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# How Asymmetric is the Monetary Policy Transmission to Financial Markets in India?

## Bhupal Singh[*]

The empirical estimates suggest that short end of the financial market, particularly the call money rate, exhibits a significant and contemporaneous (instantaneous) pass-through of 75 - 80 basis points in response to a percentage point change in the monetary policy rates under deficit liquidity conditions and phases of relatively tight monetary policy. The state of liquidity in financial markets is found to play an important role in conditioning the pass-through of policy rate changes to short end of financial market. A significant asymmetry is observed in the transmission of policy rate changes between the surplus and deficit liquidity conditions, particularly at the short end of financial market, suggesting that maintaining suitable liquidity environment is critical to yielding improved pass-through. There is also considerable asymmetry evident in the transmission of monetary policy to financial markets depending on the tight or easy cycles of monetary policy, which suggests the criticality of attaining a threshold level for the policy rate under each cycle to have desired pass-through. Medium to long term rates such as bank deposit and lending rates also exhibit asymmetrical response to policy rate changes under varied market conditions. The results from the VAR model reiterate that it is the strong presence of transmission lags that leads to higher degree of pass-through to financial markets, thus, underscoring the importance of a forward-looking approach.

## Introduction

Notwithstanding a rich theoretical foundation and large body of empirical literature on monetary policy transmission, policy makers continue to face considerable uncertainty about the impact of policy changes given the lack of direct interface of monetary policy actions with real economic activity, existence of complexities in financial

markets and presence of transmission lags. The presence of long transmission lags also make it challenging to disentangle the impact of monetary policy shocks from other exogenous shocks that may occur in the interregnum. This lack of certainty in actual magnitude and the timing of impact of policy changes on financial and real variables build in considerable caution in policy decisions. Bernanke and Gertler (1995), while raising the concern about the lack of understanding about the transmission mechanism observed that "the same research that has established that changes in monetary policy are eventually followed by changes in output is largely silent about what happens in the interim. To a great extent, empirical analysis of the effects of monetary policy has treated the monetary transmission mechanism itself as a 'black box'." Although this may not be true for many advanced economies where there are less imperfections in asset, labour and goods markets, many developing economies have not yet achieved the same degree of flexibility in such markets, and continue to face challenges in the assessment of monetary policy transmission. Given the considerable rigidities in goods and labour market in most developing economies and resultant complexities in the transmission mechanism, the motivation of this paper is to refrain from investigating the direct causation between the monetary policy shocks and macroeconomic aggregates, rather focus on clearer understanding of propagation of changes in monetary policy to various segments of financial markets.

Monetary policy affects output and prices through its influence on key financial variables such as interest rates, exchange rates, asset prices, credit and monetary aggregates, which is described as monetary transmission mechanism. The complete transmission mechanism of monetary policy to real variables could be understood as a two stage process. In the first stage of transmission, policy actions of central bank both current and expected, transmit through the money market to bond, credit and asset markets, which directly influence the savings, investment and consumption decisions of individuals and firms. This operates through the term structure of interest rates in financial markets; changes in short term rates affect the expectation of the future interest rates and thus, affect the long end of yield curve, which raises the marginal cost of funding long term assets. The second stage

of monetary transmission involves propagation of monetary policy shocks from financial markets to goods and labour markets, which are ultimately reflected in aggregate output and prices[1]. Thus, clarity about the first stage of monetary transmission is vital to understanding the transmission to aggregate output and prices. This is vital in the direction of understanding the market behaviour and bringing about more clarity of the transmission channels. Needless to say that given the great deal of uncertainties surrounding the impact of monetary policy actions on real variables typically in economies where financial market imperfections are prevalent, we consciously resist the temptation of examining the second stage of transmission. The key question that we attempt to examine in this paper is the existence of asymmetries in the transmission of monetary policy rate changes to financial market prices. More precisely, adopting an agnostic approach, we examine how the same magnitude of policy rate change causes varied impact on financial asset prices during different phases of policy cycle, varied liquidity conditions and across the spectrum of maturity. Section II sets out a brief theoretical context to understanding the propagation of monetary shocks to financial markets. We postulate a model explaining asymmetries in response of financial markets to monetary policy shocks in section III. Empirical results on assessment of degree of asymmetries in the response of financial markets to policy shocks are presented in section IV and conclusion in section V.

## Section II
## Theory

Monetary policy actions are transmitted to the rest of the economy through changes in: (i) financial prices, mainly interest rates, exchange rates, bond yields, asset prices; and (ii) financial quantities primarily money supply, credit aggregates, supply of government bonds, foreign currency denominated assets. Policy changes work through financial markets, which act as interface between monetary policy and real economy and are considered to be the purveyors of monetary policy

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1 Mainstream thinking on monetary policy transmission can be gauged from the work of Bernanke and Blinder (1992), Christiano *et al*. (1996), Kuttner and Mosser (2002), Loayza and Schmidt-Hebbel (2002) and Sims (1992).

shocks to real economy. Since monetary policy works through financial markets (by changing interest rates or quantity of money or liquidity), transmission is also contingent on the stage of development of domestic financial markets as also on the inter-linkages between financial markets, the degree of financial integration and inter-sectoral linkages between financial sector and real economy. Second, transmission to financial markets may also be affected by the degree of administrative interventions in determination of financial asset prices. Third, horizontal domestic integration and vertical integration with global market may also significantly affect the speed and efficiency of transmission. Fourth, exchange rate regimes may also have significant influence in determining the pass-through of external shocks on domestic assets and goods prices and may complicate the process of transmission. Further, in real world, trade-off between short run liquidity management and medium term price stability concerns may turn the policy communication challenging and in such situations managing expectations to guide the long run interest rates may turn complicated.

The effectiveness of monetary policy signals depends upon the speed with which policy rates are transmitted to financial markets. The speed and size of pass-through to financial asset prices depends on a number of factors such as volatility in money markets, the extent to which the policy changes are anticipated and maturity structure of banks' balance sheets. In some market segments, presence of structural rigidities in terms of imperfect competition, low integration with other market segments, regulatory norms and high cost of operations may impart inflexibility to market interest rates to respond contemporaneously to policy rate changes. Furthermore, differences in agents' expectations about short and long end of market may be a source of existence of lag in the transmission of policy rates. Understanding the behaviour and complexity of financial markets, thus, assumes critical importance in understanding the standard monetary policy transmission channels.

## Section III
## Model and Data

The following model is postulated to estimate the aggregate impact of monetary policy shocks on various segments of financial markets.

$$rt = \alpha + \sum \gamma i \; rp(t-i) + et \qquad where \; i = 1,...., n \qquad (1)$$

where, $r$ = financial market interest rate, $rp$ = policy rate, $\gamma$ = parameter of lagged policy rate and $i$ = lags.

Impact of changes in policy rates to a large extent can be conditioned by liquidity conditions in financial markets. The best measure of liquidity conditions can be central bank liquidity. Imposing liquidity constraint on equation (1) can yield different magnitude of pass-through of monetary policy rates. Thus, pass-through of policy rates to money markets with a liquidity constraint can be posited as:

$$rt = \alpha + \theta rpt + \lambda Lqt + et \qquad\qquad (2)$$

where, $\lambda$ is the impact of change in liquidity (Lq) on market interest rate.

The net impact of a unit change in policy rate on money markets can be derived as

$$\frac{drt}{drpt} = \theta \; and \; \frac{drt}{dLqt} = \lambda \qquad\qquad (3)$$

where $\theta > 0$ and $\lambda < 0$

Surplus liquidity conditions in domestic money markets would be ultimately reflected in the liquidity adjustment facility balances of commercial banks with the central bank[2]. Monetary transmission is argued to be substantially more effective in a deficit liquidity situation than in a surplus liquidity situation (RBI, 2011). It may, however, be of interest to understand how transmission of policy rates may differ under the surplus and deficit liquidity conditions. Transmission under surplus liquidity condition can be conceptualised in the manner that a change in the policy rate causes the following changes in market interest rates:

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2 The LAF framework was such that the operating policy rate alternated between the repo rate and the reverse repo rate, depending on the prevailing liquidity condition. In a surplus liquidity condition, the reverse repo rate becomes the operating policy rate and in a deficit liquidity situation, the repo rate. Based on the recommendations of the Working Group to Review the Operating Procedure of Monetary Policy in India (Chairman: Shri Deepak Mohanty), the Reserve Bank in May 2011 decided to have only one independently varying policy rate, *i.e.*, the repo rate. The transition to a single policy rate is expected to more accurately signal the monetary policy stance. The reverse repo rate is pegged at a fixed 100 basis points below the repo rate.

$$\frac{drt}{drpt} = \gamma 1 * \delta \qquad\qquad (4)$$

and under the liquidity deficit situation:

$$\frac{drt}{drpt} = \gamma 1 * \theta \qquad\qquad (5)$$

where, $\gamma 1$ is the impact of a unit change in policy rates on short term market interest rates in the absence of either significant liquidity deficit or surplus. In a situation of surplus liquidity (surplus above a certain threshold), a unit change in policy interest rate, *ceteris paribus*, would lead to $\delta\gamma 1$ change in market interest rates given that $\delta<1$. Extending the argument further, the opposite should hold in a situation when the banking system is in liquidity deficit. The transmission in a deficit liquidity situation (beyond a threshold) can be represented as $\phi\gamma 1$, where $\phi>1$. Thus, differential impact of the liquidity surplus or deficit on transmission can be illustrated as:

$\delta\gamma 1 < \gamma 1 < \phi\gamma 1$

In a significant liquidity surplus situation with $\delta<1$, the boundary case could be that an increase in policy rates may have negligible impact on short term target rates of the central bank. The magnitude of $\phi$ would also depend on the extent of deficit liquidity in the system. A deficit above the threshold would yield a higher $\phi$.

We also attempt to estimate responses of various financial asset prices to policy shocks in a dynamic framework using a vector autoregression (VAR) model.[3] The objective of using a VAR model is to understand the dominance of liquidity *vis-a-vis* policy rate shock and the persistence of a shock across various market segments. A (reduced) p-th order VAR, denoted by VAR(p), is

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + ... + A_p y_{t-p} + e_t$$

where c is a $k \times 1$ vector of constants, $A_i$ is a $k \times k$ matrix (for every i = 1, ..., p) and $e_t$ is a $k \times 1$ vector of error terms satisfying: $E(e_t) = 0$, *i.e.*, every error term has mean zero; $E(e_t e_t') = \Omega$, *i.e.*, the contemporaneous covariance matrix of error terms is $\Omega$ (a $k \times k$ positive-definite matrix); $E(e_t e_{t-k}') = 0$ for any non-zero k, *i.e.*, there is no correlation across time, in particular, no serial correlation in individual error terms. The impulse

3  Most empirical studies use vector autoregression (VAR) models to examine the transmission mechanism of monetary policy

response generated from the model would help in understanding the nature of response of financial markets to policy shocks.

For empirical assessment of policy transmission, we use the following variables to estimating the series of models[4]: (i) Reserve Bank's repo rate (rRPO), (ii) weighted average call money rates (rCall), (iii) weighted average CBLO rates (rCBLO), (iv) weighted average market repo rates (rMRPO), (v) weighted average rates on commercial papers (rCP), (vi) weighted average rates on certificates of deposit (rCD), (vii) yield on 91-day treasury bills (rTB91), (viii) average interest rate on 1-month Mumbai Interbank Offer Rate (rMBR1m)[5], (ix) average interest rate on 1-year overnight index swaps (rOIS1y), (x) average secondary market yield on government of India 10-year bonds (r10y), (xi) average yield on AAA-rated 5-year corporate bonds (rCorp), (xii) average interest rates on 1-3 year deposit rates of commercial banks (rD3y), (xiii) average interest rates on lending rates of commercial banks (rLend)[6], (xiv) wholesale price index seasonally adjusted (Lwpi), (xv) banks' outstanding liquidity balances under the liquidity adjustment facility (LAF), (xvi) rupee-dollar exchange rate (EXR), (xvii) Bombay Stock Exchange Sensex (BSE). The data are sourced from Reserve Bank of India, Clearing Corporation of India Limited, International Finance Statistics, IMF, Thomson Reuters Eikon, Thomson Reuters Datastream and the Bloomberg. The sample period for the study is 2001:M3 to 2012:M6, however, a few variables have data beginning later than 2001:M3. The rationale for choosing monthly frequency of data for the analysis is guided by the fact that not all data used in the estimates are available at less than monthly frequency. The specific methodological issues involved in the empirical exercise are contained in Annex A.

## Section IV
## Empirical Results

Before embarking on empirical analysis of the transmission mechanism, it would be pertinent to understand the degree of integration

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4 We have selected most representative benchmarks from each of the market segments.

5 MIBOR represents the interbank rate at which funds are available to the borrowing banks in the call money market. MIBOR is mostly active only in the overnight segment as the term money market in India is not developed.

6 The average lending rate series has been expanded for the recent period by including the base rates of banks. In the bank lending rate equation, we use suitable dummies to capture the shift in the process of determination of banks' lending rates.

**Table 1: Correlation Matrix (Sample: 2001:M3 to 2012:M6)**

| | rCorp | rLend | dLwpi | EXR | LAF | rMBR1m | rOIS1y | r10y | rCall | rCBLO | rCD | rCP | rMRPO | rRPO | rTB91 | rD3y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rCorp | 1.00 | 0.36 | 0.48 | -0.03 | -0.42 | 0.75 | 0.62 | 0.36 | 0.57 | 0.49 | 0.81 | 0.75 | 0.52 | 0.72 | 0.68 | 0.86 |
| rLend | 0.36 | 1.00 | -0.29 | -0.33 | 0.42 | 0.04 | -0.03 | -0.25 | 0.00 | -0.15 | 0.13 | 0.11 | -0.10 | 0.38 | -0.02 | 0.25 |
| dLwpi | 0.48 | -0.29 | 1.00 | 0.04 | -0.59 | 0.51 | 0.55 | 0.55 | 0.46 | 0.52 | 0.49 | 0.46 | 0.52 | 0.41 | 0.54 | 0.34 |
| EXR | -0.03 | -0.33 | 0.04 | 1.00 | -0.17 | 0.04 | -0.23 | -0.12 | 0.05 | 0.10 | -0.05 | 0.00 | 0.09 | -0.15 | -0.07 | 0.10 |
| LAF | -0.42 | 0.42 | -0.59 | -0.17 | 1.00 | -0.79 | -0.69 | -0.54 | -0.69 | -0.77 | -0.72 | -0.70 | -0.77 | -0.66 | -0.81 | -0.46 |
| rMBR1m | 0.75 | 0.04 | 0.51 | 0.04 | -0.79 | 1.00 | 0.80 | 0.45 | 0.87 | 0.84 | 0.94 | 0.90 | 0.86 | 0.89 | 0.94 | 0.73 |
| rOIS1y | 0.62 | -0.03 | 0.55 | -0.23 | -0.69 | 0.80 | 1.00 | 0.79 | 0.74 | 0.76 | 0.80 | 0.63 | 0.76 | 0.87 | 0.90 | 0.50 |
| r10y | 0.36 | -0.25 | 0.55 | -0.12 | -0.54 | 0.45 | 0.79 | 1.00 | 0.45 | 0.52 | 0.48 | 0.30 | 0.50 | 0.55 | 0.62 | 0.28 |
| rCall | 0.57 | 0.00 | 0.46 | 0.05 | -0.69 | 0.87 | 0.74 | 0.45 | 1.00 | 0.92 | 0.78 | 0.77 | 0.95 | 0.79 | 0.85 | 0.50 |
| rCBLO | 0.49 | -0.15 | 0.52 | 0.10 | -0.77 | 0.84 | 0.76 | 0.52 | 0.92 | 1.00 | 0.73 | 0.72 | 1.00 | 0.79 | 0.89 | 0.46 |
| rCD | 0.81 | 0.13 | 0.49 | -0.05 | -0.72 | 0.94 | 0.80 | 0.48 | 0.78 | 0.73 | 1.00 | 0.87 | 0.76 | 0.86 | 0.90 | 0.81 |
| rCP | 0.75 | 0.11 | 0.46 | 0.00 | -0.70 | 0.90 | 0.63 | 0.30 | 0.77 | 0.72 | 0.87 | 1.00 | 0.76 | 0.76 | 0.81 | 0.75 |
| rMRPO | 0.52 | -0.10 | 0.52 | 0.09 | -0.77 | 0.86 | 0.76 | 0.50 | 0.95 | 1.00 | 0.76 | 0.76 | 1.00 | 0.81 | 0.90 | 0.49 |
| rRPO | 0.72 | 0.23 | 0.41 | -0.15 | -0.66 | 0.89 | 0.87 | 0.55 | 0.79 | 0.79 | 0.86 | 0.76 | 0.81 | 1.00 | 0.94 | 0.64 |
| rTB91 | 0.68 | -0.02 | 0.54 | -0.07 | -0.81 | 0.94 | 0.90 | 0.62 | 0.85 | 0.89 | 0.90 | 0.81 | 0.90 | 0.94 | 1.00 | 0.63 |
| rD3y | 0.86 | 0.25 | 0.34 | 0.10 | -0.46 | 0.73 | 0.50 | 0.28 | 0.50 | 0.46 | 0.81 | 0.75 | 0.49 | 0.64 | 0.63 | 1.00 |

rCorp = yield on AAA-rated corporate bonds, rLend= average lending rates of commercial banks, dLwpi = inflation rate, EXR= rupee-USD exchange rate, LAF = outstanding liquidity under the liquidity adjustment facility, rMBR1m = 1-month MIBOR rate, rOIS1y = 1-year OIS yield, r10y= yield on 10-year govt. bond, rCall = weighted average call money rates, rCBLO =weighted average collateralised borrowing and lending rates, rCD = weighted average rate on certificates of deposits, rCP = weighted average rate on commercial papers, rMRPO = average interest rate on market repo transactions, rRPO = repo rate of the Reserve Bank, rTB91 = yield on 91-day treasury bills, rD3y = average interest rate on bank deposits of 1-3 year maturity.

**Note:** Some of the data series start later than 2001:M3.

of prices of various financial assets. A simple correlation analysis of the spectrum of interest rates in India presented in Table 1 exhibits a reasonably high degree of market integration. Broadly, the short end of the financial markets has higher degree of correlation with policy rates as well as with liquidity conditions in financial markets. Nevertheless, the long end of the market such as bank lending rates and interest rates on corporate bonds is also found to be correlated with the policy rate. Thus, Table 1 provides the starting point for further exploring the impact of policy rate changes on financial markets.

We estimate the pass-through of policy interest rates to financial asset prices in the framework of a distributed lag model as monetary policy may impact different segments of financial markets with varying lags[7]. Furthermore, from a policy perspective, it is important to assess the impact of policy changes in a forward looking manner. In other words, a realistic assessment of the impact of policy changes has to take into account (a) lags involved in the transmission, and (b) differences in the contemporaneous and the lagged impact of policy changes on market interest rates.[8]

**(i)   Monetary transmission to the short and long end of financial markets : A baseline case**

Due to the presence of unit roots in the variables, differenced terms were used for estimation (See Annex Table 1). Only the significant lags were retained in the model. We use dummy variables in the models to control for the effects of extreme events in financial markets generated by unanticipated exogenous shocks and which cannot be explained by other variables.[9] All the models are tested for residual diagnostic tests by

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7 We face constraints in empirically replicating the theoretical model postulated in section III due to practical difficulties in transforming liquidity balances into log levels due to the presence of negative numbers.

8 The framework used in this section to assess the impact of monetary policy shocks seems to be akin to a closed economy model as external shocks, particularly fluctuations in capital flows, are not taken into account. We would, however, like to emphasise that domestic liquidity effects of capital flows are indirectly reflected in liquidity deficits or surpluses under the LAF for banks.

