while sacrificing a domestically oriented monetary policy. However, after the crisis, the Asian developing countries, such as Indonesia, Korea, and Thailand with the exception of Malaysia, shifted to floating exchange rates and instituted inflation targeting as their new monetary policy regime geared toward domestic needs.

In the Indian context, although the macroeconomic policy led to the adoption of the US dollar peg system and allowed international capital movements in the former half of the 1990s, the Indian rupee per US dollar exchange rate gradually began to depreciate around 1996 (Figure 1). This implies that India had definitely accepted floating exchange rates, making it possible for the RBI to implement the domestic monetary policy. Indeed, on its Web site the RBI states that its primary roles as a monetary authority are maintaining price stability and ensuring adequate flow of credit to productive sectors. Accordingly, it can be assumed that the RBI seeks to minimize a weighted average of output and inflation volatilities, forecasting both economic conditions and the inflation outlook in order to make monetary policy decisions. The RBI's performance has been depicted in Figure 2. It also appears that stable inflation rates have been maintained with little sacrifice in terms of output stability.

In April 1998, the RBI employed a multiple indicator approach—including interest rate adjustment—to strengthen its ability to conduct "traditional" monetary targeting. This was because in recent years, monetary targeting based exclusively on the money demand function has seemingly lacked precision.[2] More specifically, the RBI created a *de facto* corridor with the reverse repo rate and the Bank rate as its floor and ceiling, respectively and attempted to introduce the call money rate within the corridor (Bhattacharyya and Sensarma 2008). However, given that the call money rates were volatile until 2000 the effect of the emergence of this corridor still appears to be negligible (Figure 3). On the other hand, the RBI continuously used changes in the cash reserve ratio, in addition to open market operations, as a tool to influence bank reserves and adjust financial market liquidity. Thus, it appears that the RBI consistently regarded monetary aggregates as an important policy indicator.

Subsequently, since June 2000, the RBI started to employ a Liquidity Adjustment Facility (LAF) through repo auctions. Consequently, a new corridor with the reverse repo rate and the repo rate came into existence. Moreover, the RBI regularly absorbed and injected financial liquidity in order to prevent excessive volatility in interest rates on a daily basis. As a result, the

[2] According to RBI (1998), although a long-run equilibrium relationship exists between real money balance and real income, short-run deviations from this relationship have recently emerged.

introduction of the LAF enabled the RBI to steer short-term interest rates to a much greater extent than in the past. As shown in Figure 3, it appears that relatively stable call money rates have been maintained since the introduction of the LAF, particularly since mid-2000. These results imply that the RBI has come to implement its monetary policy mainly by adjusting short-term interest rates rather than by making changes to the cash reserve ratio.

3. Effects of a monetary policy shock

Although the lack of a stable money demand function points to the importance of interest rate changes as an instrument through which the RBI can influence the Indian economy, only a handful of studies rigorously investigate the country's monetary policy transmission mechanism on the basis of interest rate changes. An important example of such studies is RBI (2005), which applies a VAR methodology to the period from 1994:4 to 2004:3 and provides evidence that output and prices were at the lowest levels around half a year after a contractionary monetary policy shock.

In this section, given the prevailing popularity of multiple indicator approaches, we explore the Indian monetary transmission mechanism on the basis of interest rate changes by estimating a 5-variable SVAR model as follows:

$$Bx_t = \mu + A_i(L)x_{t-n} + e_t , \qquad (2)$$

where matrix B may be restricted by economic theory; μ is a 5-dimensional vector of constants; x_t is a 5-dimensional vector of variables; A_i is 5×5 matrices of coefficients in the lag operator L; and e_t is a 5-dimensional vector of error terms with zero means and covariance matrix Σ_e.

The variables included in the SVAR model are consumer price index (*cp*), industrial production index (*y*), wholesale price index (*wp*), call money rate (*r*), and reserve money aggregate (*M*), in that very order [*cp*, *y*, *wp*, *r*, *M*]. We use the call money rate as an indicator of the RBI's monetary policy stance, in accordance with the discussion in Section 2. In addition, the wholesale price index is incorporated in order to solve the price puzzle.[3] All the series, with the exception of the interest rates series, are expressed in natural logarithms. The data are monthly observations between 1998:4 and 2007:3.[4] In addition, on the basis of the result of the sequential modified likelihood ratio test, the optimal lag length is set at 3.

