Monetary Transmission in India: An Evaluation

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ABSTRACT

This paper studies the monetary transmission mechanism in India for the period 2004 April to 2015 March. It examines the relative importance of different channels of monetary transmission viz, interest, credit, asset price and exchange rate channel respectively. The study employs a series of VAR models to gain insight into how a change in the policy rate affects output and the price level. The importance of each of the channels is gauged by first taking the relevant channel variable as endogenous and then taking it as an exogenous variable in the VAR models to block off all interactions between the channel variable and all other endogenous variables. The results indicate the importance of the interest channel, credit channel and the asset price channel. The exchange rate channel is found to be weak for the Indian economy during the estimation period.

Keywords: Monetary transmission mechanism, Interest rate, Credit, Asset price, VAR.

1.0 Introduction

Monetary policy affects the real sector in the short run through different transmission mechanisms. These mechanisms differ from one country to another depending on the development of the financial sector, nature of the economy, degree of independence of the central bank, operating procedure of the monetary policy etc. Economic literature identifies various channels of monetary policy transmission viz, interest rate channel, exchange rate channel, asset price channel and credit channel. The credit channel in turn can further be split into two different channels- the bank lending channel and the balance sheet channel (Mukherjee & Bhattacharya 2011). In this context, it is important to note that developing countries have several common institutional features that differentiate them from advanced countries, for example regulated banking structure, lack of access to financial services to a large share of households, underdeveloped bond markets etc. Thus monetary transmission for emerging economies is a lot different from advanced economies.

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India embarked on the process of financial reforms way back in 1992 with the implementation of the Narshimam Committee I Report. Thereafter the financial sector has been deregulated. Some of the measures include deregulation of interest rates, auction based market borrowing programme of the government, development of short term money market rates through introduction of new money market instruments like market repos and collateralised borrowing and lending obligations (CBLO), discontinuation of automatic monetisation by phasing out of ad-hoc treasury bills, and reduction in statutory reserve requirements (Ray, 2013).

Monetary policy framework in India has also undergone a significant shift since the beginning of the 2000s due to the adoption of liquidity adjustment facility (LAF) as the operating procedure of monetary policy. Here changes in the policy rates get transmitted to other interest rates of different maturities which, in turn, affect the spending and investment decisions of households and business and consequently inflation and growth. Thus post LAF, there is an increasing role assigned to interest rate in the working of monetary policy. This is in keeping with the general trend post financial liberalisation, of relying more on price instruments rather than quantity instruments in monetary policy transmission (Santiago and Coble 2011).

The interest rate channel thereby became an important channel in monetary transmission for the Indian economy. This has been found in a lot of studies on the Indian economy particularly in the post LAF period (Mohanty 2012, Singh and Kalirajan 2007, Khundrakpam and Jain 2012). However there are other studies that have focussed on the relevance of other channels, for example, credit channel (Khundrakpam 2011), exchange rate channel (Bhattacharya et al 2011). Our study looks into the importance of all the channels of monetary transmission in the Indian context in the post LAF period.

The rest of the paper is organised as follows. Section 2 reviews the literature on monetary transmission mechanism. In section 3, a brief sketch of the monetary and exchange rate policy followed by the RBI over the years is provided. Section 4 discusses the benchmark VAR model along with the variables used in the estimation and lastly the results for the period April 2004 to March 2015. In section 5, we extend the benchmark VAR model and incorporate the various channel variables to analyse their relevance for the Indian economy. Section 6 summarises the results and concludes.

2.0 Review of Literature

There are quite a number of studies on monetary transmission in developing countries. Bernanke and Blinder (1992) examine monetary transmission for USA using the VAR methodology. They find that a tight monetary policy reduces the supply of
loans to firms thus providing evidence of the credit channel. Romer and Romer (1990) on the other hand find an independent role of money affecting output and movements in lending are largely determined by movements in output. Ramey (1993) also find the interest rate channel to be more important than the credit channel in explaining monetary transmission for the US economy. In the euro area countries, Angeloni et al (2003) finds that the interest rate channel to be the most dominant channel of monetary transmission. Smets and Wouters (2002) find that incomplete exchange rate pass through in the Euro zone reduce the effectiveness of the exchange rate channel of monetary policy. Morsink and Bayoumi (2001) find that banks play an important role in transmitting monetary shocks to real activity in Japan.