9  Controlling for such extreme events is vital to deriving unbiased estimates of the impact of policy rates changes on financial asset prices.

using Breusch-Godfrey Serial Correlation LM Test.[10] All the specified models are found to be free from serial autocorrelation problem. We begin with estimating models for assessing the impact of policy rate changes (repo rate) on financial markets without differentiating either between liquidity deficit and surplus conditions or tight and easy monetary policy phases (see Chart 1 and 2 and Annex Table 2 and 3).[11] Thus, the analysis below does not attempt to capture the impact of policy rate changes under different market conditions.

First, as expected, the transmission of policy rates is instantaneous and large for money market as compared with the longer end of financial market.[12] Transmission to financial markets improves significantly as the lagged impact of policy rate changes takes effect. Second, call money market seems to be highly sensitive to the policy rate changes and displays substantial pass-through with lag effects in response to policy rate shocks. Third, policy rate changes are likely to impact the working capital cost of the corporates significantly as a policy rate shock tends to cause considerable increase (decrease) in the interest rates on commercial papers. As the funding cost of banks in the overnight market increases significantly, banks may pass it on by raising short term lending rates for corporates. Fourth, expectations seem to play an important role in explaining the market behaviour in response to policy rate shocks, as an initial shock could be construed by the market as continuation of policy rate cycle of the central bank. This is reflected in relatively strong response of 1-month MIBOR and 1-year OIS markets to policy rate shocks. The assessment of the transmission process towards the short end of financial markets suggests that between 40 to 75 basis points pass-through of a percentage point change in policy rates is realised in the same month, indicating a high degree of instantaneous pass-through (Chart 1). This can be attributed to a reasonable degree of integration of money markets observed in India (see Bhoi and

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10 The tests do not reject the null hypothesis of no serial correlation. We also use Newey-West HAC Standard Error criteria for heteroskedasticity robust standard error adjustment.

11 While changes in policy rate transmit to market interest rates including lending rates, monetary impact of changes in reserve requirements through cost of funds has separate transmission to bank lending rate. However, the major part of the changes in CRR is captured through liquidity changes, which is attempted in the subsequent analysis.

12 It is sometimes argued that short term money market rates typically factor in the expected changes in policy rates before the monetary policy announcements. Some segments of money market react to the buildup of expectations of policy rate changes a few days before the policy announcement. The impact of such expectations in an analysis of pass-through based on monthly average interest rates would be, however, captured contemporaneously.

**Chart 1: Transmission of policy rate changes to the short end of financial markets**
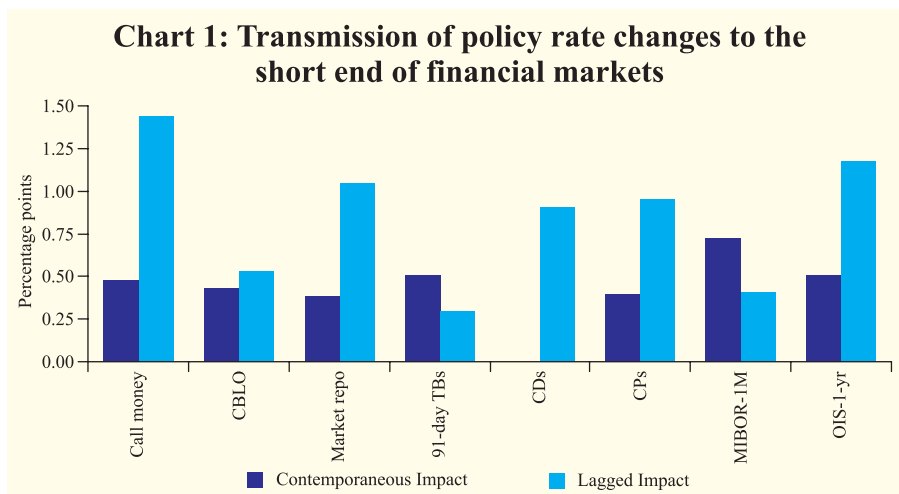


Dhal, 1998). The existence of the lag effects of policy rate changes is considerable across market segments.

Central banks often find it challenging to guide long-term interest rates, which basically directly impact the saving and investment decisions of economic agents and hence impact the macroeconomic aggregates such as output and prices. Therefore, for transmission to be effective, the short term interest rates should be significantly transmitted to long term interest rates. In theory, short end (money markets) and long end (capital markets) of financial markets are connected through expectations.13 Thus, transmission of changes in policy rates to long end of financial markets assumes critical importance. Empirical estimates suggest that bank deposit and lending rates exhibit longer lags in transmission (Chart 2 and Annex Table 3). The transmission of policy rates to deposit rates increases overtime. The presence of long lags may emanate from the fact that banks seem to be cautious about adjusting deposit rates in response to the central bank's policy rate signals due to a variety of reasons such as expectation formations regarding the likely path of future interest rates and the fear of losing their deposit base to small savings and other competing investment avenues. Regarding the long lags in lending rates, it could be possible that banks are unable to adjust their lending rates swiftly in response to policy signals until they

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13  According to the expectations hypothesis of term structure, long term interest rates are an average of expected short term interest rates. The link between short and long term rates may, however, weaken due to a number of factors such as future uncertainty about the interest rate environment, time varying risk premia and structural changes in the financial market and the real economy.

**Chart 2: Transmission of policy rate changes to the long end of financial markets**
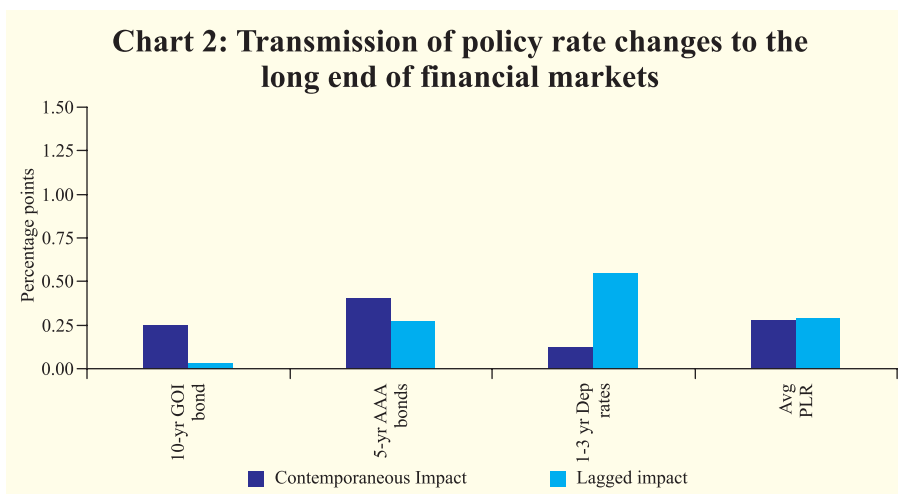


are able to adjust on the cost side by repricing the fixed-rate deposits in the next cycle. It is also possible that longer lags in deposit rates feed into lending rates adjustments. Besides these, adjustment cost of frequent revisions in lending rates and borrowers' aversion to recurrent fluctuations in cash flows may also be constraints on banks in adjusting lending rates frequently in response to changes in policy rates. Thus, due to the aforementioned structural rigidities in the deposit and credit markets, contemporaneous pass-through of policy rates to these segments seems to be low. Nevertheless, the lagged transmission of policy rate changes to deposit and lending rates seems to be reasonably significant, which has important implications for savings and investment activities.

Pass-through of policy rate changes to long term government bonds yield (*r10y*) though relatively low, is reasonably instantaneous. The corporate bonds yields (*rCorp*) show relatively faster contemporaneous transmission of policy rates changes as compared with bank lending rates due to differences in the structure of these two markets. This could also be attributed to the fact that capital markets price in market developments at a faster rate as compared with credit markets.

**(ii) Does the monetary policy transmission improve during deficit liquidity conditions?**

Central banks typically operate at the short end of financial markets by modulating liquidity (mainly overnight liquidity). It is argued that monetary transmission is substantially more effective in a deficit liquidity situation than in a surplus liquidity situation (RBI,

2011). We empirically test the hypothesis whether transmission is significantly different during the deficit liquidity from that of the surplus liquidity conditions. As liquidity position is either in surplus or deficit mode, represented in positive and negative values, normalising such series to log poses challenge. In order to empirically test the model $rt = \alpha + (\gamma1 * \phi)\ rpt + et$ postulated for the liquidity deficit situation, we capture liquidity deficit impact through a dummy variable (*DLDef*) which assumes a value 1 for liquidity deficit conditions and 0 otherwise.[14] The empirical estimates from a standard distributed lag model for call money market based on the sample period 2001:M3 to 2012:M6 are presented in Table 2.

The estimates suggest that liquidity deficit has an important role in causing changes in money market rates. Thus $\gamma1$ assumes a value of 1.84 and $\phi$ a value of 0.82, indicating that liquidity has important role in propagating monetary policy transmission. It is evident from Table 2 that after controlling for liquidity deficit, the contemporaneous term turns insignificant and hence dropped from the model. This also seems to suggest that when there is absence of liquidity stress, overnight market rate responds gradually to policy rate changes. The limitation of this model is that deficit or surplus values of varying magnitudes which have significantly differential impact on market interest rates, are assumed to be the same.[15] In order to overcome this limitation, we split the sample into periods of surplus and deficit liquidity. Based on some broad empirical observation of sample, we treat LAF deficit as conditions of liquidity stress. The empirical estimates suggest significant asymmetric behaviour of call rates, commercial paper yield and short term treasury bill yield to changes in policy rates during the deficit liquidity conditions *vis-a-vis* surplus liquidity conditions (Chart

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14  We use net LAF as a measure of overall liquidity deficit/surplus conditions in each of the money markets. Under the LAF window, banks can borrow or place funds with the central bank. Banks are players in all market segments, be it call money, market repo or CBLO. Their liquidity needs thus influence prices in each of the money market segments. This is also evident in the degree of correlation between LAF liquidity with interest rates in call money, market repo and CBLO ranging between 0.68-0.72. Call money is an interbank market. In CBLO segment, while banks are borrowers, Mutual Funds (MFs) are mainly the lenders. In market repo, while borrowings are mainly by banks and Primary Dealers, lenders are banks and MFs. Thus, it is the overall liquidity conditions prevailing in money markets on a particular day that affect the pricing in each of the segments.

15 If one uses dummy variable for periods of deficit/surplus liquidity under the LAF, the caveat is that it does not distinguish between the levels of liquidity, which could significantly alter the estimates of transmission to financial asset prices.

**Table 2: Transmission of policy rate changes to short term interest rates after controlling for liquidity conditions (Dependent variable: call money rates)**

| Variable | Coefficient | t-Statistic |
|---|---|---|
| C | 5.55 | 7.62 |
| drRPO(-1) | 0.61*** | 2.99 |
| drRPO(-2) | 0.70** | 2.06 |
| drRPO(-3) | 0.53** | 2.17 |
| DLDef | 0.96*** | 7.07 |
| DLDef*drRPO | 0.82*** | 5.41 |
| DUM2007M3 | 6.17*** | 32.32 |
| DUM2007M6M7 | -5.04*** | -19.78 |
| DUM2008M9 | 0.99*** | 3.82 |
| AR(1) | 0.93*** | 23.18 |
| $R^2$ | 0.94 | |
| DW stats | 1.95 | |
| LM test stats | 0.04(F-stats) | 0.96(prob) |

drRPO = changes in policy rates, DLDef = dummy variable representing periods of liquidity deficit conditions, DLDef*drRPO = interaction dummy variable to capture liquidity deficit impact, DUM2007M3, DUM2007M6M7, DUM2008M9 = dummy variables for extreme market volatility during particular months that are not explained by other variables.

3 and 4)[16]. The instantaneous pass-through of policy rate changes to call money rate during deficit liquidity conditions is nearly 75 basis points in response to a percentage point change in policy rate. More importantly, the lag impact is relatively much strong during the deficit than the surplus conditions, suggesting that one should take into account the persistence in the impact of policy rate change rather merely looking at the instantaneous change in order to assess the impact on financial assets and hence macro aggregates.

A distinct empirical observation is that transmission of policy rates is higher for bank deposit rates during liquidity surplus conditions. This could be a reflection of banks' behaviour of passing on to depositors the reductions in interest rates faster than the increases.[17] Overall, the

16 In empirical estimation, we used the approach of step-wise regression, *i.e.,* dropping the lags which turned out to be insignificant.

17 This is a preliminary observation which may require further empirical scrutiny.

**Chart 3: Transmission of policy rate under deficit liquidity conditions**
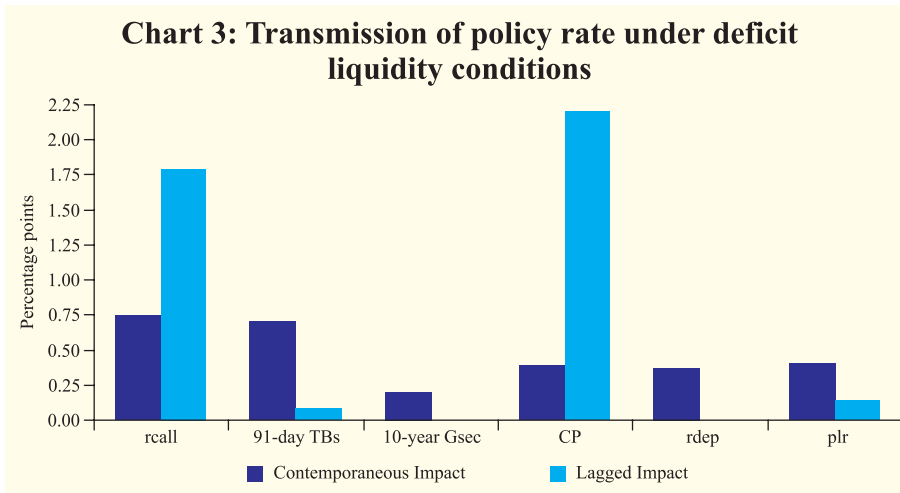


persistence of shocks seems to be higher during the deficit liquidity conditions than during surplus conditions (see Annex Table 4 and 5 for detailed results).

## (iii) How asymmetric is the transmission during tight and easy phases of monetary policy?

The transmission of policy rates to financial markets is also affected by the state of the monetary policy cycle. We believe that there exists a threshold level of policy rate that has significant bearing on prices of financial assets. For the purpose of empirical analysis, we assume that all (nominal) policy rate changes above 7 per cent, which is a long period

**Chart 4: Transmission of policy rate under surplus liquidity conditions**

**Chart 5: Transmission of policy rate under the tight cycle of monetary policy**
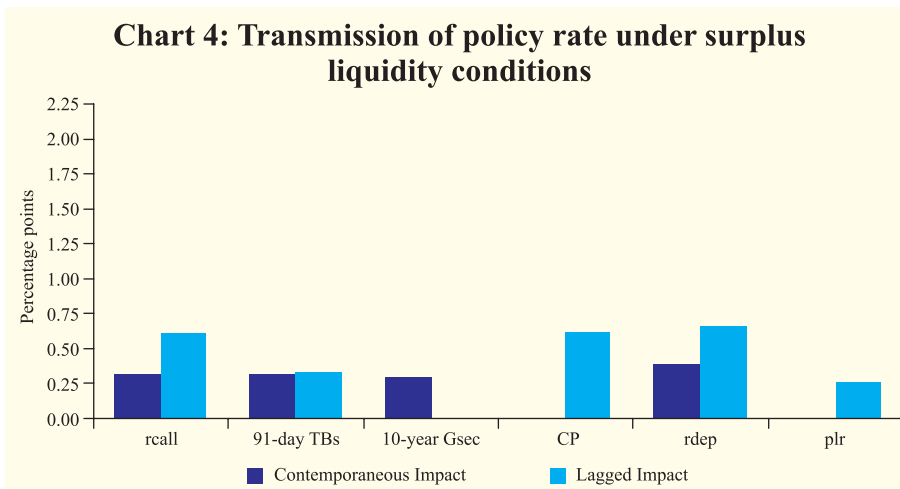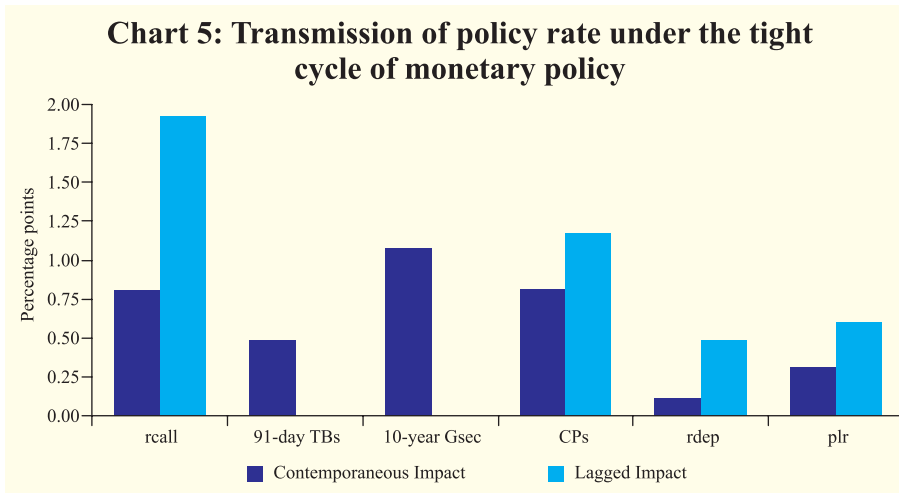


average of policy rates during all cycles, imply that monetary policy is operating in a tight phase.[18] Thus, it is assumed that all policy rate changes above a threshold rate would have relatively strong impact on financial asset prices than the policy rate changes below this threshold. Charts 5 and 6 reveal that policy rate changes have a significantly higher impact during tight phase of monetary policy for call money, commercial papers and bank lending rates (detailed results in Annex Table 6 and 7). The instantaneous pass-through of a percentage point increase in policy rate to call money rates is 81 basis points during

**Chart 6: Transmission of policy rate under the easy cycle of monetary policy**
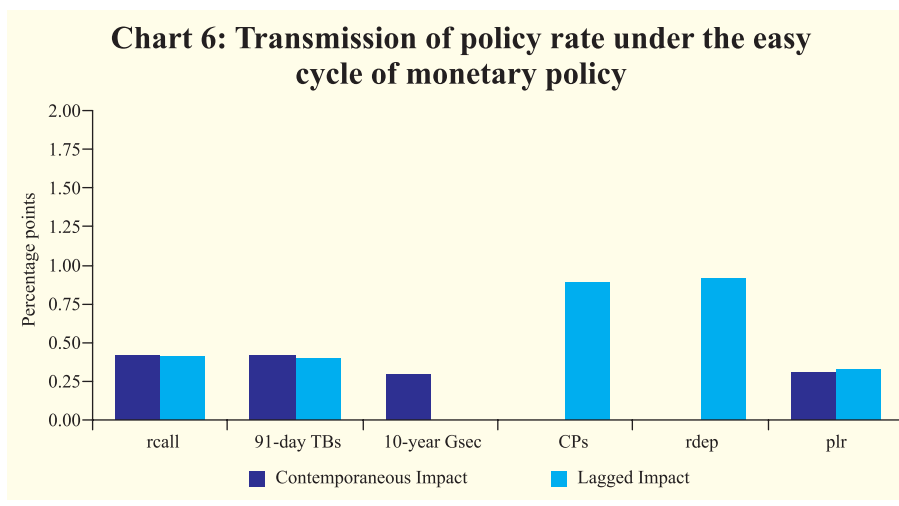


18  Some studies in the Indian context have found about 7 per cent as neutral policy rate (Singh, 2010).

tight monetary policy phase as compared with merely 41 basis points during the easy monetary policy. Further, the results indicate presence of procyclicality in the behaviour of interest rates facing the corporate sector as transmission is more pronounced during the tight phase of the policy cycle. Thus, achieving a threshold level of interest rate is critical to have desired impact of policy rate changes on financial markets and the real economy. However, there does not seem to be evidence of noticeable differences in the instantaneous transmission of policy rates to short term treasury yield. It is also observed from Charts 5 and 6 that transmission of policy rate is significantly higher during the tight phases of monetary policy due to presence of strong transmission lags. A reverse asymmetry is found with respect to bank deposit rates, which could be attributed to bank's behaviour of passing on decreases in interest rates faster than the increases.