First, to identify the impact of a monetary policy innovation, we obtain the impulse response functions by using a Choleski decomposition[5] with the above ordering. Specifically, we impose

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[3] In the existing literature, prices are often found to rise after a contractionary monetary policy shock. It is well known that the price puzzle can be avoided by including the values of commodity prices in the model; see, e.g., Christiano *et al*. (1999).

[4] The period covers the term after the RBI began to implement domestic monetary policy and adopted a multiple indicator approach. All the series data are obtained from the RBI's Web site.

[5] Regarding the Choleski decomposition, see, e.g., Christiano *et al*. (1999).

recursive zero restrictions on the contemporaneous structural parameters. Hence, (2) can be represented by

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ B_{21} & 1 & 0 & 0 & 0 \\ B_{31} & B_{32} & 1 & 0 & 0 \\ B_{41} & B_{42} & B_{43} & 1 & 0 \\ B_{51} & B_{52} & B_{53} & B_{54} & 1 \end{bmatrix} \begin{bmatrix} cp_t \\ y_t \\ wp_t \\ r_t \\ M_t \end{bmatrix} = \mu + A_i(L) \begin{bmatrix} cp_{t-n} \\ y_{t-n} \\ wp_{t-n} \\ r_{t-n} \\ M_{t-n} \end{bmatrix} + e_t, \tag{3}$$

where *cp*, *y* and *wp* are the RBI's information set variables. More specifically, we assume that the variables appearing before the call money rate in the ordering can affect a monetary policy shock contemporaneously.[6] This implies that the RBI modulates the call money rate after observing the current values of prices and output, which is consistent with a period loss function of the RBI that minimizes a weighted average of output and inflation volatilities.

Figure 4 presents the estimated impulse responses to a contractionary monetary policy shock (a positive one-standard-deviation innovation to the call money rate).[7] The solid lines represent the point estimates of the impulse response functions. The dashed lines denote a 95% confidence interval for the impulse response functions. The horizontal axis represents the time (in months) after the shock. However, some of the impulse response functions are statistically insignificant and lead to unreasonable interpretations, compared with the standard macroeconomic theory. More specifically, the call money rate rises, whereas the amount of reserve money initially rises. In addition, consumer prices begin to decline in two months following the shock but they are statistically insignificant. These results imply the misidentification of a monetary policy shock.[8] Therefore, we attempt to employ an alternative to the Choleski decomposition.

Consequently, we impose non-recursive zero restrictions[9] on the contemporaneous structural parameters. Accordingly, (2) now takes the following specific form:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ B_{21} & 1 & 0 & 0 & 0 \\ B_{31} & B_{32} & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & B_{45} \\ B_{51} & B_{52} & 0 & B_{54} & 1 \end{bmatrix} \begin{bmatrix} cp_t \\ y_t \\ wp_t \\ r_t \\ M_t \end{bmatrix} = \mu + A_i(L) \begin{bmatrix} cp_{t-n} \\ y_{t-n} \\ wp_{t-n} \\ r_{t-n} \\ M_{t-n} \end{bmatrix} + e_t. \tag{4}$$

The first, second, and third rows in matrix *B* represent the real sector. The fourth row corresponds to the monetary policy rule. It is assumed that the RBI sets the interest rate after observing the current value of money. This assumption is consistent with the monetary-targeting

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6 Note that if one is solely interested in the effect of a monetary policy shock, the ordering of the variables before the call money rate is not important, since the block recursive assumption ensures the same estimation result.

7 The impulse response of wholesale prices is not shown.

8 We adopt the alternative ordering [*cp*, *y*, *wp*, *M*, *r*]. However, the estimated impulse response functions are very similar to the results in the order [*cp*, *y*, *wp*, *r*, *M*]. In addition, using the zero restrictions in *B*, we still don't get sensible impulse responses.

9 See, e.g., Sims (1986), Christiano *et al.* (1999), and Kim and Roubini (2000).

framework. The fifth row corresponds to the money demand equation. The over-identification restrictions are not rejected (p-value = 28.6%).