Coming to the issue of monetary policy transmission in emerging economies Amarasekara (2008) looks into the effects of interest rate, money growth and movements in nominal exchange rate on real GDP growth and inflation for the Sri Lankan economy. The study shows that following a positive innovation in interest rate, GDP growth and inflation decreases while the exchange rate appreciates. Disyatat et al (2003) study the monetary transmission mechanism in Thailand and find that the interest rate channel and the bank lending channel are the dominant channels of monetary transmission. Fung (2002) analyses the effects of monetary policy shocks in some East Asian countries. The results show a relatively small weight on the exchange rate for some of the economies despite an important role played by the exchange rate. Mishra et al (2010) study the monetary transmission mechanism in low income countries and find that the bank lending channel to be the dominant channel in these countries. Pandit and Vashist (2011) analyse the policy rate channel of monetary transmission of several emerging economies. They conclude that the policy rate is an important determinant of firms’ demand for bank credit.

In the Indian context, there have been quite a few studies on monetary transmission. Singh & Kalirajan (2007) in their study show that the interest rate is the major policy variable for conducting monetary policy in the post liberalised Indian economy. Aleem (2010) uses the VAR approach and finds evidence of the bank lending channel due to the important role of banks in the intermediation process. Mohanty (2012) in his study shows that with the gradual deregulation of interest rates, the interest rate channel has become an important channel for the Indian economy. Bhattacharya et al (2011) find evidence of significant exchange rate rate pass through. They conclude that the most effective mechanism through which monetary policy impacts inflation runs through the exchange rate. Khundrakpam (2012) finds that the interest rate channel completely dominates the exchange rate channel in monetary transmission although the latter channel has non negligible impact on investment and
imports. Khundrakpam (2011) examines the relevance of the credit channel and finds that this channel to be significant and robust for the Indian economy. Thus from the review we see that in the Indian context monetary policy transmission occurs through various channels.

3.0 Monetary and Exchange Rate Policy

The RBI followed the monetary targeting framework with feedback as recommended by the Chakravarty Committee during the mid-eighties. In the mid-nineties, a relook at this policy was deemed necessary due to a host of reasons: (a) the biggest problem of explicit monetary targeting was the fact that the RBI had no control over its credit to the central government, which accounted for the bulk of the creation of reserve money (b) rapid pace of financial development which included market determination of interest rates and deepening of financial markets leading to enhanced role of market forces in interest rate determination (c) increase in capital inflows which raised the proportion of net foreign assets in the total reserve money making control of monetary aggregates difficult.

The multiple indicator approach was introduced in April 1998 where information from a host of price variables like interest rates in different financial markets, exchange rate, inflation rate along with quantity variables like money, credit, output were analysed for obtaining the monetary policy. This process was augmented by forward looking indicators and a panel of parsimonious time series models. (Mohanty, 2010).

The multiple indicator approach made the money market the focal point of the conduct of monetary policy. The Liquidity Adjustment Facility (LAF) was introduced in June 2000 to manage market liquidity on a daily basis and also to transmit interest rate signals to the market. The LAF was operated through overnight fixed rate repo and reverse repo which provided an informal corridor for the call money rate. (RBI, 2011). This helped to develop interest rate as an instrument of monetary transmission. However it suffered from two weaknesses. First, there was a lack of a single policy rate as the operating policy rate alternated between repo (during deficit liquidity situation) and reverse repo (during surplus liquidity situation). Second, there was a lack of a strict corridor as the overnight call rate sometimes breached the upper or lower limit in extreme deficit or surplus conditions.

To address these shortcomings, a new operating procedure was introduced in May 2011. It included some new features. First the weighted average overnight call money rate was explicitly recognised as the operating target of monetary policy. Second, the repo rate was made the only policy rate. Third, a new Marginal Standing
Facility (MSF) was instituted under which scheduled commercial banks (SCBs) could borrow overnight at 100 basis points above the repo rate up to one percent of their net demand and time liabilities (NDTL). The limit was subsequently raised to two percent of NDTL. Fourth the revised corridor was defined with a fixed width of 200 basis points. The repo rate was placed in the middle of the corridor, the reverse repo rate at 100 basis points below it and the MSF, Bank rate 100 points above it. The new operating procedure has tried to address some of the earlier concerns by reducing confusion about the policy rate and making the signalling of monetary policy stance more accurate.