**(iv)  An assessment of liquidity and policy rate shocks during varied financial market conditions: Results from VAR models**

In view of structural changes as well as financial innovations, the size of the pass-through as well as the precise transmission lags may differ during the business cycles. In order to further explore monetary transmission to financial markets, we estimated two VAR models, one for the short end of financial market and the other for the long end.[19] First, a 7-variable VAR model is estimated based on monthly data for the period 2001:M3 to 2012:M6, in an attempt to assess the response of short term financial assert prices to policy rate and the liquidity changes.[20] The variables in the VAR model are: Liquidity under the LAF, changes in policy rates (rRPO), weighted average call money rates (rCall), yield on 91-day treasury bills (rTB91), weighted average rates on commercial papers (rCP), BSE Sensex and rupee-dollar exchange rate (EXR). In the model, the variable on deficit liquidity under the LAF (D=1 for liquidity deficit condition and 0 otherwise) is introduced so that the model does not lead to overestimation of the impact of

19  The optimum lag length for the models is chosen to be 3 months based on alternative information criteria. The lag length for most distributed lag models estimated also reveals that maximum significant lag is 3 months.

20  We estimate the VAR by differencing the non-stationary series, wherever required. The stationarity conditions are satisfied by using diagnostic tests such as ADF test and Phillips-Perron test.

**Chart 7: Impulse responses of the short end of financial markets in India to shocks to policy rates and liquidity**
**(Model : DLDef, rRPO, rCall, rTB91, rCP, BSE, EXR)**
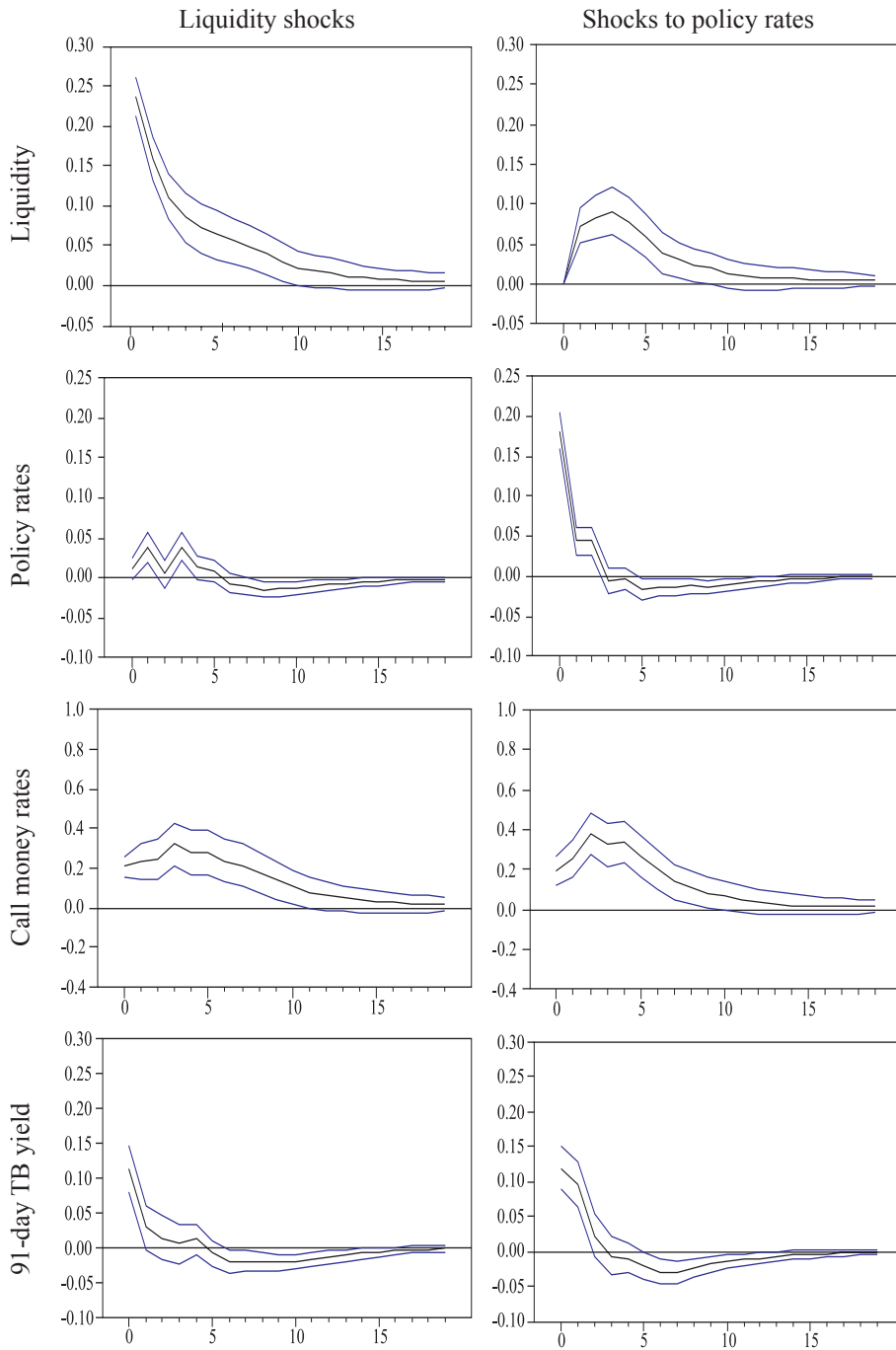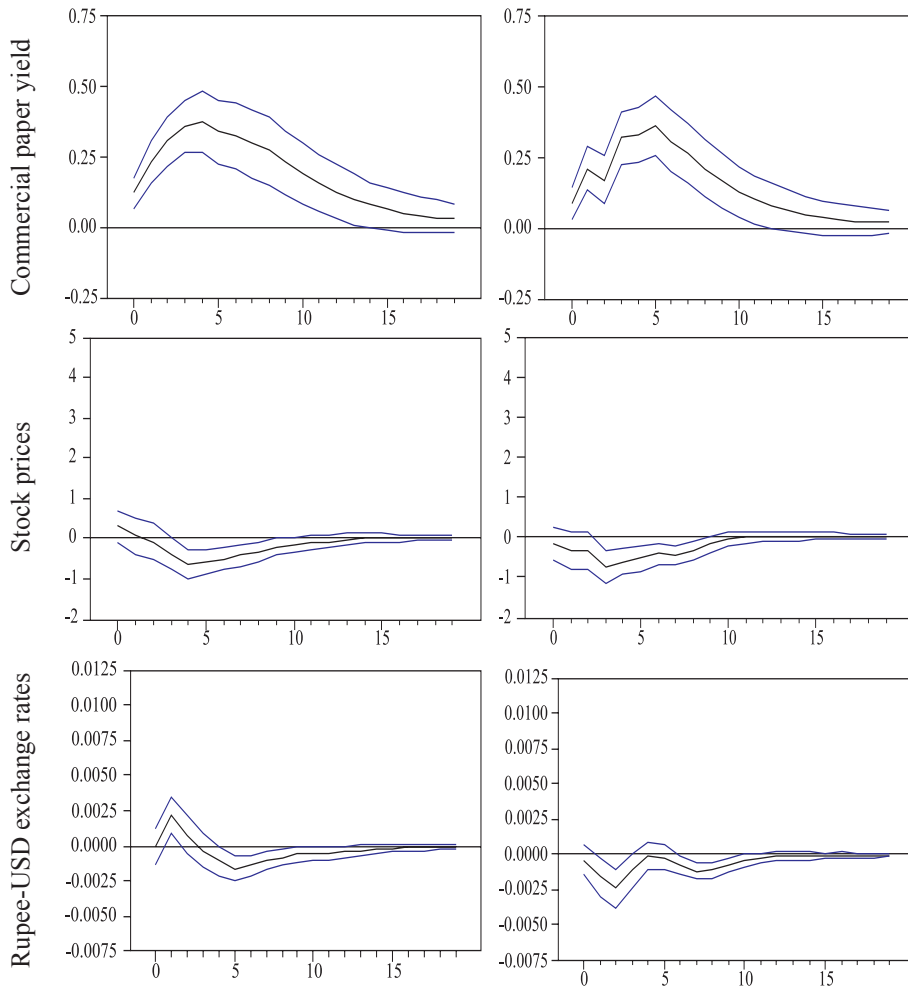
interest rate shocks.[21] There is evidence of significant impact of policy rates shocks on the short end of the financial market, including stock prices and exchange rate (Chart 7).[22] The peak impact of policy rate shocks to money markets is realised after a lag of 1-5 months. An initial shock to liquidity and policy rates affects call money, treasury bill and commercial paper yield with persistence of shocks varying from 2-10

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21 The usual limitation of using such formulation, as explained earlier, is that it does not differentiate between the levels of liquidity surpluses or deficits.

22  For the impulse responses, Bootstrapping method is used to generate confidence intervals. It is the empirical distribution function and not some pre-specified distribution such as the Normal that is used to generate the random variables. The bootstrap sample is a random sample of size T drawn with replacement from the observed data putting a probability of 1/T on each of the observed values.

months. A positive policy rate shock also leads to some moderation in stock prices with a lag and persists for a short period. Thus, asset price channel of monetary policy seems to be in operation.[23] It would however, be too early to conclude about the considerable wealth effect of monetary policy shocks given the limited household ownership of stocks in their asset portfolio in India. We also find some evidence of exchange rate channel of monetary policy. The nominal rupee-dollar exchange rate appreciates in response to policy rate shocks, though the impact is transitory.[24] Regarding the impact of liquidity shocks on financial assets, it is generally found that liquidity shocks are less pronounced *vis-a-vis* interest rate shocks. Overall, the results suggest varying persistence of monetary policy shocks across the short end of financial market. The counter-factuals on the impact of policy rate shocks on financial market prices with and without controlling for liquidity conditions are presented in Appendix 1 and 2.

We also estimate a 6-variable VAR model based on monthly data for the period 2002:M2 to 2012:M6 to examine how the long end of financial market responds to policy rate changes.[25] [26] The variables included in the VAR model are: Liquidity under the LAF, changes in policy rates (rRPO), average secondary market yield on government of India 10-year bonds (r10y), average interest rates on 1-3 year deposit rates of commercial banks (rD3y), average yield on AAA-rated 5-year

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23 The argument of the paper is not that monetary policy shocks are able to explain the entire changes in asset prices but it is making the case that policy rates do cause changes in asset prices. There is a large body of theoretical as well as empirical literature on the subject and we avoid putting those details here.

24 According to the Dornbusch overshooting model, when a change in monetary policy occurs, markets adjust to a new equilibrium between prices and quantities. Initially, because of the 'stickiness' of prices of goods, the new equilibrium level will first be achieved through shifts in financial market prices. Then, gradually, as prices of goods adjust to the new equilibrium, the foreign exchange market continuously reprices, approaching its new long term equilibrium level. Thus, foreign exchange market initially overreacts to a monetary change, achieving a new short term equilibrium. However, over time, goods prices eventually respond, allowing the foreign exchange market to dissipate its overreaction, and the economy to reach a new long run equilibrium price.

25 It is believed that policy rate changes first affect the short end of financial market, which in turn impacts long end of the market. In order to test this counter-factual, we estimated a VAR model including call money rates. The results of the model with and without call money rates do not seem to be significantly different.

26 Based on alternative information criteria, we choose a lag length of 4 months in this model.

**Chart 8: Impulse responses of the long end of financial markets in
India to shocks to policy rates and liquidity
(Model : DLDef, rRPO, r10y, rD3y, rCorp, rLend)**
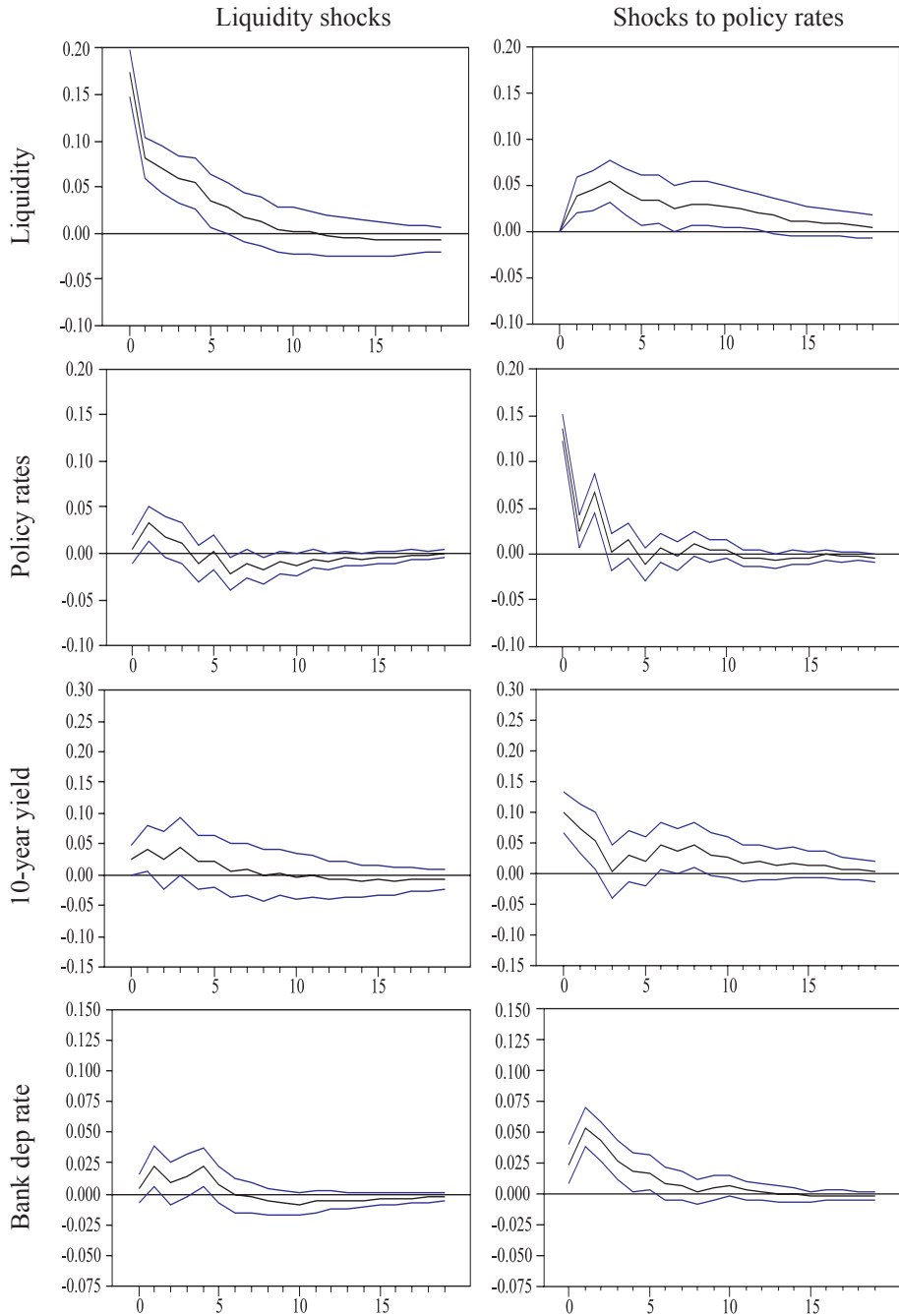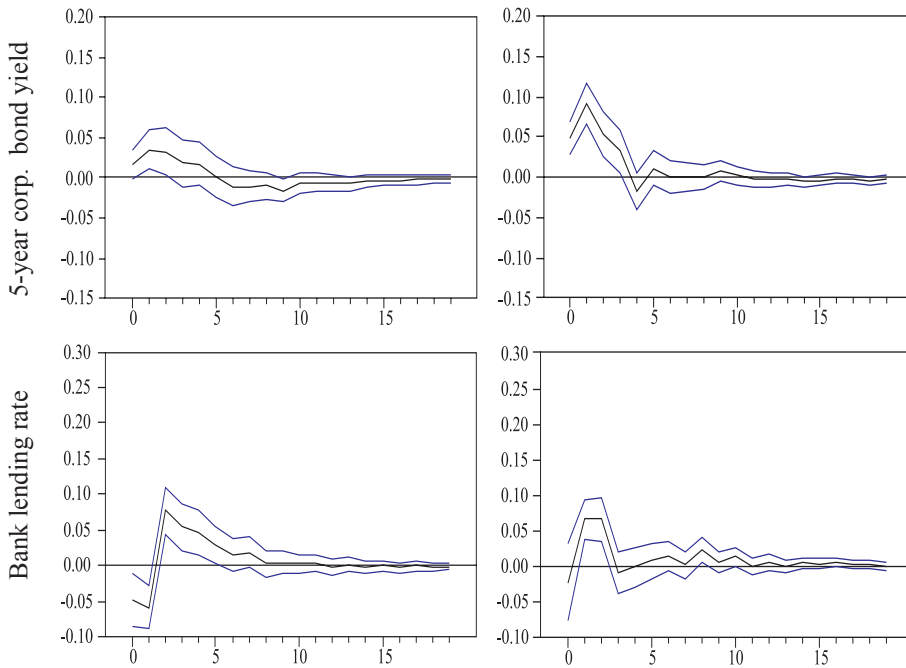
corporate bonds (rCorp) and average interest rates on lending rates of commercial banks (rLend). The impact of policy rate shock on long term interest rates, though relatively less pronounced as compared to short end of the markets, is found to be significant. The interest rate channel rather than the quantity channel is found to be dominant towards the long end of the markets. There are also lags observed in transmission of policy rates shocks to long term interest rates.[27] Bank lending channel of monetary policy transmission seems to be evident as policy rates impact both deposit and lending rates. Nevertheless, there is greater persistence of policy rate shocks on deposit rates as compared with lending rates, reflecting the pricing behaviour. The less pronounced impact of policy rate shocks on lending rates can also be seen in the context of the fact that long term interest rates are also influenced by a number of other factors such as fiscal position of government, inflation expectations and

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27 An important implication of this empirical finding is that given the lags in transmission of policy rate shocks to long end of financial markets, there are bound to be longer lags in transmission of monetary policy to real economy.

assessment of credit risk by economic agents (Chart 8).[28] A comparative assessment of the impulse responses suggests that a shock to policy rate leads to significant change in yield on 10-year government bonds. As the government bond yield acts as a benchmark for corporate bond pricing, changes in sovereign bond yields are instantaneously priced in the corporate bonds. While the changes in liquidity conditions have only transitory impact on corporate bond yields, there is some tendency of short run persistence in the response of corporate bond yields to policy rate shocks. A comparative picture of the responses of long end of financial asset prices to policy rate shocks with and without controlling for liquidity conditions is presented in Appendix 3 and 4.

## Section V
## Conclusion

The evidence suggests that transmission of monetary policy changes is instantaneous and large for money market as compared with the long end of financial markets in India. During deficit liquidity and tight phase of monetary policy, there is evidence of about 75-80 basis points contemporaneous pass-through to money market interest rate of a percentage point change in policy rate suggesting a reasonably high degree of pass-through. The pass-through improves significantly during the tight cycles of monetary policy. Bank deposit and lending rates exhibit longer lags in transmission with cumulative pass-through of about 50-70 basis points in response to changes in policy rate. Regarding the lags in the transmission of policy rates to lending rates, it could be possible that banks are unable to adjust their lending rates swiftly in response to policy signals until they are able to adjust on the cost side by repricing the fixed-rate deposits in the next cycle. To the extent that there exists significant wedge between the response of short term and long term interest rates to monetary policy changes, greater is the burden of adjustment on policy interest rates in order to have desirable effect on real variables. Across the maturity spectrum, there is existence of asymmetry in response of financial markets to policy

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28  It is also believed by some that bank lending channel of transmission could be weakened in India due to access of large corporate to overseas markets through overseas commercial borrowings.

rates changes depending on the state of liquidity in financial markets and the cycle in which monetary policy is operating. The pass-through of policy rates is found to be significantly higher in deficit liquidity conditions and during the tight monetary policy cycle largely due to the presence of transmission lags. Such transmission lags also reemphasise the importance of forward-looking approach to the policy.