Figure 5 presents the re-estimated impulse responses to a contractionary monetary policy shock.[10] The impulse responses have the expected dynamics under monetary contraction without generating any puzzles. Initially rising in response to the innovation, the call money rate then begins to fall and returns to the initial level after nine months. Meanwhile, the amount of reserve money decreases sharply and hits its lowest point in the first month. Industrial production decreases but it becomes statistically significant only four to five months later. Finally, consumer prices decline gradually and reach the nadir ten months after the shock.[11] These results[12], which might be slightly different from those of RBI (2005), imply that the RBI may regard the amount of reserve money as the centered information variable of the monetary policy and that the effects of a monetary policy shock are felt by the entire economy within a year's time. Further, the RBI is found to exercise leverage over the real interest rate over relatively short time horizons owing to the inertia in domestic price adjustments.

In addition, we discuss the effects of the other shocks in the system (Figure 6). First, a p shock has a negative impact on output and on the call money rate. This may imply that the RBI implements an expansionary monetary policy, reacting to the decrease in output. On the other hand, a y shock has a positive impact on the call money rate.[13] Finally, an increase in reserve money leads to a rise in the call money rate, which suggests that an M shock can be interpreted as a money demand shock.

Lastly, we extend the above model to the open economy[14] and incorporate the exchange rate into the SVAR system, which appears to be relevant in India:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ B_{21} & 1 & 0 & 0 & 0 & 0 \\ B_{31} & B_{32} & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & B_{45} & 0 \\ B_{51} & B_{52} & B_{53} & 0 & 1 & 0 \\ B_{61} & B_{62} & B_{63} & B_{64} & B_{65} & 1 \end{bmatrix} \begin{bmatrix} cp_t \\ y_t \\ wp_t \\ r_t \\ M_t \\ f_t \end{bmatrix} = \mu + A_i(L) \begin{bmatrix} cp_{t-n} \\ y_{t-n} \\ wp_{t-n} \\ r_{t-n} \\ M_{t-n} \\ f_{t-n} \end{bmatrix} + e_t . \tag{5}$$ [15]

In the above, f represents the nominal effective exchange rate. The data are also obtained from the RBI's Web site. Accordingly, an increase in f denotes an appreciation in the Indian Rupee. A

[10] The impulse response of wholesale prices is not shown.

[11] Upon referring to some previous studies in this field (e.g., Christiano *et al*. 1999 and Kim 2000), we interpret that the response may be statistically significant eleven months after the shock.

[12] Additional evidence from the analysis of forecast error variance decompositions provides further support for the results of the impulse responses.

[13] However, here, if one is solely interested in the effects of a monetary policy shock, the ordering of the variables before the call money rate is not important.

[14] Although we first add an international output figure—such as OECD total output and US industrial production—as an exogenous variable, some impulse responses to a monetary policy shock are unreasonable or insignificant.

[15] The over-identification restrictions are not rejected (p-value = 23.4%).

call money rate shock has a negative but insignificant impact on the exchange rate. This result may be due to the fact that the depreciation effects outweigh the appreciation effects. More specifically, a decrease in output because of a contractionary monetary policy leads to a decrease in exports. The other estimated impulse responses look quiet similar to the results in Figure 5, although they are mostly insignificant (Figure 7).

4. Concluding remarks

In this paper, we investigated the Indian monetary transmission mechanism on the basis of interest rate changes over a period that covers the term after the RBI adopted a multiple indicator approach. We conducted the study using an SVAR approach. Furthermore, we arrived at some key findings. The RBI regards the current value of money as the centered information variable of the monetary policy. Moreover, as a result of inertia in consumer price inflation, the RBI can exercise leverage over the real interest rate.

Based on the empirical results, we conclude that although the interest rate adjustment has gradually become effective in recent times, the monetary aggregates adjustment has still played a significant role.

References

Bernanke, B.S. and M. Gertler (1995) “Inside the black box: the credit channel of monetary policy transmission” *Journal of Economic Perspectives* **9**, 27–48.

Bhattacharyya, I. and R. Sensarma (2008) “How effective are monetary policy signals in India?” *Journal of Policy Modeling* **30**, 169–183.

Charoenseang, J. and P. Manakit (2007) “Thai monetary policy transmission in an inflation targeting era” *Journal of Asian Economics* **18**, 144–157.

Christiano, L.J., M. Eichenbaum and C.L. Evans (1999) “Monetary policy shocks: what have we learned and to what end?” in *Handbook of Macroeconomics* **1A** by J.B. Taylor and M. Woodford, Eds., North-Holland: Amsterdam.

Espinosa-Vega, M.A. and A. Rebucci (2003) “Retail Bank Interest Rate Pass-Through: Is Chile Atypical?” IMF Working Papers 03/112, International Monetary Fund.