The exchange rate was administered by the RBI till 1993. Since then, India has been operating with a managed flexible regime where the exchange rate is largely determined by the demand and supply conditions in the market. The stated objective of the RBI is not to achieve any explicit or implicit target for the exchange rate but to contain its volatility by ensuring orderly market conditions. Recent studies (Sahoo, 2012) have shown that the RBI undertakes both 'passive' and 'active' intervention. The former takes place to avoid a nominal appreciation whereas the latter is done to avoid disruptive market conditions.

There are quite a few studies in India, trying to ascertain the true level of flexibility of the Indian rupee (Cavoli and Rajan, 2007; Patnaik, 2007; Patnaik and Shah, 2010). The consensus view is that till March 2004, the Indian rupee was effectively pegged to the US dollar. After that, the flexibility of the exchange rate started to increase coinciding with the capital flows. The change in the exchange rate regime which took place in March 2004 was both statistically and economically significant.

4.0 Benchmark VAR Analysis

The VAR approach is employed to examine the effects of a monetary shock on output and prices. The benchmark VAR (p) model is represented as follows-

$$\sum_{i=0}^{p} a_i Y_t = bX_t + \epsilon_t$$

where $Y_t$ is the vector of endogenous domestic variables and $X_t$ is the vector of exogenous foreign variables, $a$ & $b$ are polynomials and $\epsilon_t$ are structural innovations. It is assumed that the exogenous variables have contemporaneous effects on the endogenous variables but there is no feedback effect from the endogenous variables on the exogenous variables. The reason is that the Indian economy is too small to impact international variables.
The endogenous variables of the model are, an output variable iip (index of industrial production, base 2004-05), a price variable wpi (wholesale price index, base 2004-05) and a proxy for monetary policy variable cmr (overnight weighted average call money rate). Thus the vector of endogenous variables consists of iip, wpi and cmr.

\[ Y_t = (iip, wpi, cmr) \]

The VAR is identified with recursive Choleski decomposition with this ordering. The rationale of the ordering is guided by the fact that the output variable is not affected contemporaneously by shocks in the other variables while cmr responds to innovations in output and price within the same period. Thus output is the least responsive to shocks followed by prices and finally interest rates.

A vector of exogenous foreign variables is also taken to control for international factors. International commodity price index \(P_1\) is included to control for supply shocks (Disyatat et al 2003). The federal funds rate \(r\) is taken as it is seen in earlier studies (Aleem 2010) that the US Federal Reserve’s monetary policy has an external influence on the Indian monetary policy. Lastly the index of industrial production of USA \(iipu\) (base 2004-05) is taken to represent world demand. Thus the vector of exogenous foreign variables consists of the international commodity price index \(P_1\), federal funds rate \(r\) and index of industrial production of USA \(iipu\).

\[ X_t = (P_1, r, iipu) \]

All the variables except ‘cmr’ and ‘r’ are in logarithmic values. We use monthly data of the variables for the period April 2004 to March 2015. The reasons for choosing April 2004 as the starting point are: (a) End March 2004 marked a structural change in India’s de facto exchange rate regime towards significant exchange rate flexibility from US dollar peg (Patnaik and Shah, 2010) and so this period will throw light on the significance of the exchange rate channel, (b) From March 2004, the entire central bank refinancing was made available at the repo rate and this led to the repo rate emerging as the key lending rate of the RBI replacing the erstwhile bank rate (Aleem, 2010).

All the variables are tested for stationarity using the Phillips Perron (PP), Augmented Dickey Fuller (ADF) and Kwiatowsky et al. (KPSS) tests. The results (not reported as variables are estimated in levels) show that except ‘cmr’, the variables are non-stationary. Lag selection for the VAR model was done on the basis of Akaike information criteria (AIC) and Schwarz Bayesian information criteria (SBC) and it was found that the optimal lag length to be four.