The results from a VAR analysis of policy rate and liquidity shocks suggest that the quantity channel operates along with the interest rate channel towards the short end of financial markets and both liquidity and interest rate shocks seem to be equally persistent. It is the interest rate channel of monetary policy transmission that is dominant towards the long end with persistence varying from 4 to 10 months. Thus, the dominant impact of interest rate channel in affecting long term interest rates brings out the stabilisation role of monetary policy. The estimates also exhibit that both the exchange rate and asset price channel of monetary policy are in operation. The exchange rate channel of transmission reveals that policy rate shocks and domestic liquidity tightening both lead to initial appreciation of nominal exchange rate, which does not seem to be persistent. There is some evidence of the wealth channel of monetary policy as positive interest rate shocks are found to cause a reduction in stock prices, which may impact on household wealth and hence consumption demand. This would, however, be limited, given the lower share of stocks in total household wealth in India.

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## Annex A: Methodological Issues

(i) List of variables: rRPO = repo rate of the Reserve Bank, rCall = weighted average call money rates, rCBLO = weighted average collateralised borrowing and lending rates, rMRPO = average interest rate on market repo transactions, rTB91 = yield on 91-day treasury bills, rCD = weighted average rate on certificates of deposits, rCP = weighted average rate on commercial papers, rOIS1y = 1-year OIS yield, rMBR1m = 1-month MIBOR rate, rD3y = average unweighted interest rate on bank deposits of 1-3 year maturity, r10y= yield on 10-year govt. bond, rLend= avg. lending rates of commercial banks, rCorp= yield on AAA-rated corporate bonds, dLwpi = change in log of wholesale price index, EXR = rupee-dollar exchange rate, SENSEX = BSE Sensex. These notations have been referred to in the foregoing analysis. The data used are monthly averages rather than end month data as the end month figures could be subject to volatility and may not be appropriate to capture the underlying relationships between the variables. LAF outstanding for a month is the average of daily outstanding balances during the month. Average bank lending rate is the prevailing unweighted lending rate and not the average rate on outstanding credit. Rupee-dollar exchange rate and BSE 30 share SENSEX are average of daily closing rates/prices.

(ii) Identification of deficit and surplus liquidity samples: A month has been labelled as liquidity deficit or surplus depending on the average daily balances in deficit or surplus mode. However, we have also applied our judgement in defining some of the months as liquidity deficit or surplus depending on how many days the liquidity was in surplus or deficit and depending on the level of surplus or deficit so as to retain some element of time series properties while classifying the samples (see Chart A). Based on these properties, sample has been reclassified for the analysis.



**Chart A: Net Liquidity Adjustment Facility (LAF) Balances**
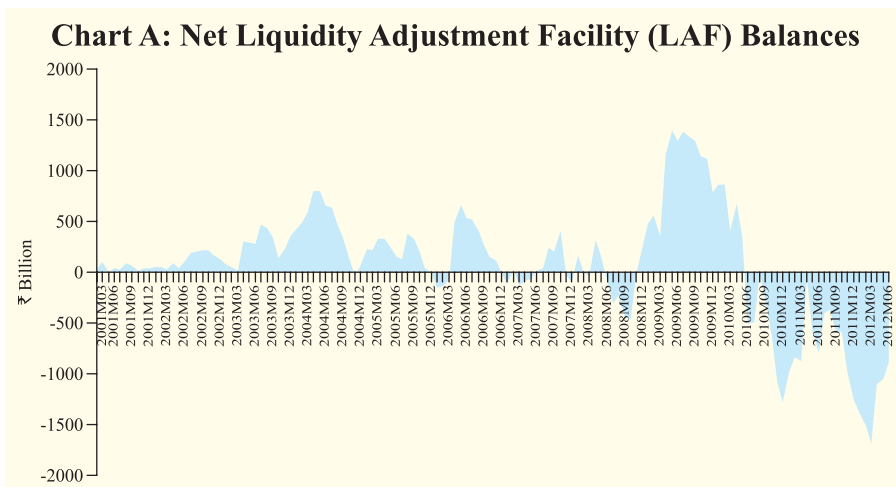
(iii) Identification of tight and easy monetary policy cycles: There are a few studies in the Indian context which point to a neutral nominal policy rate of about 6.5 to 7 per cent. Further, a preliminary alalysis reveals that the average WPI inflation rate during the period 2001-02 to 2011-12 was about 6.5 per cent (excluding some months with abnormally low or negative inflation rate during global financial crisis) and the average nominal policy rate of 6.8 per cent, implying a negligible real policy interest rate. It may be noted that although the concept of neutral rate is understood in terms of real interest rate in advanced economies, in case of emerging market economies like India, where there is relative volatility in inflation, a nominal measure of neutral rate may be more appropriate to assess the policy stance. Rather than going into the debate of the neutral policy rate, we assume that on an average above 7 per cent would indicate a tight monetary policy stance. Accordingly, the sample has been reclassified for the two sub periods.

**Annex Table 1: Unit Root tests**

| Variables | Level/ First diff. | Augmented Dickey-Fuller test statistic | Phillips-Perron test statistic | Test critical values | | |
|---|---|---|---|---|---|---|
| | | | | 1% level | 5% level | 10% level |
| rRPO | level | -2.6 | -2.2 | -3.5 | -2.9 | -2.6 |
| | Δ | -4.8 | -7.4 | -3.5 | -2.9 | -2.6 |
| rCall | level | -4.0 | -3.9 | -3.5 | -2.9 | -2.6 |
| rCBLO | level | -3.2 | -2.7 | -3.5 | -2.9 | -2.6 |
| rMRPO | level | -3.5 | -3.1 | -3.5 | -2.9 | -2.6 |
| rTB91 | level | -1.9 | -2.3 | -3.5 | -2.9 | -2.6 |
| | Δ | -9.5 | -9.5 | -3.5 | -2.9 | -2.6 |
| rCD | level | -1.9 | -2.0 | -3.5 | -2.9 | -2.6 |
| | Δ | -10.9 | -10.9 | -3.5 | -2.9 | -2.6 |
| rCP | level | -2.8 | -2.8 | -3.5 | -2.9 | -2.6 |
| rOIS1y | level | -3.1 | -2.5 | -3.5 | -2.9 | -2.6 |
| rMBR1m | level | -2.5 | -2.3 | -3.5 | -2.9 | -2.6 |
| | Δ | -7.9 | -7.9 | -3.5 | -2.9 | -2.6 |
| rD3y | level | -1.5 | -1.5 | -3.5 | -2.9 | -2.6 |
| | Δ | -5.6 | -5.7 | -3.5 | -2.9 | -2.6 |
| r10y | level | -2.8 | -2.8 | -3.5 | -2.9 | -2.6 |
| rLend | level | -1.5 | -1.4 | -3.5 | -2.9 | -2.6 |
| | Δ | -8.0 | -8.1 | -3.5 | -2.9 | -2.6 |
| rCorp | level | -2.0 | -2.1 | -3.6 | -2.9 | -2.6 |
| | Δ | -7.2 | -7.2 | -3.6 | -2.9 | -2.6 |

rRPO = repo rate of the Reserve Bank, rCall = weighted average call money rates, rCBLO = weighted average collateralised borrowing and lending rates, rMRPO = average interest rate on market repo transactions, rTB91 = yield on 91-day treasury bills, rCD = weighted average rate on certificates of deposits, rCP = weighted average rate on commercial papers, rOIS1y = 1-year OIS yield, rMBR1m = 1-month MIBOR rate, rD3y = average interest rate on bank deposits of 1-3 year maturity, r10y= yield on 10-year govt. bond, rLend= avg. lending rates of commercial banks, rCorp= yield on AAA-rated corporate bonds. These notations may be referred to in the subsequent analysis.

**Annex Table 2: Transmission of policy rate changes to the short end of financial markets**

| Variables | rCall | rCBLO | rMRPO | rTB91 | rCD | rCP | rMBR1m | rOIS1y |
|---|---|---|---|---|---|---|---|---|
| C | 6.11 | 5.80 | 5.68 | 0.01 | 0.04 | 7.99 | -0.52 | 6.27 |
| | (6.17) | (4.26) | (6.75) | (0.49) | (0.98) | (9.60) | (-2.78) | (8.33) |
| ΔrRPO | 0.38** | 0.43* | 0.39* | 0.51*** | | 0.39* | 0.73*** | 0.51*** |
| | (2.35) | (1.90) | (1.87) | (4.36) | | (1.92) | (4.83) | (3.55) |
| ΔrRPO(-1) | 0.60*** | 0.53*** | 0.50** | 0.29** | 0.91*** | 0.51** | 0.40*** | 0.58*** |
| | (2.58) | (2.90) | (2.22) | (2.23) | (5.73) | (2.41) | (3.09) | (2.78) |
| ΔrRPO(-2) | 0..62** | | 0.55* | | | | | 0.34*** |
| | (2.24) | | (1.79) | | | | | (3.35) |
| ΔrRPO(-3) | 0.45** | | | | | 0.45** | | 0.25* |
| | (2.34) | | | | | (2.06) | | (1.90) |
| rCall | | | | | | | 0.09*** | |
| | | | | | | | (3.16) | |
| DUM2004M6_2007M1 | | | | | 1.53*** | | | |
| | | | | | (43.63) | | | |
| D2007M3_2008M9 | 6.27*** | | | | | | | |
| | (32.63) | | | | | | | |
| DUM2007M6M7_2009M4 | | -4.57*** | | -1.52** | -1.56*** | | | |
| | | (-17.04) | | (-2.53) | (-37.52) | | | |
| DUM2007M6M7 | -5.04*** | | -3.14*** | | | | | |
| | (-19.31) | | (-6.40) | | | | | |
| DUM2007M8_2008M7 | | | | 1.19*** | | | | |
| | | | | (3.53) | | | | |
| DUM2008M9M10 | 1.35*** | | | | | | | |
| | (6.39) | | | | | | | |
| DUM2008M12 | | | | | | | -0.63** | |
| | | | | | | | (-2.47) | |
| DUM2010M6_M10 | | 0.92*** | | | | 1.89** | | |
| | | (4.05) | | | | (2.44) | | |
| AR(1) | 0.94*** | 0.93*** | 0.92*** | | | 0.90*** | | 0.95*** |
| | (34.22) | (27.74) | (19.82) | | | (21.34) | | (26.15) |
| $R^2$ | 0.93 | 0.88 | 0.85 | 0.51 | 0.45 | 0.82 | 0.41 | 0.92 |
| DW Statistics | 1.96 | 1.98 | 1.83 | 1.89 | 2.02 | 2.07 | 2.07 | 1.84 |
| BG-LM Test-F Stats | 0.04 | 0.02 | 0.72 | 0.99 | 1.37 | 0.61 | 0.82 | 2.10 |
| Prob. | (0.96) | (0.98) | (0.49) | (0.38) | (0.26) | (0.54) | (0.44) | (0.11) |
| Sample | 2001 M3 to 2012 M6 | 2003 M2 to 2012 M6 | 2003 M2 to 2012 M6 | 2001 M3 to 2012 M6 | 2001 M5 to 2012 M6 | 2001 M8 to 2012 M6 | 2001 M5 to 2012 M6 | 2001 M8 to 2012 M6 |

*, **, *** represent significance level of 10%, 5% and 1%, respectively.
DUM: Dummy variables to capture extreme fluctuations in the series. Dummy variable defined to represent a particular month in a year.
Note: The Newey-West estimator (bartlett kernel, fixed bandwidth) is used to estimate covariance matrix of parameters of the models.
      The estimator improves OLS estimation in the presence of heteroskedasticity/autocorrelation.
      The figures in brackets are t-statistics.

**Annex Table 3: Transmission of policy rate changes to the long end of financial markets**

| Variables | r10y | rCorp | rD3y | rLend |
|---|---|---|---|---|
| C | 7.02 | 0.01 | 0.02 | 0.01 |
|  | (9.78) | (0.27) | (0.90) | (0.39) |
| ΔrRPO | 0.25 * | 0.41 *** | 0.12 ** | 0.27 *** |
|  | (1.83) | (4.61) | (2.12) | (4.67) |
| ΔrRPO(-1) | 0.22 * | 0.27 *** | 0.33 *** | 0.15 *** |
|  | (1.90) | (3.64) | (4.66) | (2.60) |
| ΔrRPO(-3) | -0.19 ** |  |  |  |
|  | (-2.40) |  |  |  |
| ΔrRPO(-4) |  |  | 0.22 *** | 0.14 *** |
|  |  |  | (2.98) | (2.55) |
| dLwpi | 0.07 *** |  |  |  |
|  | (2.70) |  |  |  |
| DUM2003M2_2008M10 |  | 1.11 *** |  |  |
|  |  | (26.89) |  |  |
| DUM2007M4 |  |  |  | 0.62 *** |
|  |  |  |  | (5.41) |
| DUM2007M7_2008M12 |  | -0.99 *** |  |  |
|  |  | (-5.28) |  |  |
| DUM2008M6 | 0.62 *** |  |  |  |
|  | (11.85) |  |  |  |
| DUM2008M12 | -1.13 *** |  |  |  |
|  | (-8.42) |  |  |  |
| DUM2010M7 |  |  |  | -3.42 *** |
|  |  |  |  | (-21.13) |
| DUM2011M2_2012M2 |  |  | 1.05 *** |  |
|  |  |  | (3.54) |  |
| DUM2012M1 |  |  | -1.75 *** |  |
|  |  |  | (-62.07) |  |
| AR(1) | 0.97 *** | -0.24 ** |  |  |
|  | (31.84) | (-2.15) |  |  |
| R² | 0.94 | 0.61 | 0.71 | 0.81 |
| DW Statistics | 1.76 | 1.97 | 1.98 | 1.82 |
| BG-LM Test-F Stats | 0.76 | 1.55 | 0.13 | 0.23 |
| prob | (0.47) | (0.22) | (0.88) | (0.80) |
| Sample | 2002M2 to 2012M6 | 2002M2 to 2012M6 | 2002M2 to 2012M6 | 2002M2 to 2012M6 |

*, **, *** represent significance level of 10%, 5% and 1%, respectively.
dLwpi = change in log of wholesale price level.
Note: The Newey-West estimator (bartlett kernel, fixed bandwidth) is used to estimate covariance matrix of parameters of the models. The estimator improves OLS estimation in the presence of heteroskedasticity/autocorrelation.
    The figures in brackets are t-statistics.

## Annex Table 4: Transmission of policy rate under deficit liquidity conditions

| Variables | rCall | rTB91 | r10y | rCp | rD3y | rLend |
|---|---|---|---|---|---|---|
| C | 7.35 | 0.02 | 7.28 | 9.35 | 0.10 | 0.06 |
| | (19.32) | (0.61) | (46.54) | (32.08) | (2.79) | (2.10) |
| $\Delta$rRPO | 0.74*** | 0.71*** | 0.20* | 0.39** | 0.38*** | 0.41*** |
| | (5.82) | (11.86) | (1.87) | (2.15) | (3.85) | (3.33) |
| $\Delta$rRPO(-1) | 0.63*** | 0.14* | | 0.82*** | | 0.14*** |
| | (3.41) | (1.92) | | (6.06) | | (3.87) |
| $\Delta$rRPO(-2) | 0.63*** | -0.19*** | | 0.75*** | | |
| | (2.68) | (-2.93) | | (4.32) | | |
| $\Delta$rRPO(-3) | 0.53*** | 0.13*** | | 0.63*** | | |
| | (2.64) | (2.87) | | (3.30) | | |
| dLwpi | | | 0.11*** | | | |
| | | | (5.70) | | | |
| DUM1 | 6.21*** | 1.24*** | 0.73*** | 2.18*** | 1.42*** | |
| | (31.84) | (4.03) | (13.44) | (7.89) | (39.13) | |
| DUM2 | -5.09*** | -2.39*** | -1.80*** | -1.30*** | -2.14*** | -1.68*** |
| | (-22.68) | (-56.54) | (-3.87) | (-4.96) | (-6.07) | (-5.84) |
| AR(1) | 0.78*** | | 0.63*** | 0.68*** | | |
| | (7.97) | | (4.25) | (5.76) | | |
| $R^2$ | 0.88 | 0.89 | 0.79 | 0.81 | 0.85 | 0.83 |
| DW Statistics | 1.95 | 1.74 | 2.22 | 1.93 | 1.97 | 1.57 |
| BG-LM Test-F Stats | 0.05 | 1.51 | 0.23 | 0.29 | 0.12 | 1.60 |
| prob | (0.95) | (0.23) | (0.79) | (0.75) | (0.89) | (0.21) |
| Obs. | 71 | 71 | 71 | 71 | 71 | 71 |

*, **, *** represent significance level of 10%, 5% and 1%, respectively.
DUM1 and DUM2 are dummy variables used for months with extreme price volatility either positive or negative.
Note: The Newey-West estimator (bartlett kernel, fixed bandwidth) is used to estimate covariance matrix of parameters of the models.
    The estimator improves OLS estimation in the presence of heteroskedasticity/autocorrelation.
    The figures in brackets are t-statistics.

**Annex Table 5: Transmission of policy rate under surplus liquidity conditions**

| Variables | rCall | rTB91 | r10y | rCp | rD3y | rLend |
|---|---|---|---|---|---|---|
| C | 0.03 | 0.02 | 6.79 | 6.31 | -0.02 | -0.01 |
|  | (1.43) | (0.93) | (8.91) | (11.90) | (-0.79) | (-0.86) |
| ΔrRPO | 0.31** | 0.32* | 0.30* |  | 0.39*** |  |
|  | (2.41) | (1.85) | (1.89) |  | (3.08) |  |
| ΔrRPO(-1) | 0.35*** | 0.33*** |  |  | 0.42*** | 0.26** |
|  | (3.32) | (2.75) |  |  | (3.49) | (2.08) |
| ΔrRPO(-3) | 0.26** |  |  | 0.62*** | 0.24** |  |
|  | (2.37) |  |  | (3.78) | (2.62) |  |
| DUM1 | 0.96*** | 0.35*** |  | 2.12*** | 2.91*** | 1.76*** |
|  | (43.48) | (12.89) |  | (7.65) | (26.79) | (11.86) |
| DUM2 | -1.06*** | -0.81*** | -1.10*** |  | -0.37*** | -0.74*** |
|  | (-6.15) | (-12.15) | (-4.20) |  | (-9.22) | (-39.71) |
| AR(1) |  |  | 0.95*** | 0.85*** |  |  |
|  |  |  | (26.38) | (10.18) |  |  |
| $R^2$ | 0.76 | 0.57 | 0.90 | 0.81 | 0.95 | 0.76 |
| DW Statistics | 1.98 | 1.98 | 1.75 | 1.82 | 2.19 | 2.33 |
| BG-LM Test-F Stats | 0.63 | 0.40 | 0.58 | 0.93 | 0.67 | 1.19 |
| prob | (0.54) | (0.67) | (0.56) | (0.40) | (0.52) | (0.31) |
| Obs. | 65 | 65 | 65 | 65 | 65 | 65 |

*, **, *** represent significance level of 10%, 5% and 1%, respectively.
\Note: The Newey-West estimator (bartlett kernel, fixed bandwidth) is used to estimate covariance matrix of parameters of the models. The estimator improves OLS estimation in the presence of heteroskedasticity/autocorrelation.
    The figures in brackets are t-statistics.