Jadhav, N. (2003) “Central bank strategies, credibility and independence: Global evolution and the Indian experience” Reserve Bank of India Occasional Papers 24 (1 and 2).

Johansen, S. (1988) “Statistical analysis of cointegration vectors” *Journal of Economic Dynamics and Control* **12**, 231–254.

Joshi, H. (2004) “The interbank money market in India: Evidence on volatility, efficacy of regulatory initiatives and implications for interest rate targeting” Reserve Bank of India Occasional Papers 25 (1, 2 and 3).

Kim, S. (2001) “International transmission of U.S. monetary policy shocks: Evidence from VAR’s” *Journal of*

Monetary Economics **48**, 339-372.

Kim, S. and N. Roubini (2000) “Exchange rate anomalies in the industrial countries: A solution with a structural VAR approach” *Journal of Monetary Economics* **45**, 561–586.

Krugman, P.R. and M. Obstfeld (2006) *International Economics: Theory and Policy*, Addison-Wesley, 7th edition: Boston.

Kubo, A. (2008) “Macroeconomic impact of monetary policy shocks: Evidence from recent experience in Thailand” *Journal of Asian Economics* **19**, 83–91.

Mohan, R. (2007) “Monetary policy transmission in India” Reserve Bank of India Bulletin (April).

Pandit, B.L., A. Mittal, M. Roy and S. Ghosh (2006) “Transmission of monetary policy and the bank lending channel: Analysis and evidence for India” Development Research Group Study 25, Reserve Bank of India.

Reserve Bank of India (1998) *Report of the Working Group on Money Supply: Analytics and Methodology of Compilation* (Chairman: Dr. Y. V. Reddy).

Reserve Bank of India (2005) *Report on Currency and Finance 2003-2004*.

Sims, C.A. (1986) “Are forecasting models usable for policy analysis?” *Federal Reserve Bank of Minneapolis Quarterly Review* **10**, 2–16.

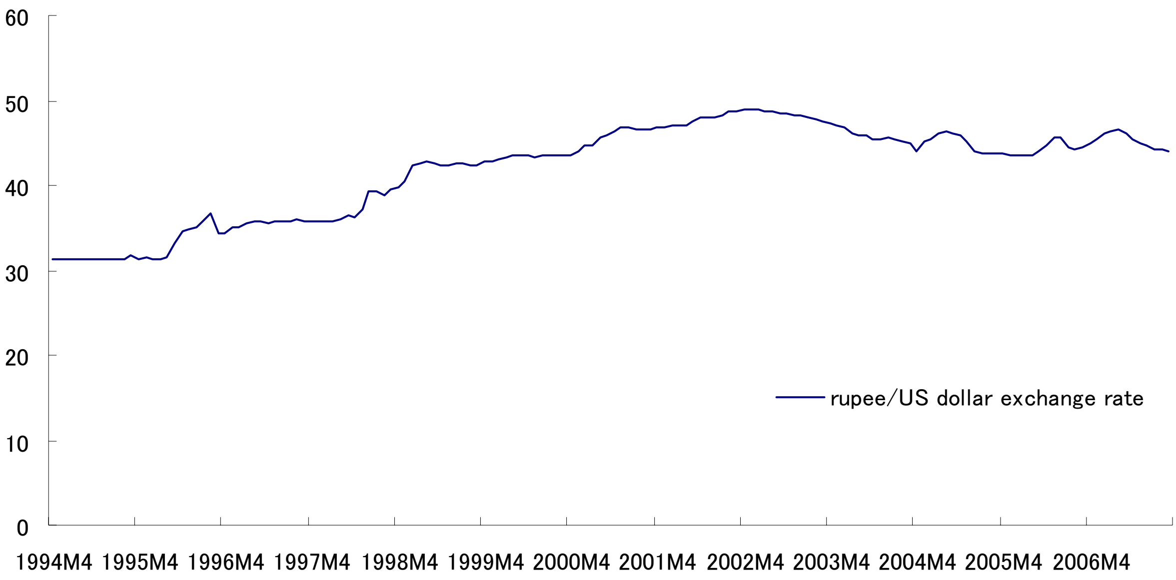

Figure 1. Exchange rate market behavior. *Source:* the RBI's Web site.