There is a trade-off between estimating the VAR in levels versus in first differences. The trade-off is between the loss of efficiency (when the VAR is estimated in levels) and the loss of information about long run relationships (when VAR is estimated in first differences). Since the purpose of our study is to understand the
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relationships among the variables, we have estimated the VAR in levels. This approach is followed widely in the literature (Aleem, 2010; Disyatat et al., 2003). It is important to note here that estimation in levels may incur some efficiency losses but there is no loss of consistency of estimators (Sims, Stock and Watson, 1990).

4.1 Results of the Benchmark model

We look into the impulse response functions from the benchmark model which are presented in Figures 1-3. These trace the dynamic responses of output, prices and overnight call money rate to a positive one standard deviation overnight call money rate shock.

An unanticipated tightening of monetary policy leads to an initial positive response of output (iip) for three months after which it reverses its direction and turns negative. The negative impact continues till the seventh month and then dissipates. This shows that it takes a few months for the effect of monetary tightening to be felt on output but after that monetary policy affects the output variable as expected in the theory.

Prices decline in response to a positive overnight call money shock. The maximum decrease in prices is achieved in the sixth month of 0.3% and after that the response dissipates by the twelfth month. The results highlight the fact that a contractionary monetary policy puts the brakes on inflation. Lastly, the overnight call money rate falls rapidly due to a shock in the call money rate and touches the baseline level by the eighth month and from thereon it stabilizes.

Figure 1: Response of log iip to 1 std. dev. cmr innovation
Figure 2: Response of log wpi to 1 std. dev cmr innovation

![Graph showing response of log wpi to 1 std. dev cmr innovation.]

Figure 3: Response of cmr to 1 std. dev cmr innovation

![Graph showing response of cmr to 1 std. dev cmr innovation.]

5.0 Monetary transmission channels

We now augment the benchmark VAR model by including an additional endogenous variable (w) which represents a particular monetary transmission channel. The variable w responds contemporaneously to shocks in iip, wpi and cmr but the converse does not hold. Thus the vector of endogenous variables is as follows:

\[ Y_t = (iip, wpi, cmr, w) \]

The VAR model is estimated for the same period and the impulse responses of the variables are calculated for shocks in cmr.

Next we exogenize w and re-estimate the VAR containing the other exogenous variables. This blocks off all interactions between w and other endogenous variables.

The modified VAR model has the following vector of endogenous and exogenous variables

\[ Y_t = (iip, wpi, cmr) \]
\[ X_t = [ P_1, r, iipu, w(-1), ..., w(-p) ] \]

where p represents the number of lags.

The intensity of each channel is examined by comparing the impulse responses in the two VAR models.

5.1 Credit channel

The credit channel can be further split into two different channels – the bank lending channel and the balance sheet channel. The bank lending channel says that a contractionary monetary policy in addition to lowering the demand for loans by making the cost of capital higher also lowers the supply of loans given by financial institutions. This is so because the institutions (mostly banks) have to keep higher reserves as a fraction of deposits. Thus monetary policy has amplified effects on aggregate demand by affecting the availability of new loans.

The balance sheet channel says that a contractionary monetary policy reduces cash flow of firms and lowers the prices of financial assets. This results in lower net worth of firms and increases their difficulty in securing bank credit as lower asset prices lowers the value of collateral.

The importance of the credit channel depends on two factors – (i) the degree to which the central bank can affect the supply of bank loans & (ii) the dependence of borrowers on bank loans. Coming to the first issue, the central bank can affect the supply of bank loans through a variety of instruments like the cash reserve ratio (CRR), bank rate, priority sector lending. In the Indian context, there are studies looking into this aspect, for example, Pandit et al. (2006) show that changes in CRR and bank rate get transmitted into bank lending during the period 1997 to 2002. The impact is more acute
for small banks than large banks. In the post LAF period, Bhaumik et al. (2010) has examined the relationship between monetary policy changes and supply of bank credit while segregating banks according to the nature of ownership. They find that monetary policy instruments affect loan supply and this effect is more prominent in deficit rather than surplus liquidity conditions.

Regarding the second issue, the banking sector has played an important role in allocating credit to the private sector after the financial reforms. The ratio of bank credit to GDP has steadily increased from 0.30 in 2003-04 to 0.50 in 2009-10 and subsequently to 0.52 in 2014-15.