**Annex Table 6: Transmission of policy rate under the tight cycle of monetary policy**

| Variables | rCall | rTB91 | r10y | rCp | rD3y | rLend |
|---|---|---|---|---|---|---|
| C | 5.49 | -0.04 | 7.64 | 0.03 | 0.04 | 0.02 |
| | (9.86) | (0.96) | (22.64) | (0.39) | (1.11) | (0.82) |
| ΔrRPO | 0.81*** | 0.48*** | 1.08*** | 0.81*** | 0.12*** | 0.31*** |
| | (4.03) | (8.36) | (6.26) | (3.31) | (3.46) | (5.01) |
| ΔrRPO(-1) | 0.45** | | | 1.17*** | 0.48*** | 0.73*** |
| | (2.35) | | | (3.61) | (4.24) | (4.43) |
| ΔrRPO(-2) | 0.76*** | | | | | -0.12*** |
| | (3.00) | | | | | (-2.74) |
| ΔrRPO(-3) | 0.72*** | | | | | |
| | (2.94) | | | | | |
| dLwpi | 0.29*** | | 0.07*** | | | |
| | (3.50) | | (12.37) | | | |
| DUM1 | 6.17*** | 1.05*** | 0.64*** | 2.05*** | 1.04*** | 0.35*** |
| | (31.97) | (7.17) | (6.52) | (11.96) | (3.14) | (4.42) |
| DUM2 | -5.03*** | -1.22*** | -0.62*** | -1.73*** | -1.71*** | -2.80*** |
| | (-18.19) | (-3.06) | (-3.55) | (-11.32) | (-52.07) | (-11.74) |
| AR(1) | 0.65*** | | 0.86*** | | | |
| | (5.15) | | (14.67) | | | |
| $R^2$ | 0.91 | 0.61 | 0.86 | 0.62 | 0.79 | 0.93 |
| DW Statistics | 1.99 | 2.21 | 1.65 | 1.96 | 1.85 | 1.78 |
| BG-LM Test-F Stats | 0.27 | 0.58 | 1.62 | 0.12 | 0.59 | 0.34 |
| prob | (0.76) | (0.57) | (0.21) | (0.88) | (0.56) | (0.71) |
| Obs. | 68 | 68 | 68 | 68 | 65 | 65 |

*, **, *** represent significance level of 10%, 5% and 1%, respectively.
Note: The Newey-West estimator (bartlett kernel, fixed bandwidth) is used to estimate covariance matrix of parameters of the models.
The estimator improves OLS estimation in the presence of heteroskedasticity/autocorrelation.
The figures in brackets are t-statistics.

**Annex Table 7: Transmission of policy rate under the easy cycle of monetary policy**

| Variables | rCall | rTB91 | r10y | rCp | rD3y | rLend |
|---|---|---|---|---|---|---|
| C | 0.03 | 0.05 | 0.00 | 0.01 | 0.00 | -0.02 |
| | (1.00) | (2.24) | (0.06) | (0.09) | (0.04) | (-1.34) |
| ΔrRPO | 0.41*** | 0.41** | 0.30*** | | | 0.31* |
| | (2.62) | (2.32) | (2.71) | | | (1.70) |
| ΔrRPO(-1) | | 0.40*** | | 0.89** | 0.53*** | |
| | | (2.86) | | (2.32) | (3.80) | |
| ΔrRPO(-3) | 0.41*** | | | | 0.38*** | 0.33*** |
| | (2.95) | | | | (3.40) | (2.72) |
| rCall | | | | 0.68*** | | |
| | | | | (3.31) | | |
| dLwpi | | | 0.05*** | | | |
| | | | (3.13) | | | |
| DUM1 | 0.86*** | 0.66*** | 0.60*** | 3.04*** | 3.12*** | 0.44*** |
| | (6.38) | (5.42) | (8.12) | (8.60) | (70.30) | (13.51) |
| DUM2 | -1.04*** | -0.73*** | -2.42*** | -1.49*** | -0.62*** | -3.45*** |
| | (-5.62) | (-6.90) | (-23.44) | (-5.35) | (-12.96) | (-38.38) |
| AR(1) | | | -0.39*** | -0.27** | | |
| | | | (-2.24) | (-2.01) | | |
| $R^2$ | 0.74 | 0.63 | 0.75 | 0.70 | 0.91 | 0.89 |
| DW Statistics | 2.07 | 2.05 | 1.81 | 1.95 | 1.63 | 1.98 |
| BG-LM Test-F Stats | 0.89 | 0.36 | 1.90 | 0.92 | 1.35 | 0.22 |
| prob | (0.42) | (0.70) | (0.18) | (0.40) | (0.27) | (0.81) |
| Obs. | 67 | 67 | 67 | 67 | 66 | 66 |

*, **, *** represent significance level of 10%, 5% and 1%, respectively.
Note: The Newey-West estimator (bartlett kernel, fixed bandwidth) is used to estimate covariance matrix of parameters of the models. The estimator improves OLS estimation in the presence of heteroskedasticity/autocorrelation.
The figures in brackets are t-statistics.

## Appendix 1: Impulse response of short end of financial markets to various shocks after controlling for liquidity conditions
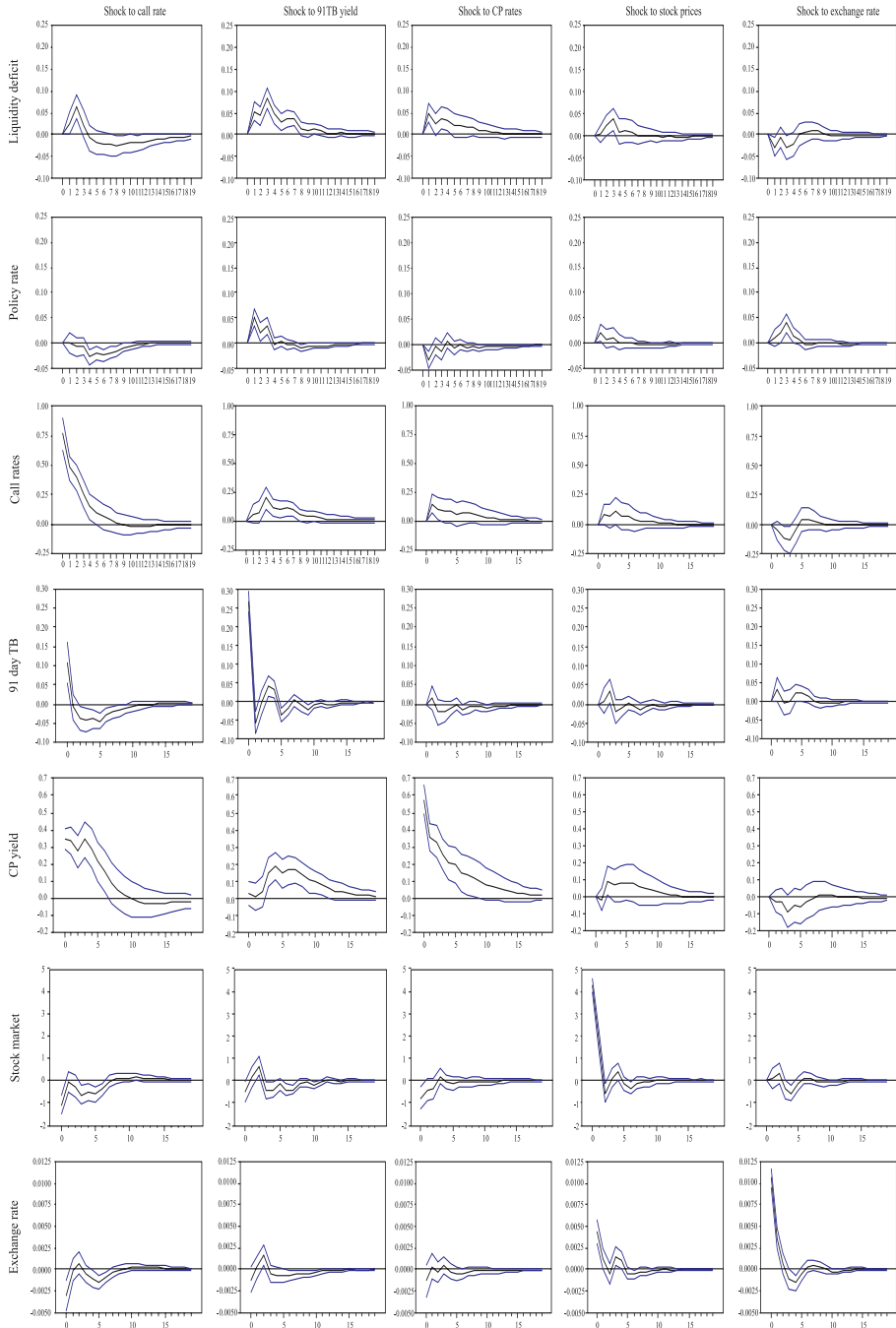
**Appendix 2: Impulse response of short end of financial markets to various shocks without controlling for liquidity conditions**
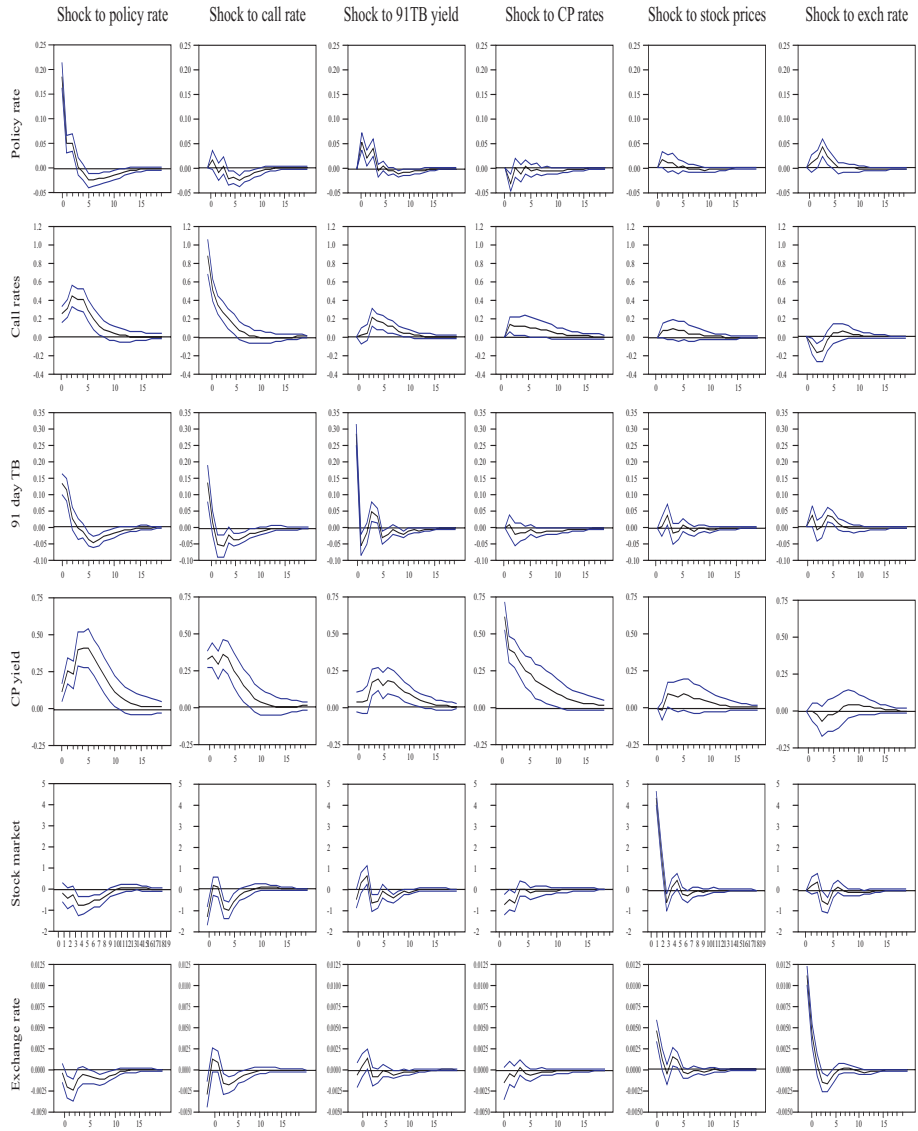
## Appendix 3: Impulse response of long end of financial markets to various shocks after controlling for liquidity conditions
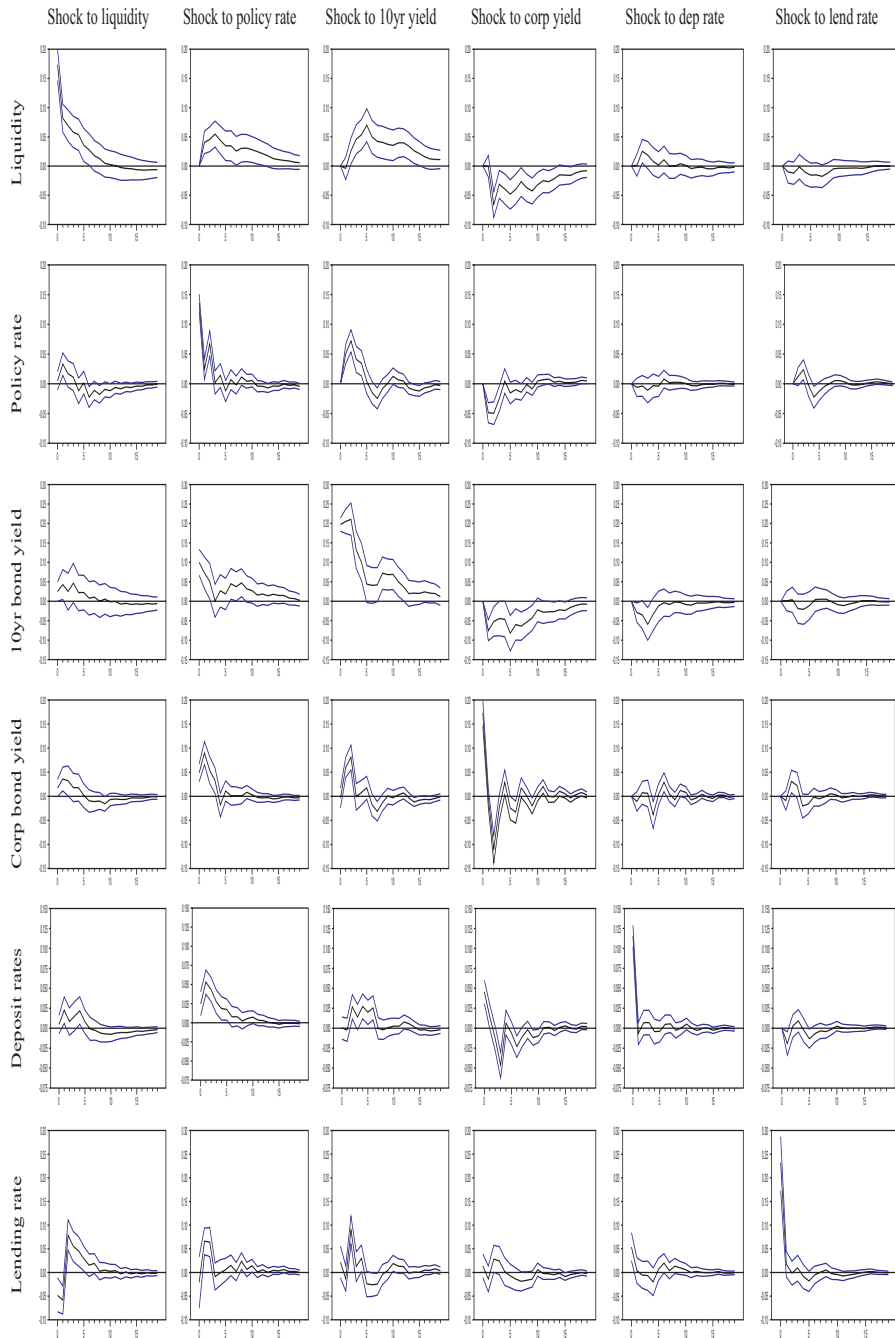
**Appendix 4: Impulse response of long end of financial markets to various shocks without controlling for liquidity conditions**

# *Industry Effects of Monetary Transmission Mechanism in India: An Empirical Analysis of Use-based Industries*

## Sarat Dhal[1]

This study evaluates the industry effects of monetary transmission mechanism in line with the literature on disaggregated approach to policy transmission mechanism. The study uses vector auto regression (VAR) model and monthly data from April 1993 to October 2011 pertaining to output growth of five use-based industries, call money rate and WPI inflation rate for evaluating the tr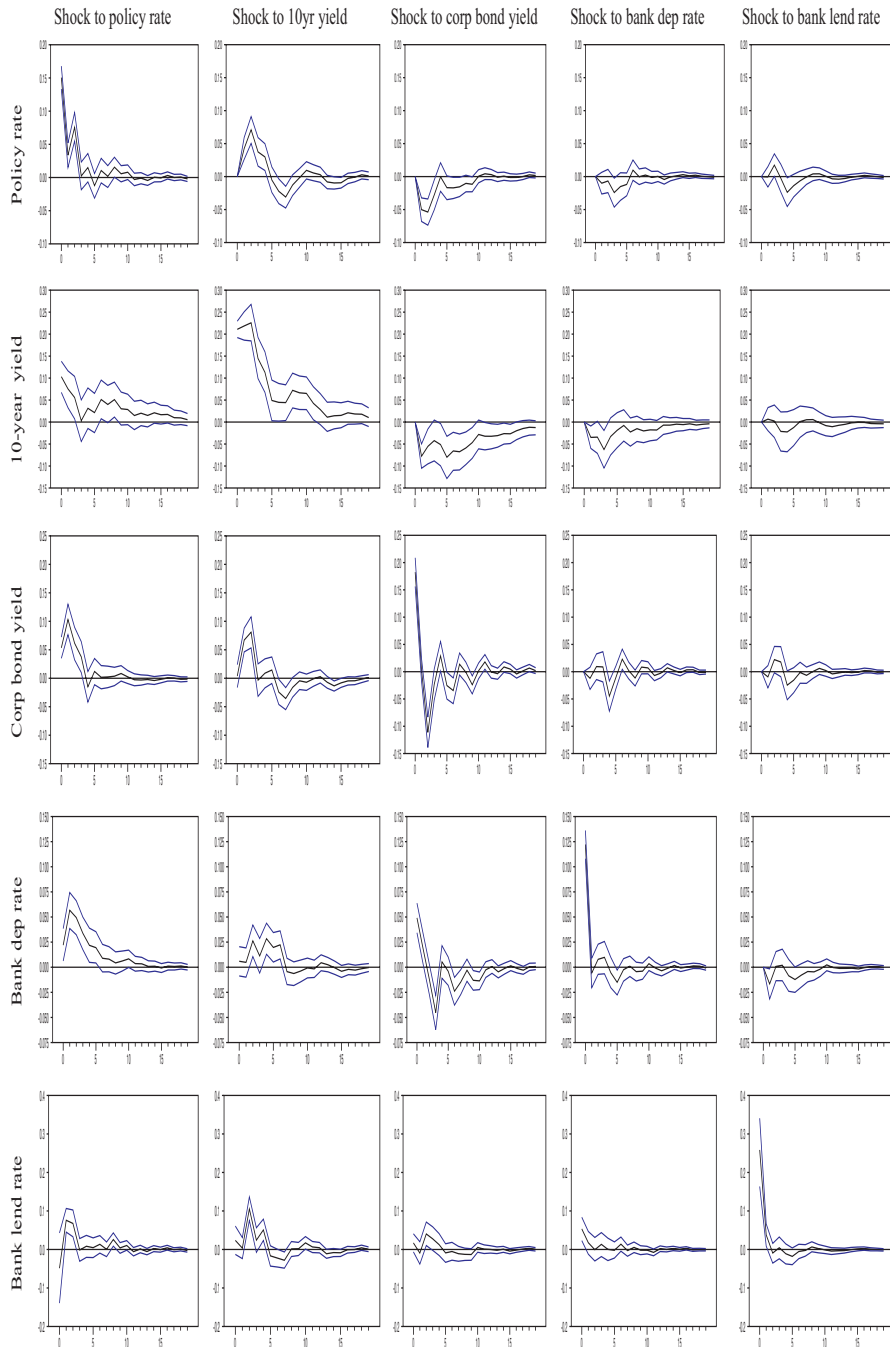ansmission mechanism. The generalised accumulated impulse response analysis from the VAR model showed that following a tight monetary policy shock, the output growth could be affected more for capital goods and consumer durables than basic, intermediate and consumer non-durable goods. Intermediate and consumer non-durable goods could show a relatively moderate transient response and transmission lag could be evident for the consumer non-durable goods. However, relatively wide asymptotic standard error bands associated with the impulse responses could be reflecting uncertainty in the impact of transmission mechanism.