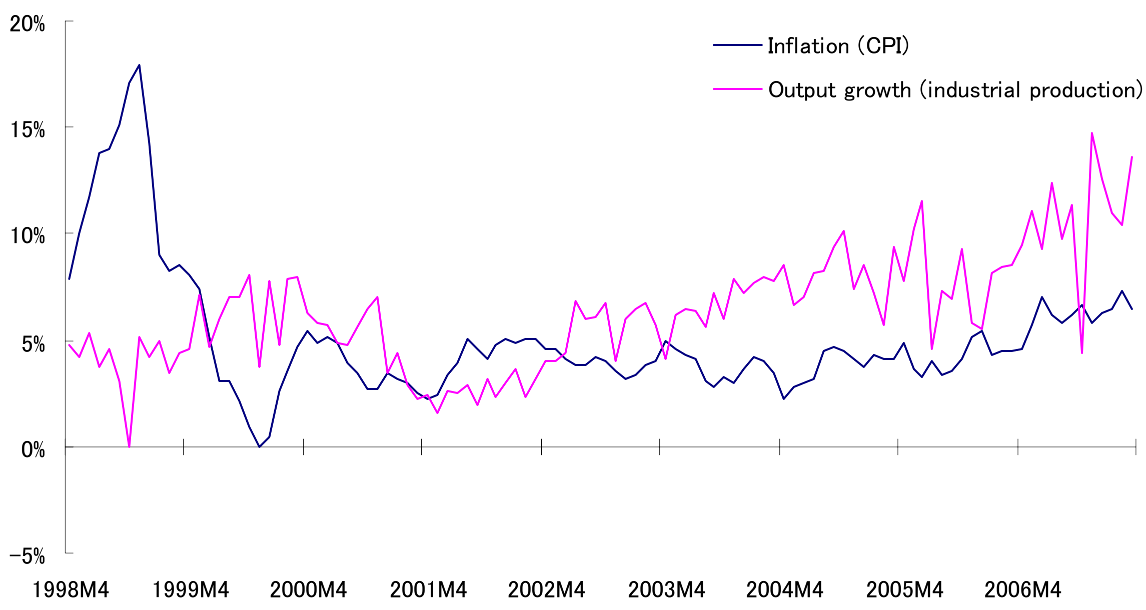

Figure 2. Inflation and output growth rates. *Source:* the RBI's Web site.

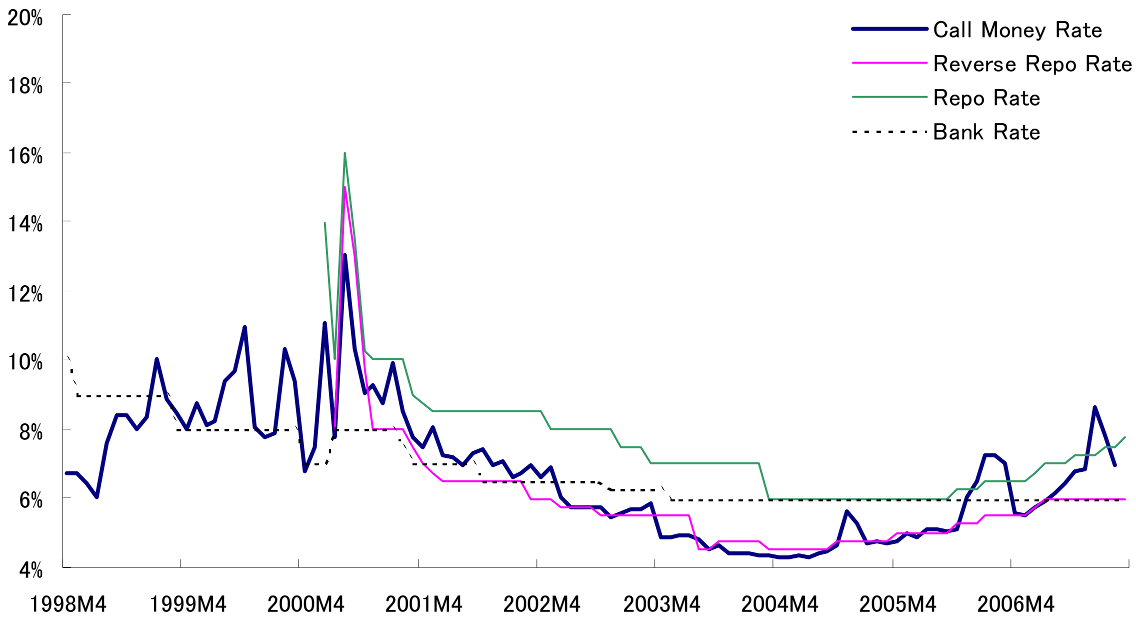

Figure 3. The interest rates in money market. *Source:* the RBI's Web site.