To examine the role of bank credit in the transmission mechanism we extend the benchmark model and include non-food credit (nfc) in log values. The VAR model thus comprises of iip, wpi, cmr and nfc. Figures 4-6 show the impulse responses of iip, wpi and nfc to innovations in cmr. The output response is positive which peaks to .4% in the third month and stabilizes by the ninth month. The effect on price is negative which bottoms out by the seventh month to .3%. The response of non-food credit to a positive ‘cmr’ innovation is positive which peaks in the second month but thereafter it decreases and becomes negative by the seventh month. This implies that commercial banks eventually respond to a monetary tightening through a reduction in non-food credit.

**Figure 4: Response of log iip to 1 sd. cmr innovation (credit channel)**
Figure 5: Response of log wpi to 1 std. dev. cmr innovation (credit channel)

Figure 6: Response of log nfc to 1 std. dev. cmr innovation (credit channel)
We now exogenize non-food credit in the VAR model to look into the importance of banks in the monetary transmission process. The result (Figure 7) indicates that the output response is positive but dies out by the sixth month. Thus exogenizing the credit variable leads to a dampening of the output response to a positive ‘cmr’ shock. Also the response of the credit variable (fig 6) suggests that the bank lending channel was operating in India during the estimation period.

**Figure 7: Response of log iip to 1 std. dev. cmr innovation (nfc exogenous)**

![Graph showing response of log iip to 1 std. dev. cmr innovation](image)

5.2 Asset price channel

 Monetary policy affects output and prices through fluctuations in asset prices. A tightening of monetary policy through high interest rates makes equity prices less attractive compared to alternative assets like bonds leading to a fall in equity prices. In such a situation firms find it costly to replace existing capital via, the Tobin’s q effect. So investment and output is reduced. In addition to this, decline in equity prices lowers the net wealth of households and its effect is felt through a lowering of consumption expenditure which also has a dampening effect on output.

To capture the effect of the asset price channel in India, we considered BSE Sensex 30, i.e., sen (in log values) which is an index of the Bombay Stock index. (It is a basket of thirty constituent stocks which is widely reported in domestic and
international markets). Thus the VAR model has the following vector of endogenous variables – iip, wpi, cmr, sen.

Figure 8 shows that monetary tightening has an initial positive effect on output which gets reverted within the third month and then we have the expected negative effect on output except for a minor blip in the fifth month. The output effect bottoms out by the eleventh month to 1.5% The effect on price is negative throughout and it dampens out by the twelveth month (Figure 9). Equity prices have the expected negative relationship (Figure 10) following a restrictive monetary policy with the peak occurring in the sixth month (5%).

**Figure 8: Response of log iip to 1 std. dev cmr innovation (Asset price channel)**

![Graph showing response of log iip to 1 std. dev cmr innovation](image)

Comparing the results with the case when ‘sen’ is exogenous, it is seen that following a monetary tightening there is a perceptible change in the output response (Figure 11). The response is positive and it peaks by the fifth month to 4%. The expected negative impact on output is not visible till the ninth month following an increase in interest rates. This perverse response indicates that the asset price channel has become an important conduit of monetary policy transmission after the financial crisis.
Evidence of this is also seen through the steep decrease in equity prices after a restrictive monetary policy (Figure 10).

**Figure 9:** Response of log wpi to 1 std. dev. cmr innovation (asset price channel)

**Figure 10:** Response of log sen to 1 std. dev cmr innovation
5.3 Exchange rate channel

For open economies, the exchange rate channel is an important component of monetary policy transmission. A restrictive monetary policy through high interest rates leads to capital inflows causing a nominal appreciation. This combined with sticky prices causes a real appreciation in the short run thereby reducing net exports. However, if a restrictive monetary policy represents lower growth expectations then capital flows may not rise and a real depreciation may also be a reality.

The strength of the exchange rate channel depends on a host of factors ie, responsiveness of the exchange rate to monetary policy shocks, degree of openness of the economy, sensitivity of net exports to exchange rate variations, degree of exchange rate pass through to domestic prices etc. The importance of each of these factors varies over time thus making the effect of a monetary shock on the real exchange rate uncertain.