## Introduction

In recent years, trends in the growth of industrial production in the Indian context have given rise to various concerns, notwithstanding the discussion over data quality and turbulent period of the global crisis. Should the industry sector be accorded policy attention by the authorities, especially from the perspective of monetary policy? How does monetary policy affect the industry sector? Answers to these questions, *prima facie*, cannot overlook some stylised facts. In the year 2011-12, the industry sector, comprising mining, manufacturing, and electricity, gas and water supply, accounted for 18.3 per cent of

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GDP at factor cost at current prices, as compared with the shares of agriculture and services sectors at 17.2 per cent and 64.5 per cent, respectively. However, the industry sector played a dominant role in the Indian economy in various other ways including investment (or capital formation) activities, economy-wide gross output or aggregate economic transaction, inter-sectoral intermediate demand, merchandise trade, employment and bank credit in the organised sector. Firstly, the national accounts statistics (NAS) for 2010-11 showed that the industry sector accounted for 41.0 per cent of economy-wide gross domestic capital formation, closer to services sector's share 51.0 per cent and substantially higher than the agriculture sector's share 8.0 per cent. Secondly, the Input-Output transaction Table 2006-07 showed that the secondary sector led by industries accounted for 40 per cent of economy-wide gross output or economic transaction as compared with the shares of 47 per cent and 13 per cent for services sector and 'agriculture and allied activities', respectively. The secondary sector accounted for the bulk 58 per cent of aggregate inter-industry intermediate demand for goods and services, reflecting its backward and forward linkages with other sectors. Thirdly, according to the balance of payments (BOP) accounts 2011-12, merchandise and invisibles items accounted for 58.5 per cent and 41.5 per cent of India's exports of goods and services in the current account, respectively. Exports of manufactured goods accounted for the bulk of merchandise exports with a share of 61.3 per cent. In 2011-12, imports of industrial inputs accounted for 51.0 per cent of India's total merchandise imports and 73.5 per cent and 89.9 per cent of non-oil imports and non-oil and non-gold-silver imports, respectively. Fourthly, according to the NSSO Report on employment and unemployment survey 2009-10, there were 545 persons for every 1000 persons employed in non-agricultural activities. The industry sector accounted for 22 per cent of employment in the non-agricultural sector. Fifthly, industry sector comprising small, medium and large enterprises accounted for 45.8 per cent of gross non-food credit, leaving 12.2 per cent for agriculture and 42.0 per cent for other sectors, respectively. Finally, from the perspective of business cycle, a principal component analysis of GDP in terms of growth rate of broad sectors such as agriculture, industry and services reveals the crucial role of industry sector. The first principal component based on ordinary correlations could be associated with similar loadings (weights) to industry and services sectors (Annex 1).

The above stylised facts persuaded this study for analysis of monetary transmission mechanism for India's industry sector. At this juncture, however, a mute question arises. Should the empirical analysis be confined to monetary implications for the industry sector at the aggregate level? This is an important issue because the industry sector is heterogeneous in nature in terms of product composition varying from salt and pepper to heavy transport machinery and aeronautics, agro-based products to resource based minerals, metal products and chemicals and used-based consumer durable and non-durable goods to basic goods, capital goods and intermediate goods. From this perspective, the study derives inspiration from the literature on disaggregated monetary transmission mechanism. According to this literature, it is important to understand how the effects of change in policy instruments pass through the economy, which sectors respond first to a policy innovation and whether the effects could be more pronounced in some sectors than others. A comparison of the monetary impact across different sectors may provide valuable information for policy purposes (Ganley and Salmon, 1997). In the study, the analysis is focused on monetary transmission mechanism for five use-based industries. Using the standard VAR model and monthly data for the sample period April 1993 to October 2011, the study finds that the output growth response to monetary policy shock could be higher for consumer durables and capital goods industries than basic, intermediate and consumer non-durable goods. Intermediate goods industries could exhibit a muted response whereas consumer non-durables could exhibit moderate transitory response accompanied by lags in the transmission mechanism. These findings are expected to provide crucial information for policy purposes. The remainder of the paper is organised in five sections comprising review of literature, methodology and data, empirical findings and conclusion.

## Section II
## Review of Literature

The subject of monetary transmission mechanism has witnessed a paradigm shift over the years. For the first three to four decades during the post World War II period, economists adhered to the IS-LM type

aggregate macroeconomic model for evaluating the role of monetary policy in economic stabilisation through aggregate output growth and price inflation. Within this framework, it was postulated that policy induced changes in monetary variables could affect aggregate demand and consequently, the growth of economy-wide measure of output such as real gross domestic product and the inflation in the aggregate price index. This characterisation of the monetary transmission mechanism was later construed as a 'black box' view, as it did not tell about what happened in the interim in the transmission of policy shocks to the real economy (Bernanke and Gertler, 1995). Thus, the more recent literature on monetary transmission mechanism has embraced disaggregated analyses for a better understanding of how monetary variables affect various components of aggregate demand such as consumption, investment and trade and economic activities across firms, industries, sectors and regions within and across the nations. Studies in this tradition are inspired by the seminal works on asymmetric information, market imperfection and moral hazard by Stiglitz and Weiss (1981) and the credit channel comprising balance sheet channel (Bernake and Gertler, 1995) and the bank lending channel (Kashyap *etal*.1993 and Kashyap and Stein 1995). Also, several other studies emphasising on the heterogeneous characteristics of producing sectors pertaining to product composition, production technology reflecting upon the intensity of labour and capital inputs, financial structure of firms, openness to trade, wage contracts and flexibility in product prices have contributed to the growth of disaggregate analysis of monetary transmission mechanism [Ahmed (1987), Ahmed and Miller (1997), Angeloni, *et al*. (1995), Bernanke and Blinder (1988), Bernanke and Gertler (1995), Dale and Haldane (1995), David *et al*. (2000), Dedola and Lippi (2000), Ganley (1996), Ganley and Salmon (1997), Gertler and Gilchrist (1994), Gaiotti and Generale (2001), Hayo and Uhlenbrock (1999), Kandil (1991), Kashyap *et al*. (1993), Kashyap and Stein (1995), Kretzmer (1989), Loo and Lastrapes (1998), Shelley and Wallace (1998), Peersman and Smets (2005)]. In the Indian context, studies in this tradition are scarce. Dhal (2012) provided an analysis of regional aspect of monetary transmission mechanism in terms of credit dispersion to states in the Indian context. Theoretical and empirical studies on disaggregated transmission mechanism focused on the industry sector provide various perspectives as discussed briefly in the following.

Firstly, the credit channel of transmission mechanism provides an explanation of differential effect of monetary transmission mechanism for firms and industries. Bernanke and Gertler (1995) provided explanation that monetary policy could affect the small firms differently from the large firms. The credit channel perspective on firm size implications for monetary transmission mechanism could be extended to the industry level analysis. Illustratively, basic, capital and consumer durable goods industries could be characterised with a concentration of large firms whereas intermediate and consumer non-durable goods could be characterised with several small firms. According to the credit channel, financial structure or leverage structure of small firms could be different from that of large firms. In this context, the financial accelerator theory of the monetary transmission mechanism states that asymmetric information between borrowers and lenders could give rise to an external finance premium, which typically depends on the net worth of the borrower. A borrower with higher net worth could be capable of posting more collateral and thereby, reduce its cost of external financing. As emphasised by Bernanke and Gertler (1989), the dependence of the external finance premium on the net worth of borrowers creates a "financial accelerator" propagation mechanism. A policy tightening will not only increase the cost of capital through the conventional interest rate channel, it will also lead to a fall in collateral values and cash flow, which will tend to have a positive effect on the external finance premium. Moreover, since collateral values and cash flows are typically low in a recession, the sensitivity of the external finance premium to changes in interest rates will be higher in recessions. Small firms, due to limited access to capital market and external borrowing, are likely to be more dependent on bank credit than large firms. Therefore, monetary policy involving contractions in bank credit and increased interest rate may affect expenditure by small firms more than the large firms. However, an alternative perspective is also maintained by several researchers. Due to large financing requirement at medium and longer horizons for investment activity, large firms may attach greater importance to credit and interest burden than smaller firms.

Secondly, the capital-labour intensity of production provides another explanation (Hayo and Uhlenbrock, 1999, Berument *etal*., 2004, Ganley and Salmon, 1997). This perspective derives from Tobin's (1960) work relating to money in the neoclassical growth model. In Tobin's model, real money balance was postulated to affect capital-labour intensity in production, and thus, output growth. Deriving from this hypothesis, researchers argue that capital goods industries are likely to be associated with longer gestation lags, sufficiently large investment requirement and larger amount of credit with longer-maturity and higher interest rates than consumer goods. Thus, the causal nexus of monetary variables such as credit and interest rates with consumer goods and investment goods may not be similar. Berument *etal.* (2004) showed that an increase in interest rates affected the capital-intensive sectors more than labor-intensive ones. Similarly, Ganley and Salmon (1997) in a study of the UK economy showed that manufacturing, construction, distribution and transportation, exhibited the largest output responses to a monetary shock. Financial services and utilities responded relatively little to the monetary shock. The mining sector's response was somewhat erratic and ambiguous and the agricultural sector's response was insignificant.

Thirdly, there is an inventory adjustment perspective (Benito, 2002, Ehrmann and Ellison, 2002, Kashyap *etal.* 1994,Gertler and Gilchrist,1994). According to Ehrmann and Ellison (2002), the progress in production technology in terms of greater flexibility due to just-in-time production, lean manufacturing and improved inventory management enable firms to adjust their production levels more quickly, easily and at lower cost. Greenspan (2001) recognised that new technologies for supply-chain management and flexible manufacturing imply that businesses can perceive imbalances in inventories at an early age, virtually in real time, and can cut production promptly in response to the developing signs of unintended inventory building. Kashyap *etal* (1994) found for the US that the inventory investment of firms without access to public bond markets was significantly liquidity-constrained during the 1981-82 and 1974-75 recessions, in which tight money also appeared to have played a role. Gertler and Gilchrist (1994) examined movements in sales, inventories, and short-term debt for small and

large manufacturing firms and confirmed that the effects of monetary policy changes on small-firm variables were greater when the sector as a whole was growing more slowly.

Fourthly, in terms of product characteristics, studies have examined the sensitiveness of durable goods to monetary policy as compared with non-durable goods (Mishkin 1976, Jung and Yun 2005, Haimowitz, 1996, Kretzmer,1989, Ganley and Salmon,1997, Hayo and Uhlenbrock, 2000 and Dedola and Lippi, 2000, Peersman and Smets,2002, Drake and Fleissig, 2010, Erceg and Levin, 2002). Mishkin (1976) addressed the neglected illiquid aspect of the consumer durable asset. He suggested that increased consumer liabilities are a major deterrent to consumer durable purchases and increased financial asset holdings a powerful encouragement. Monetary policy was found to have a strong impact on consumer durable expenditure through two additional channels of monetary influence. One, monetary policy affects the price of assets in the economy. Consumer financial asset holdings, thereby, affected expenditure on durables. Two, past monetary policy will have affected the cost and availability of credit, thus influencing the size of consumers' debt holdings and hence consumer durable expenditure. Kretzmer (1989) suggested that unanticipated money could more likely display non-neutrality in the durable goods sector as agents spend unanticipated increases in their money holdings on goods which provide consumption services over time. Peersman and Smets (2002) showed the demand for durable products, such as investment goods, much more affected by a rise in the interest rate through the usual cost-of-capital channel than the demand for non-durables.

Fifthly, some industries may be producing more tradable goods than others catering to domestic demand. Here, the transmission mechanism could be influenced by the openness of the economy through monetary policy impact on exchange rate, capital flows and export and import prices (Berument *etal*. 2007). In a study of European countries, Llaudes (2007) found the tradable sector showing a higher degree of responsiveness to monetary policy shocks than the non-tradable sector and emphasised on the importance of industrial structure for the analysis of monetary policy.

## Section III

## Methodology and Data

For the empirical analysis, we follow the literature and use standard vector auto regression (VAR) model. Due to the popularity of VAR model, we refrain from rehashing the model's technical details. However, it is useful to highlight some applied issues relating to the VAR model for aggregated transmission mechanism as compared with the disaggregated model.

Firstly, for the aggregate transmission mechanism, researchers generally use a VAR model comprising three endogenous variables; an indicator of output growth, aggregate price inflation and the monetary policy variable, typically, the short-term interest rate. In principle, a VAR model is a reduced form of a structural model and residuals from the reduced form model cannot be considered as pure innovations. Accordingly, a meaningful analysis of impulse response and forecast error variance decomposition cannot be possible with a reduced form VAR model. It is in this context that researchers rely on orthogonalization of residuals from the reduced form VAR model. Orthogonalized innovations have two principal advantages over non-orthogonal ones: (i) because they are uncorrelated, it is very simple to compute the variances of linear combinations of them, and (ii) it can be rather misleading to examine a shock to a single variable in isolation when historically it has always moved together with several other variables. Orthogonalisation takes this co-movement into account. The greatest difficulty with orthogonalisation is that there are many ways to accomplish it, so the choice of one particular method is not innocuous. Researchers, however, often rely on Choleski factorization involving a lower triangular variance-covariance matrix of VAR residuals for deriving orthogonal shocks to the endogenous variables. The Choleski decomposition is sensitive to the ordering of variables in the VAR model when residuals are correlated. Studies on standard monetary transmission mechanism prefer output, inflation and interest rate variables appearing in order. In this way, the orthogonal innovations are justified with a structural identification of shocks to variables based on macroeconomic postulates such as technology shock driving output

growth, Philips curve describing inflation and output relationship and a monetary policy reaction function associated with output growth and inflation. In the case of disaggregated model involving more than three variables and more than one sectoral output indicators in particular, structural identification of shocks becomes extremely complicated and the straightforward Choleski factorization may not be meaningful. Illustratively, for a VAR model with seven variables comprising interest rate, inflation, and output growth of five use-based industries, the ordering choice becomes complicated with respect to which industry sector should precede or follow other sectors. On the statistical ground, one could find a solution through Granger's causality among the output indicators. However, such causal ordering may not be consistent with the real world and the underlying technological relationship among producing sectors. In this context, we followed Pesaran and Shin (1998) who suggested that the generalized impulse response analysis, which is free from ordering of variables in the model, could provide a meaningful alternative to impulse response analysis.

Secondly, a peculiar feature of time series models such as the VAR pertains to its sensitivity to measurement of variables, data frequency, and the sample period. In the Indian context, monetary policy works through both quantity (liquidity management) and interest rate channels. Both effects are expected to affect the interbank call money rate in the same direction. Illustratively, a tight liquidity and an increase in the short-term policy rate such as the repo rate are expected to push up the call money rate and vice versa for easy liquidity and decline in the repo rate. For this purpose, we use monthly data for the weighted average interbank call money rate as the policy variable. The aggregate price variable is measured by year-on-year WPI inflation rate based on monthly data[2]. Similarly, the monthly data on output variables are used for deriving annualised or year-on-year growth rate of seasonally adjusted index of industrial production for five use-based industries. There are two principal reasons for using output growth and inflation rate variables. First, there is an information perspective relating to

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2 The year-on-year inflation and output growth rates are defined as $\text{Log}(P_t/P_{t-12})*100$ and $\text{Log}(Y_t/Y_{t-12})*100$, respectively, where P and Y refer to price and industrial production indices and Log denote for natural logarithm.

economic agents' consumption, investment and production decisions and expectation formation process. The official source in India like the Central Statistical office releases monthly data on price and production indices in levels as well as year-on-year percentage increases. However, the year-on-year percentage increase in WPI index, *i.e.*, inflation rate and the year-on-year percentage increase in industrial output indices or growth rates contribute to the headline news. From this perspective, it makes sense to emphasise that economic agents' behavior and expectations could be influenced by information that is available, interpreted and understood. Secondly, the rate variables enable us to work with a VAR model comprising stationary variables. In our case, we found the variables stationary based on ADF and PP unit root tests. The empirical exercise with level variables (after long transformation of the price and output indices) will have to contend with non-stationary variables and require vector error correction and co-integration (VECM) model. However, the VECM model may involve multiple long-run co-integrating relationships among the variables, requiring identification of the multiple equilibrium trajectories in line with theoretical postulates, which may not be unique. Thus, it is useful to consider a VAR of stationary variables when the purpose is to understand the dynamic interaction among the variables. Moreover, the VAR model is also capable of reflecting upon the short-run and medium-longer horizon responses of variables to various types of shocks.

Thirdly, for a VAR model, the common lag length for the endogenous variables assumes critical importance. In this context, empirical studies often have to contend with alternative scenarios deriving from different lag selection criteria. Like other studies, we also faced difficulties in this regard. Some lag selection criteria like Schwartz Information Criterion (SIC) and Hannan and Quinn (HQ) criteria show lower lags (in our case 2 to 3 months) while others including Likelihood ratio(LR), adjusted LR and Akaike's Final prediction Error (FPE) show higher lags (in our case 13 months). A lower lag length, however, could not ensure VAR residuals free from serial autocorrelation problem, especially, of first order which is a serious problem for statistical modeling. According to Lutkepohl *etal*. (2006), the lower lag length in this context could be inadequate to capture the underlying dynamic interaction among the

variables in the VAR model. On the other hand, a model with a higher lag length, though appropriate to capture the underlying dynamic interaction among the variables, could suffer from over parameterisation and efficiency. Nevertheless, most of the empirical studies in the transmission mechanism literature prefer full lag length, *i.e.*, 4 to 5 lags for quarterly data and 12 to 13 lags for monthly data. Thus, in our study based on monthly data, we preferred 13 lags for the models in line with AIC and the empirical tradition.

Fourthly, the period-by-period impulse responses may appear obscure and lack smoothness due to large number of lags and high frequency monthly data. In this context, given the purpose of assessing the total impact of monetary policy shocks on output growth and inflation over different shorter and medium term horizons, an alternative approach entails accumulated impulse responses over different forecast horizon for the VAR model (Lutkepohl, 1990). We examined the cumulative impulse response over the time horizon spanning 1 to 60 months (five year) as this is consistent with the business cycle literature which maintains a typical business cycle spanning a period 2 to 5 years.

## Section IV

## Empirical Findings

For the empirical analysis, we adopted a structured approach by estimating the VAR model with alternative combinations of endogenous variables and some exogenous variables in order to provide robustness to the findings. Before moving to the empirical findings, we bring some further facts about the use-based industries in order to facilitate the analysis and interpretation of the industry effects of monetary transmission mechanism.