Figure 4. Impulse responses of the Indian macroeconomic variables to a monetary policy shock (The impulse response of wholesale prices is not shown.).

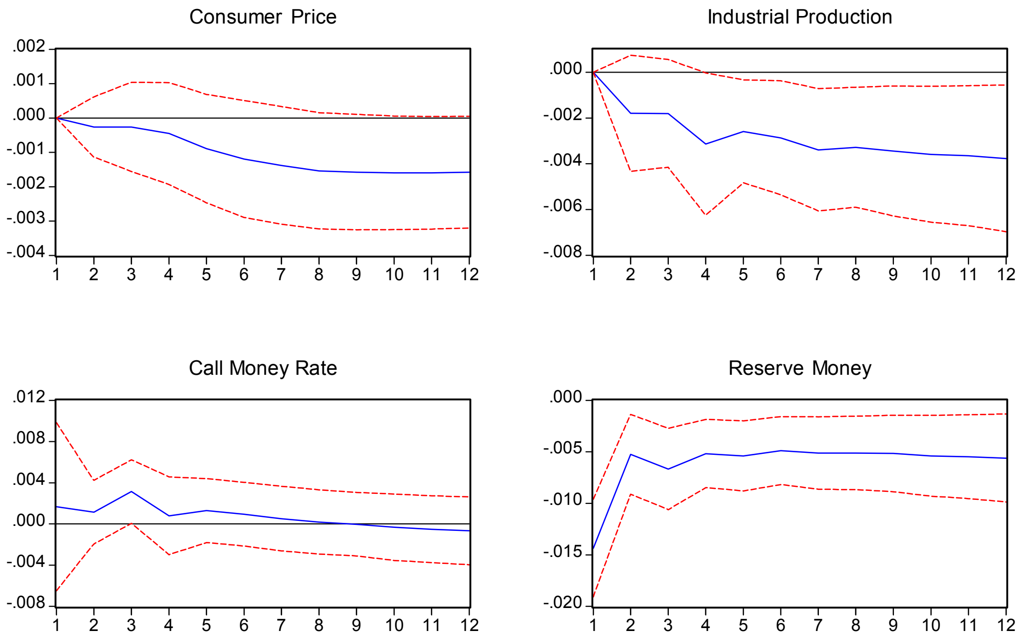

Figure 5. Impulse responses of the Indian macroeconomic variables to a monetary policy shock (The impulse response of wholesale prices is not shown.).