To examine the role of exchange rates in the Indian economy, we add the log of the real exchange rate ie, reer (36 country, trade wtd. base 2004-05=100) to our basic VAR model. Figure 12 shows the response of output to innovations in cmr. Positive shocks to cmr causes output to rise for two months but then it falls and bottoms out by the eleventh month. Prices fall (Figure 13) and reaches its peak by the seventh month.
and then stabilizes by the twelfth month. Reer depreciates (Figure 14) following a rise in the interest rate which dissipates by the eleventh month. The depreciation of the reer in the Indian context can be explained by the fact that in India, capital flows are not guided too much by interest differentials (Verma and Prakash 2011).

Figure 12: Response of log iip to 1 s.d cmr innovation (exchange rate channel)

Figure 13: Response of log wpi to 1 s.d cmr innovation (exchange rate channel)
FDI and equity flows in India in particular are not responsive to interest rates but to the growth prospects of the Indian economy, confidence of international investors etc. The negative output and price response may be due to weak sentiments about the domestic economy especially after the financial crisis.

**Figure 14: Response of log reer to 1 s.d cmr innovation (exchange rate channel)**

Figure 15 shows the effect of output to innovations in cmr when the exchange rate channel is blocked. We see that the response of output has not changed very much due to this. Thus we conclude that the exchange rate channel does not constitute an important channel of monetary transmission in India.

### 5.4 Direct interest rate channel

To get an idea of the presence of the interest rate channel we augment the baseline VAR model by including simultaneously all the three channel variables as endogenous variables and compare the response with that obtained by making all the three channel variables exogenous (Disyatat et al 2003). It must however be noted that besides these four traditional channels, there could be other channels of monetary transmission (for example, confidence channel) which would be captured in the interest rate channel.
The results from the output responses of both the cases (Figures 16 and 17) show that the interest rate channel accounts for nearly half of the output response after twelve months. This indicates that in the post LAF period the interest rate channel has become an important conduit for monetary policy transmission.

Figure 16: Response of log iip to 1s.d cmr innovation (all channel variables endogenous)
Our study provides a detailed analysis of the monetary transmission mechanism of India. We examined a number of VAR models to examine the various transmission channels of monetary policy using monthly data from 2004 April to 2015 March. The benchmark VAR model is composed of a number of exogenous and endogenous variables. We have identified the benchmark VAR model through the imposition of a number of restrictions on the contemporaneous effects of endogenous variables. The results show that an unanticipated monetary shock leads to an initial positive response of output which is soon reverted and we get an expected negative relationship which dissipates by the seventh month. Prices also fall but stabilize by the twelfth month. The call money rate falls rapidly and touches the baseline level by the eighth month.

We have extended our benchmark model to study the three channels of monetary transmission. This is done by incorporating the relevant channel variable in the vector of endogenous variables of the VAR model. After that lagged values of the same variable is included in the vector of exogenous variables. This is done to block off all interactions between the relevant channel variables and the other endogenous variables.

The results show that the credit channel, asset price channel and the interest rate channel are the important conduits of monetary transmission during the estimation
period. The results are on expected lines as commercial banks constitute an important source of institutional credit in India. Reluctance of banks to disburse credit will ultimately affect output in India. As for the asset price channel, India was a recipient of huge capital flows and a sizeable chunk of it went to equities. India’s steady financial liberalisation has made her integrated with financial markets of developed countries which has caused sizeable fluctuations in asset prices. This has an important relation with domestic investment which is picked up through the asset price channel. The interest rate channel has become important after the adoption of the LAF whereby the RBI has laid more emphasis on developing interest rate as an instrument of monetary transmission.

Lastly the exchange rate channel is found to be weak in our exercise. This is corroborated in other studies on monetary transmission in India (Aleem, 2010; Khundrakpam and Jain, 2012). The reason may be due to the intervention activities of the RBI restricting the movement of the exchange rate during times of increased volatility which impedes the operation of this channel in India.

End notes

1. After the financial crisis of 2008, other channels like portfolio balance channel, confidence channel have also been discussed in the literature.

2. The call money market rate reflects the liquidity conditions after the implementation of the LAF due to its strong correlation with the policy rates (Mohanty, 2012).

References