Firstly, the weights assigned to different use-based industries and the product compositions within each industry group provide some interesting insights. In the construction of index of industrial production, the highest weight is given to basic goods (46 per cent), followed by consumer non-durables (21 per cent), intermediate goods (16 per cent), capital goods (9 per cent) and consumer durables (8 per cent). Annex 2 shows top fifteen products in each user-industry group along with their weights. The distribution of weights reflects the concentration of

activities across the industry groups. Basic goods and consumer durables sectors show higher concentration of weights. This is reflected in top fifteen items accounted for 82 per cent, and 90 per cent of the respective sector's weight whereas these figures stood at 64 per cent, 55 per cent and 66 per cent, respectively for capital goods, intermediate goods and consumer non-durables (Annex 2). In the basic goods group, two most important items were mining minerals (31 per cent) and electricity (23 per cent) – the utility sector mostly under the public sector, accounting for more than fifty per cent of the basic goods sector and a fifth of the total industry sector's weight.

Secondly, the growth dynamics of use-based industries showed that during the sample period the mean growth rate was highest for the consumer durables followed by capital goods, intermediate goods, consumer non-durables and basic goods (Table 1). In terms of volatility, *i.e.*, standard deviation of growth rate, capital goods were most volatile followed by consumer durables, consumer non-durables, intermediate goods and basic goods. The volatility in industry output growth was also corroborated by maximum and minimum growth rates, reflecting sharper fluctuations in capital goods and consumer durables than other sectors.

**Table 1: Summary Statistics of Industry Growth Rate**

|  | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS | ZQS |
|---|---|---|---|---|---|---|
| Sector Weight | 46 | 9 | 16 | 8 | 21 | 100 |
| Mean | 5.88 | 11.70 | 7.19 | 14.40 | 6.16 | 7.50 |
| Median | 5.62 | 9.89 | 6.68 | 13.65 | 5.63 | 7.10 |
| Maximum | 15.21 | 62.15 | 27.08 | 56.63 | 33.82 | 20.40 |
| Minimum | -2.18 | -26.58 | -7.72 | -17.76 | -20.75 | -7.25 |
| Std. Dev. | 3.46 | 15.40 | 5.51 | 11.97 | 6.86 | 4.58 |
| Weighted contribution to overall Industry sector's growth | 36 | 14 | 15 | 17 | 18 | 100 |

Third, the weighted contribution of use-based industries to the overall industry sector's growth provides another interesting insight.

The contributions of capital goods and consumer durables to the industry sector's growth were higher than their weights, unlike basic goods, intermediate goods, and consumer non-durables. The weighted contribution of use-based industries to overall industry sector's growth turned out almost evenly distributed when we considered three groups, *i.e.*, i) basic goods, (ii) capital goods and consumer durables and (iii) intermediate and consumer non-durables.

## IV.1 The Aggregate Approach

Beginning with the aggregate analysis, we worked with a VAR model comprising variables, namely, the growth rate of general index of industrial production, the WPI inflation, the interest rate, and the interest rate (the call money rate). The accumulated generalised impulse responses of output growth and WPI inflation rates to one standard deviation shock to call money rate are shown in Annex 3. It was evident that a tight money policy through a positive one standard deviation shock to the call money rate led a decline in output growth and inflation rates. The impact was found moderate for the first six months and accentuating thereafter to reach a cumulative peak around 4 year horizon. The negative impact on the inflation rate occurred with a lag of 3-months but the output growth responded quickly in this manner after one month. Overall, however, responses of inflation rate and output growth appeared similar over medium term horizon. A critical perspective derives from the standard error bands associated with the impulses responses. The standard error bands associated with impulses responses of output growth and inflation variables turned out wider especially over the medium horizon, suggesting the uncertainty over the impact of policy shock. As we shall see later, this finding also held for the disaggregated VAR models. In this context, it is useful to consider the suggestions of Lutkepohl (1990): despite the substantial estimation uncertainty, impulse responses with expected sign are useful for qualitative analysis. Large estimation uncertainty is the price that has to be paid in VAR analysis for not forcing possibly false *a priori* structure on the system.

## IV.2  Disaggregated Models

Moving to the disaggregated model, we considered first the VAR model (Model 1) comprising six variables, the interest rate and the output growth rates of five use-based industries. The impulse responses of sectoral output growth to call money rate shock is shown in Annex 4 and summarised in Table 2. Here, a couple of interesting insights emerged. One, a decline in the output growth following the tight money policy was associated with basic, capital, intermediate and consumer durable goods. However, consumer non-durables showed a transmission lag as the decline in output growth occurred after 8 months. Two, different sectors showed different peaks and maximum adverse impact due to the tight money policy shock. The maximum adverse impact was observed for the capital goods followed by consumer durables, basic goods, consumer non-durables and intermediate goods. Three, the peak period of cumulative maximum adverse impact (after which the policy shock faded away with no adverse impact) occurred over the period of 3-year horizon for consumer durables, followed by capital goods (2-years) and basic goods (one and half year). Intermediate goods and consumer durables were associated with moderate impact for shorter horizon of about a year.

**Table 2: Impact of One Standard deviation Shock to Call Rate: Accumulated Responses of Output growth** (Model without Inflation Rate)

| Period | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
|---|---|---|---|---|---|
| 1 | -0.31 | -0.81 | -0.12 | -0.07 | 0.26 |
| 6 | -0.76 | -6.15 | -0.37 | -5.36 | 1.77 |
| 7 | -1.17 | -7.09 | -0.35 | -7.53 | 2.20 |
| 8 | -1.46 | -8.19 | -0.26 | -9.28 | 2.48 |
| 10 | -2.08 | -11.69 | -0.61 | -11.62 | 1.31 |
| 12 | -2.66 | -15.40 | -0.15 | -14.19 | 0.54 |
| 13 | -2.54 | -17.07 | 0.18 | -14.70 | -0.37 |
| 18 | -3.29 | -23.73 | 1.82 | -16.81 | -1.96 |
| 20 | -3.21 | -25.71 | 2.48 | -16.55 | -2.40 |
| 25 | -3.08 | -27.29 | 3.70 | -16.70 | -1.78 |
| 37 | -1.80 | -25.57 | 3.14 | -18.91 | 0.56 |
| 60 | -1.35 | -21.06 | 5.45 | -15.37 | 1.24 |
| Generalised Impulse | | | | | |

### IV.2.1 Model with Aggregate Price Inflation

In the Model 1, we did not include the inflation rate. However, monetary policy can affect inflation expectation and consequently, aggregate demand and supply conditions and real activity. Thus, we moved to the VAR model (Model 2) with WPI inflation as an endogenous variable in addition to the interest rate and sectoral output growth variables. The impulse responses of sectoral output in response to tight money policy shock are shown in Annex 5 and summarised in Table 3.

**Table 3: Impact of One Standard deviation Shock to Call Rate: Accumulated Responses of Output growth and inflation rate**
(Model with WPI Inflation Rate as an endogenous variable)

| Period | ZINF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
|---|---|---|---|---|---|---|
| 1 | 0.00 | -0.37 | -0.82 | -0.09 | 0.05 | 0.17 |
| 8 | -1.73 | -2.25 | -7.88 | -0.94 | -10.23 | 2.28 |
| 12 | -3.47 | -4.18 | -14.93 | -1.55 | -16.91 | -0.09 |
| 31 | -8.64 | -8.81 | -29.16 | -2.77 | -32.02 | -4.50 |
| 33 | -8.78 | -8.95 | -29.39 | -3.40 | -33.54 | -4.30 |
| 38 | -8.88 | -8.58 | -30.44 | -4.56 | -35.54 | -4.15 |
| 40 | -8.83 | -8.52 | -30.00 | -4.82 | -35.85 | -3.99 |
| 41 | -8.77 | -8.49 | -29.98 | -4.78 | -36.06 | -3.77 |
| 60 | -8.76 | -8.05 | -23.94 | -2.91 | -31.60 | -2.38 |
| Generalised Impulse | | | | | | |

The empirical findings from the Model 2 show some similarity as well as some notable departures from the Model 1. One, basic goods, capital goods, consumer durables and intermediate goods showed a decline in output growth following tight money policy shock while consumer non-durables showed a transmission lag. Moreover, consumer durables and capital goods were affected more than the three other sectors. Two, a comparison of the Model 2 (with inflation) with the Model 1 (without inflation) showed that all five use-based industries witnessed an accentuation of the maximum adverse impact on output growth due to tight money policy shock in the presence of inflation variable. Three, some sectors witnessed a significant increase in the time horizon for the adverse output

effect; from 18 months (Model 1) to 33 months (Model 2) for basic goods and from 10 months to 40 months for the intermediate goods sector. Similarly, consumer non-durables also showed an increase in the time horizon of declining output response from one year (between 8-20 months) to two year horizon (between 8-31 months). Four, consumer durables witnessed maximum impact followed by capital goods in Model 2 unlike the capital goods being impacted more than consumer durables in the Model 1.

### IV.2.2  Model with Exogenous Supply Shocks

In the Indian context, the sharp fluctuation in inflation condition often occurs due to supply shocks arising from the movement in the prices of oil and food commodities. Empirical studies generally consider such supply shocks as exogenous in nature as they could not be affected by policy intervention. From this perspective, we estimated VAR model (Model 3) with oil price inflation and food price inflation as exogenous variables. The impulse responses of sectoral output growth to call money rate shock are summarised in Annex 6 and Table 4. A couple of notable findings emerged from the comparison of Model 3 with Model 2. One, all sectors witnessed a moderation in the maximum adverse output effect due to tight money policy shock in the presence of oil price and food price inflation variables. This suggested that supply shocks may not accelerate the monetary impact on real activity. Two, at the same time, Model 3 showed consumer durables with higher impact than capital goods, similar to Model 2. However, the difference between the magnitudes of maximum impact for these two sectors in Model 3 was significantly higher than the Model 2. In other words, a model without controlling for supply shocks could show some overreaction in the growth response of capital goods to policy shock. This is a critical finding because capital goods have implications for overall capacity building and long-run growth trajectory of the economy.

**Table 4: Impact of One Standard deviation Shock to Call Rate:**
**Accumulated Responses of Output growth and inflation rate**

(Model with Exogenous Oil and Food Inflation)

| Period | ZINF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
|--------|------|------|------|------|-------|--------|
| 1 | -0.02 | -0.36 | -0.65 | -0.15 | 0.02 | 0.20 |
| 8 | -2.09 | -1.89 | -4.78 | -0.50 | -9.74 | 2.34 |
| 9 | -2.49 | -2.24 | -5.78 | -0.55 | -11.32 | 1.56 |
| 12 | -3.65 | -3.49 | -9.51 | -0.25 | -15.08 | -0.08 |
| 24 | -6.95 | -6.27 | -18.55 | 1.29 | -21.68 | -5.00 |
| 33 | -8.67 | -7.09 | -16.88 | -1.75 | -27.33 | -5.09 |
| 37 | -8.64 | -6.72 | -15.07 | -2.56 | -28.22 | -5.23 |
| 40 | -8.30 | -6.57 | -13.53 | -2.92 | -27.94 | -5.25 |
| 60 | -7.70 | -6.69 | -14.37 | -1.43 | -23.73 | -6.19 |
| Generalised Impulse | | | | | | |

## IV.2.3   Model with Core (Manufacturing) Inflation

An alternative perspective to account for supply shocks entails a model with core inflation without the presence of exogenous supply shocks. Thus, we experimented with the VAR model (Model 4) with manufacturing price inflation as endogenous variable rather than aggregate price inflation as in the Model 3. The impulse response analysis arising from Model 4 is provided in Annex 7 and in Table 5. Here again the common finding was that the impact of tight money policy shock on output growth of capital goods and consumer durables in Model 4 turned out to be higher than Model 3. On other hand, the impact was more or less similar for basic goods and intermediate goods but consumer non-durables showed a lower response in Model 4 than Model 3.

| Table 5: Impact of One Standard deviation Shock to Call Rate: Accumulated Responses of Output growth and Inflation rate (Model with Manufacturing Inflation as Endogenous Variable) | | | | | | |
|---|---|---|---|---|---|---|
| Period | ZMNF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
| 1 | -0.02 | -0.25 | -0.93 | -0.02 | -0.12 | 0.15 |
| 8 | -1.31 | -1.19 | -7.76 | 0.45 | -9.46 | 2.38 |
| 13 | -3.18 | -2.52 | -16.34 | 0.65 | -15.35 | -0.43 |
| 29 | -7.57 | -6.48 | -30.06 | -1.27 | -28.73 | -3.22 |
| 38 | -8.45 | -6.50 | -34.14 | -2.73 | -33.18 | -2.56 |
| 40 | -8.42 | -6.53 | -33.87 | -2.84 | -33.56 | -2.24 |
| 42 | -8.37 | -6.52 | -33.75 | -2.75 | -33.85 | -1.91 |
| 60 | -8.70 | -6.88 | -31.42 | -1.70 | -33.49 | -1.50 |
| Generalised Impulse | | | | | | |

## IV.2.4 Model with Exogenous Real Exchange Rate Variation

The empirical exercises in the above could be consistent with a closed economy approach to transmission mechanism. However, the Indian economy has witnessed significant integration with the world economy due to trade and capital flows reflecting the impact of reform, the increasing competitiveness of industries in their pursuit of internationalisation and the stronger economic growth prospect. According to macroeconomics literature, the open economy aspects of transmission mechanism could be captured through the role of exchange rate, which determines exports and imports and thus, aggregate economic activity. Here, the argument could arise whether to consider nominal or real exchange rate as exogenous or endogenous variable in the VAR model. In this regard, empirical studies consider the assumptions relating to a relatively small open economy, exchange rate regime, central bank intervention in the foreign exchange market and external integration in terms of a country's share in global trade and capital flows. Since our focus is on monetary transmission mechanism and the robustness of empirical findings, we consider a VAR model (Model 5) with annual variation in multiple currency trade weighted real exchange rate as an exogenous variable along with the endogenous variables in line with the Model 4. Taking further clue that REER information is available with a lag of one to two months, we consider

one-month lag of year-on-year variation in the real exchange rate. The impulse responses arising from the Model 5 are shown in Annex 8 and Table 6. The findings from the Model 5 are notable when compared with Model 4. Though with the presence of real exchange rate variation, all sectors witnesses a strengthening of monetary impact, capital goods, intermediate goods and consumer non-durables show a significantly higher impact of tight policy in Model 5 than in Model 4.

**Table 6: Impact of One Standard deviation Shock to Call Rate: Accumulated Responses of Output growth and Inflation rate**
(Model with Exogenous Real Exchange rate variation)

| Period | ZMNF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
|--------|------|------|------|------|-------|--------|
| 1 | -0.02 | -0.24 | -0.95 | -0.02 | -0.10 | 0.11 |
| 8 | -1.31 | -1.10 | -8.20 | 0.48 | -8.94 | 1.55 |
| 12 | -2.74 | -2.20 | -16.52 | 0.64 | -12.41 | -2.80 |
| 24 | -5.80 | -5.67 | -37.23 | -1.19 | -21.23 | -9.25 |
| 29 | -6.87 | -6.81 | -44.23 | -3.32 | -28.30 | -9.40 |
| 35 | -7.88 | -7.44 | -50.57 | -4.77 | -35.81 | -8.05 |
| 39 | -8.17 | -7.34 | -52.56 | -4.47 | -37.86 | -6.70 |
| 51 | -8.36 | -7.20 | -47.01 | -1.92 | -39.47 | -2.33 |
| 60 | -8.99 | -7.04 | -40.30 | -1.07 | -38.77 | -0.85 |
| Generalised Impulse | | | | | | |

### IV.2.5  Impact of the Global Crisis

A viewpoint may arise that last four to five years could be construed as a special situation attributable to the global crisis period, necessitating rapid policy response to tackle the adverse conditions. In this context, we evaluated a VAR model (Model 3) with sample period April 1993 to March 2008, excluding the global crisis period. The impulse responses of the use-based industries to tight monetary policy shock are shown in Annex 9 and Table 7. It was evident that the crisis did not affect the underlying nature of transmission mechanism in terms of maximum impact of tight monetary policy shock on the output growth of capital goods and consumer durables. However, the magnitude of impact showed a softening during the crisis. Also, there was some evidence on the faster pace of transmission mechanism in terms of time period for the maximum impact across the sectors.

### IV.2.6   *Variance Decomposition Analysis*

The forecast error variance decomposition showed the findings more or less similar to the impulse response analysis, *albeit* with some marginal difference. Illustratively, Table 8 provides of the Forecast Error Variance Decomposition (FEVD) analysis for the Model 4. The impact of call money rate shock in explaining total variation of output growth in the medium term (between 12-36 months) was highest for consumer durables, followed by basic goods, capital goods, consumer non-durables and intermediate goods. This finding also extended to other models. A notable finding here was that the inter-industry interaction, comprising own and other sectors' contributions, accounting for more than three-fourth of total variation of output growth for the use-based industries. Illustratively, over 36 months, own lags reflecting the persistence of the sector accounted for 30 per cent and the lags of other sectors accounted for 58 per cent of total variation in the output growth of capital goods sector.

**Table 7: Global Crisis and the Impact of One Standard deviation Shock to Call Rate: Accumulated Responses of Output growth and Inflation rate**

|  | Period with the Global Crisis | | | | Period without Global Crisis | | | |
|---|---|---|---|---|---|---|---|---|
|  | Model 1 | Model 2 | Model 3 | Model 4 | Model 1 | Model 2 | Model 3 | Model 4 |
| Basic Goods | -9.0 | -7.1 | -6.9 | -7.4 | -10.3 | -9.1 | -7.4 | -9.1 |
|  | (33) | (33) | (60) | (35) | (33) | (26) | (41) | (41) |
| Capital Goods | -30.4 | -18.6 | -34.1 | -52.6 | -62.0 | -26.6 | -37.6 | -61.5 |
|  | (38) | (24) | (38) | (39) | (60) | (60) | (60) | (60) |
| Intermediate goods | -4.8 | -2.9 | -2.8 | -4.8 | -12.8 | -7.9 | -8.8 | -12.0 |
|  | (40) | (40) | (40) | (35) | (44) | (34) | (40) | (42) |
| Consumer durables | -36.1 | -28.2 | -33.9 | -39.5 | -58.1 | -27.5 | -35.3 | -47.3 |
|  | (41) | (37) | (42) | (51) | (60) | (33) | (60) | (47) |
| Consumer non-durables | -4.5 | -6.2 | -3.2 | -9.4 | -13.4 | -9.3 | -9.6 | -16.0 |
|  | (31) | (60) | (29) | (29) | (60) | (29) | (60) | (60) |
| Figures indicate maximum impact in terms of cumulative impulse response to one standard deviation shock to call money rate. Figures in bracket indicate the period taken to reach maximum impact. | | | | | | | | |