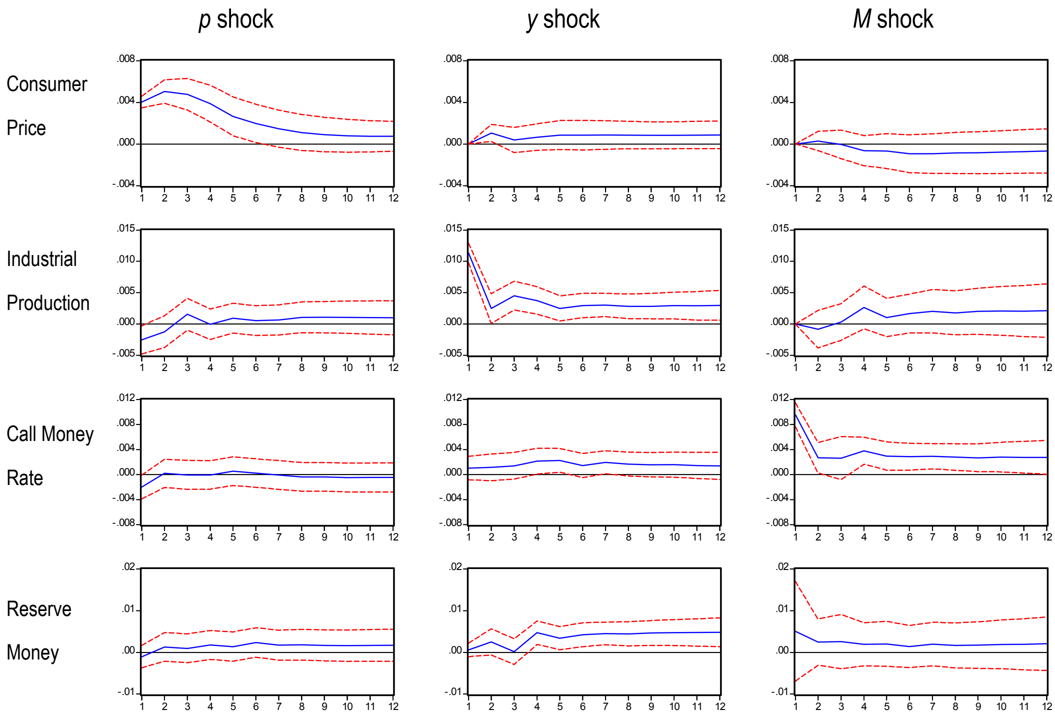

Figure 6. Impulse responses of the Indian macroeconomic variables to the other shocks (The impulse response of wholesale prices is not shown.).

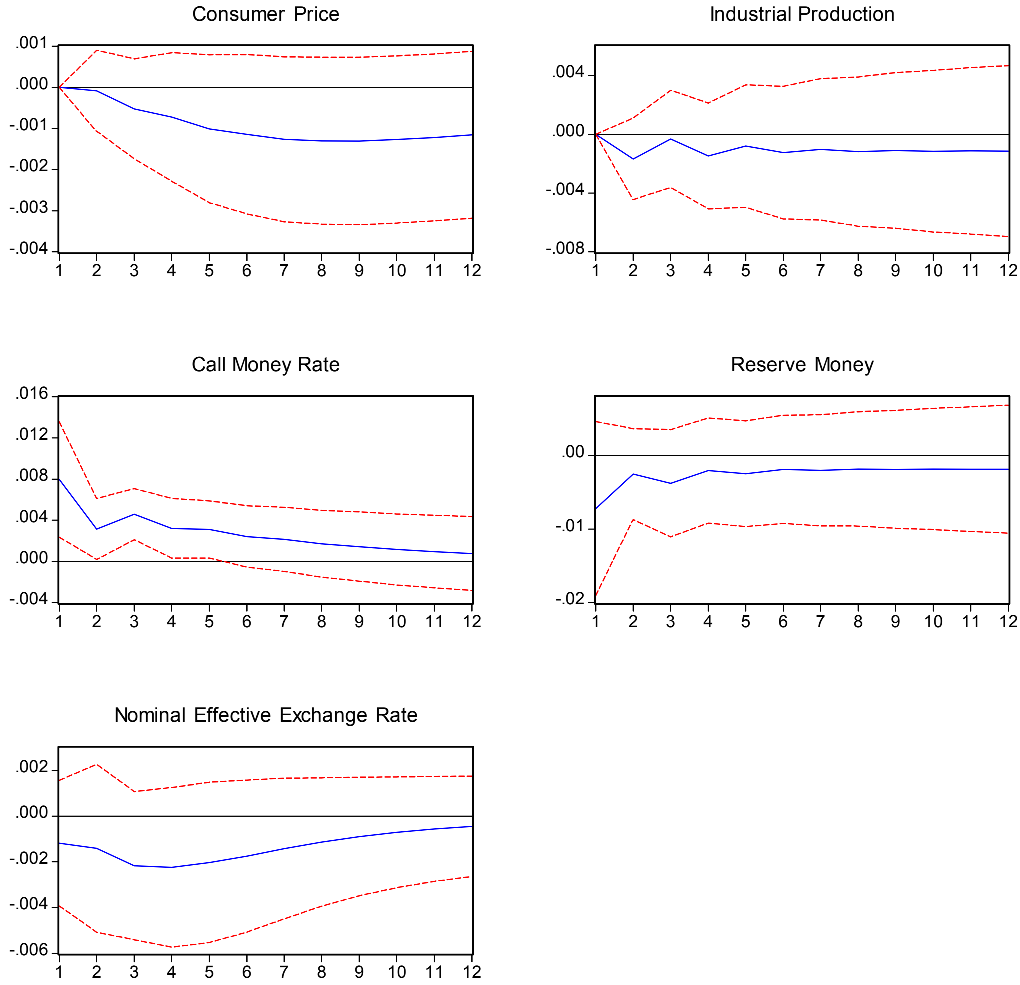

Figure 7. Impulse responses of the Indian macroeconomic variables to a monetary policy shock (The impulse response of wholesale prices is not shown.).