**Table 8: Generalised Forecast Error Variance**
**Decomposition Analysis**

| Horizon | CALL | ZINF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
|---|---|---|---|---|---|---|---|
| 0 | 0.05 | 0.00 | 1.00 | 0.03 | 0.06 | 0.06 | 0.00 |
| 6 | 0.09 | 0.01 | 0.80 | 0.03 | 0.18 | 0.07 | 0.05 |
| 12 | 0.15 | 0.02 | 0.69 | 0.03 | 0.15 | 0.08 | 0.09 |
| 24 | 0.18 | 0.10 | 0.49 | 0.03 | 0.11 | 0.13 | 0.10 |
| 36 | 0.18 | 0.10 | 0.45 | 0.04 | 0.11 | 0.13 | 0.11 |
| 48 | 0.17 | 0.10 | 0.44 | 0.04 | 0.11 | 0.14 | 0.11 |
| 60 | 0.17 | 0.10 | 0.44 | 0.04 | 0.11 | 0.14 | 0.11 |
| Horizon | CALL | ZINF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
| 0 | 0.01 | 0.00 | 0.03 | 1.00 | 0.02 | 0.03 | 0.00 |
| 6 | 0.07 | 0.06 | 0.13 | 0.71 | 0.13 | 0.12 | 0.04 |
| 12 | 0.12 | 0.14 | 0.11 | 0.47 | 0.12 | 0.14 | 0.13 |
| 24 | 0.12 | 0.15 | 0.09 | 0.33 | 0.09 | 0.14 | 0.22 |
| 36 | 0.12 | 0.15 | 0.09 | 0.31 | 0.09 | 0.15 | 0.23 |
| 48 | 0.11 | 0.15 | 0.10 | 0.30 | 0.10 | 0.15 | 0.22 |
| 60 | 0.11 | 0.15 | 0.11 | 0.30 | 0.10 | 0.15 | 0.21 |
| Horizon | CALL | ZINF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
| 0 | 0.00 | 0.00 | 0.06 | 0.02 | 1.00 | 0.13 | 0.00 |
| 6 | 0.01 | 0.02 | 0.09 | 0.04 | 0.92 | 0.09 | 0.02 |
| 12 | 0.01 | 0.02 | 0.10 | 0.04 | 0.86 | 0.09 | 0.04 |
| 24 | 0.01 | 0.08 | 0.09 | 0.07 | 0.71 | 0.15 | 0.06 |
| 36 | 0.03 | 0.09 | 0.10 | 0.07 | 0.66 | 0.14 | 0.07 |
| 48 | 0.03 | 0.09 | 0.11 | 0.07 | 0.62 | 0.13 | 0.09 |
| 60 | 0.03 | 0.09 | 0.11 | 0.07 | 0.61 | 0.13 | 0.09 |
| Horizon | CALL | ZINF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
| 0 | 0.00 | 0.00 | 0.06 | 0.03 | 0.13 | 1.00 | 0.00 |
| 6 | 0.10 | 0.02 | 0.08 | 0.04 | 0.25 | 0.77 | 0.03 |
| 12 | 0.16 | 0.03 | 0.13 | 0.06 | 0.24 | 0.65 | 0.04 |
| 24 | 0.18 | 0.06 | 0.12 | 0.05 | 0.22 | 0.58 | 0.05 |
| 36 | 0.20 | 0.06 | 0.12 | 0.05 | 0.21 | 0.55 | 0.05 |
| 48 | 0.19 | 0.06 | 0.13 | 0.05 | 0.21 | 0.54 | 0.05 |
| 60 | 0.19 | 0.06 | 0.13 | 0.05 | 0.21 | 0.53 | 0.05 |
| Horizon | CALL | ZINF | ZBGS | ZKGS | ZIGS | ZCDGS | ZCNDGS |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| 6 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.85 |
| 12 | 0.07 | 0.05 | 0.06 | 0.02 | 0.05 | 0.04 | 0.72 |
| 24 | 0.08 | 0.10 | 0.07 | 0.05 | 0.06 | 0.08 | 0.58 |
| 36 | 0.08 | 0.10 | 0.07 | 0.05 | 0.06 | 0.10 | 0.57 |
| 48 | 0.08 | 0.10 | 0.07 | 0.05 | 0.07 | 0.10 | 0.56 |
| 60 | 0.08 | 0.10 | 0.07 | 0.05 | 0.07 | 0.10 | 0.55 |

## Section V

## Conclusion

In this study, we examined how monetary policy shock impinges on the output growth of five use-based industries such as basic goods, capital goods, intermediate goods, consumer durables, and consumer non-durable goods. The empirical findings from the VAR model with alternative combinations of variables brought to the fore a common perspective. Monetary policy could affect capital goods and consumer durables more than other three used-based industries. In some cases, basic goods also showed a response similar to durables and capital goods. Intermediate goods and consumer non-durables showed moderate response to policy shock, and the latter was also associated with a lag in transmission effect. The supply side factors affecting inflation through oil and food prices could play a role in determining the output cost of disinflation. Empirical findings suggested that without supply shocks, the impulse response of output and inflation to monetary policy could be overestimated. The industry effects of monetary transmission mechanism could also be different for an open economy with exogenous fluctuation in real exchange rate. These findings provide insights about how monetary policy affects consumption and investment demands and thereby, the economic growth and inflation. It is expected that these findings could find useful for policy analysis in the Indian context. For further research, policy analysis would benefit from studies focused on disaggregate approach to transmission mechanism based on corporate balance sheets across different industries and sectors.

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## Annex 1: Principal Component Analysis (PCA) of Broad GDP Components:

## Agriculture, Industry and Services Sectors

### *Ordinary Correlation Based PCA*

| Eigen values: (Sum = 3, Average = 1) | | | | |
|---|---|---|---|---|
| Number | Value | Difference | Proportion | Cumulative Value |
| 1 | 1.444435 | 0.465440 | 0.4815 | 1.444435 |
| 2 | 0.978995 | 0.402424 | 0.3263 | 2.423430 |
| 3 | 0.576570 | --- | 0.1922 | 3.000000 |
| Eigenvectors (loadings): | | | | |
| Variable | PC 1 | PC 2 | PC 3 | |
| XGAGS | 0.283025 | 0.937788 | 0.201121 | |
| XGINDS | 0.658422 | -0.342452 | 0.670229 | |
| XGSRVS | 0.697408 | -0.057269 | -0.714383 | |
| Ordinary correlations: | | | | |
| | XGAGS | XGINDS | XGSRVS | |
| XGAGS | 1.000000 | | | |
| XGINDS | 0.032489 | 1.000000 | | |
| XGSRVS | 0.149690 | 0.406406 | 1.000000 | |

### *Ordinary (uncentered) Correlation Based PCA*

| Eigen values: (Sum = 3, Average = 1) | | | | | |
|---|---|---|---|---|---|
| Number | Value | Difference | Proportion | Cumulative Value | Cumulative Proportion |
| 1 | 2.256865 | 1.601170 | 0.7523 | 2.256865 | 0.7523 |
| 2 | 0.655696 | 0.568257 | 0.2186 | 2.912561 | 0.9709 |
| 3 | 0.087439 | --- | 0.0291 | 3.000000 | 1.0000 |
| Eigenvectors (loadings): | | | | | |
| Variable | PC 1 | PC 2 | PC 3 | | |
| XGAGS | 0.464988 | 0.883436 | 0.057677 | | |
| XGINDS | 0.620079 | -0.371487 | 0.691013 | | |
| XGSRVS | 0.631893 | -0.285548 | -0.720537 | | |

| Ordinary (uncentered) correlations: | | | | | |
|---|---|---|---|---|---|
|  | XGAGS | XGINDS | XGSRVS | | |
| XGAGS | 1.000000 | | | | |
| XGINDS | 0.439016 | 1.000000 | | | |
| XGSRVS | 0.494075 | 0.910311 | 1.000000 | | |

# Annex 2: Major Product Items in Use-based Industries

| Basic goods | | Capital goods | | Intermediate goods | | Consumer durables | | Consumer non-durabels | |
|---|---|---|---|---|---|---|---|---|---|
| products | weight | products | weight | products | weight | products | weight | products | weight |
| Minerals | 141.6 | Com-mercial Vehicles | 19.3 | Cotton yarn | 15.1 | Passenger Cars | 19.7 | Antibiotics | 23.8 |
| Electricity | 103.2 | Boilers | 4.0 | LPG | 11.2 | Gems & Jewellery | 17.7 | Apparels | 20.3 |
| Cement | 24.1 | Tractors | 3.8 | Non-cot-ton yarn | 7.1 | Motor Cycles | 9.5 | sugar | 15.2 |
| Diesel | 21.1 | Three-Wheelers | 3.3 | Fasteners | 5.7 | Colour TV | 3.8 | Newspa-pers | 10.1 |
| H R Coils | 13.0 | Refractory Bricks | 3.2 | Petrol | 5.6 | Glazed / Ceramic Tiles | 3.6 | grey cloth | 9.1 |
| Plates | 12.5 | Grinding Wheels | 2.9 | Synthetic yarn | 5.5 | Air Condi-tioner | 2.9 | Cigarettes | 8.7 |
| sponge iron | 10.0 | Engines | 2.9 | Steel Structures | 5.5 | Woollen Carpets | 2.6 | Cotton cloth | 8.0 |
| Bars & Rods | 9.8 | Plastic Machinery | 2.6 | Naphtha | 5.4 | Wood Furniture | 2.4 | Leather Garments | 7.5 |
| Carbon steel | 7.8 | Trans-formers | 2.4 | Block Board | 5.1 | Tyre, Truck/ Bus | 2.4 | Rice | 6.6 |
| Urea | 6.4 | Computers | 2.3 | Purified acid | 4.2 | Telephone Instru-ments Including Mobile | 2.2 | Tea | 6.5 |
| Stainless/ alloy steel | 6.4 | Earth Moving Machinery | 2.3 | Furnace Oil | 3.9 | Scooter and Mo-peds | 2.1 | Pens of All Kind | 5.9 |
| Ferro manga-nese | 6.4 | Switch-gears | 2.2 | Bearings (Ball/ Roller) | 3.4 | Pressure Cooker | 2.1 | Milk, Skimmed, Pasteurised | 5.7 |
| CR Sheets | 5.6 | Conductor, Alumin-ium | 2.0 | Polypro-pylene | 3.0 | Tyre, Car/ Cab | 2.0 | Razor/ Safety Blades | 5.3 |
| Copper and Prod-ucts | 5.5 | Air & Gas Compres-sors | 1.9 | Industrial Alcohol | 2.6 | PVC Pipes and Tubes | 1.9 | Biri | 5.1 |
| Stampings & Forg-ings | 4.9 | Textile Machinery | 1.7 | Glass Bottles | 2.6 | Marble Tiles/ Slabs | 1.2 | Non-cotton cloth | 3.9 |
| sub-total | 378.2 | sub-total | 56.8 | sub-total | 85.9 | sub-total | 76.2 | sub-total | 141.7 |
| All | 456.8 | All | 88.3 | All | 156.9 | All | 84.6 | All | 213.5 |

# Annex 3

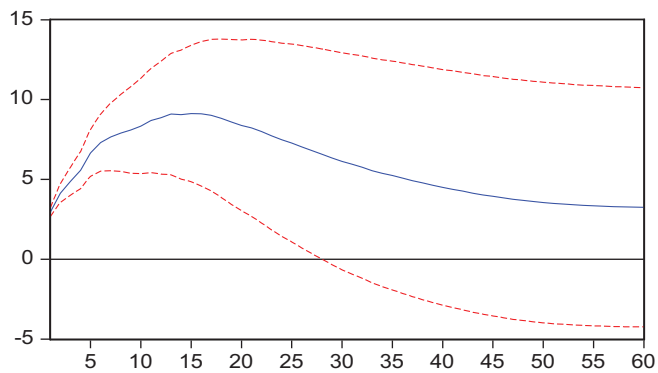## Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

### Accumulated Response of ZQS to CALL
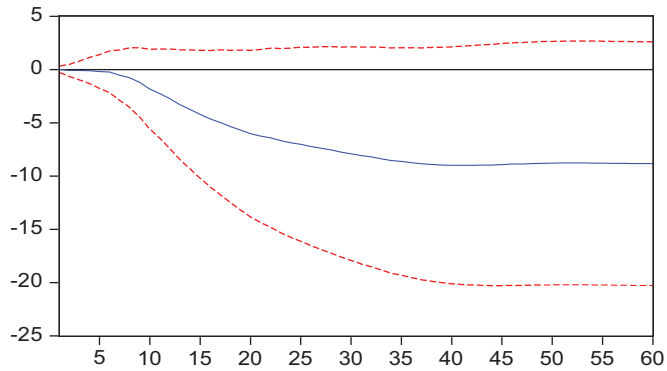
### Accumulated Response of ZINF to CALL
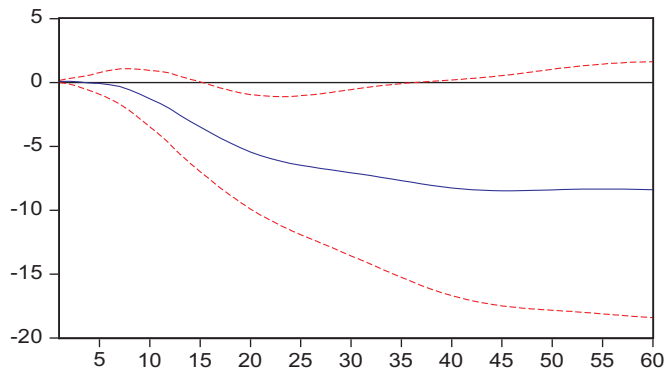
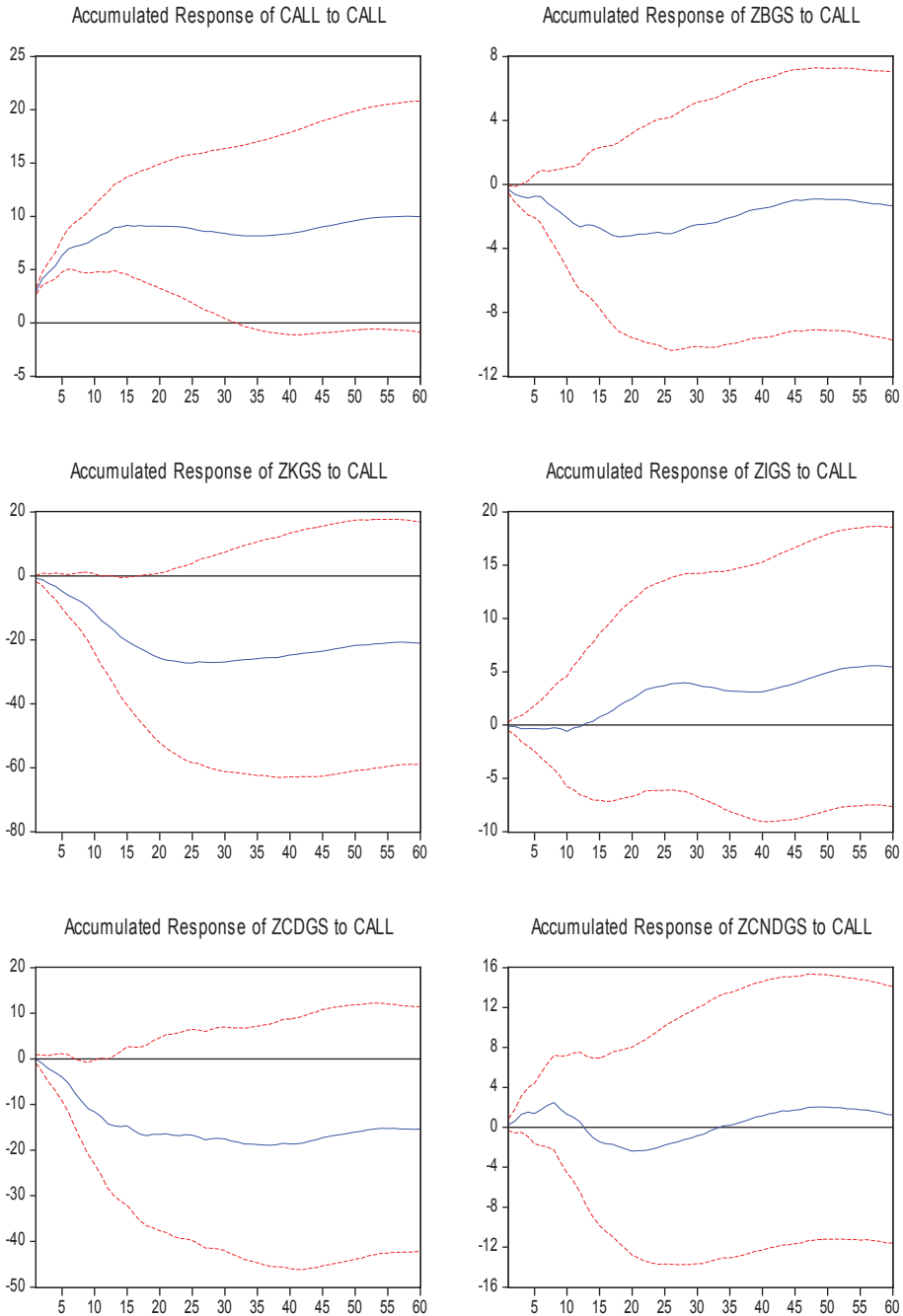### Accumulated Response of CALL to CALL

# Annex 4

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Accumulated Response of CALL to CALL

Accumulated Response of ZBGS to CALL
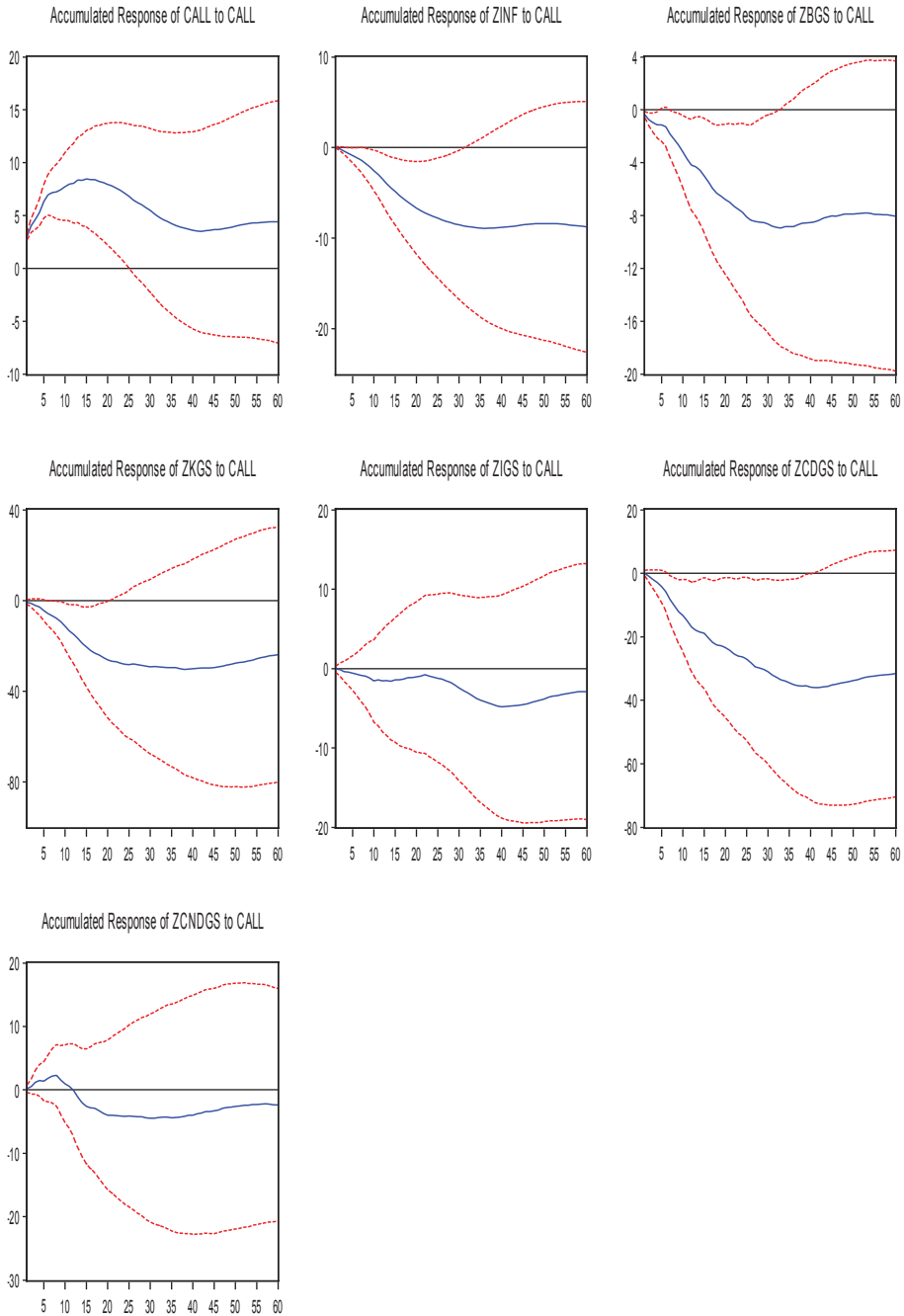
Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL

# Annex 5

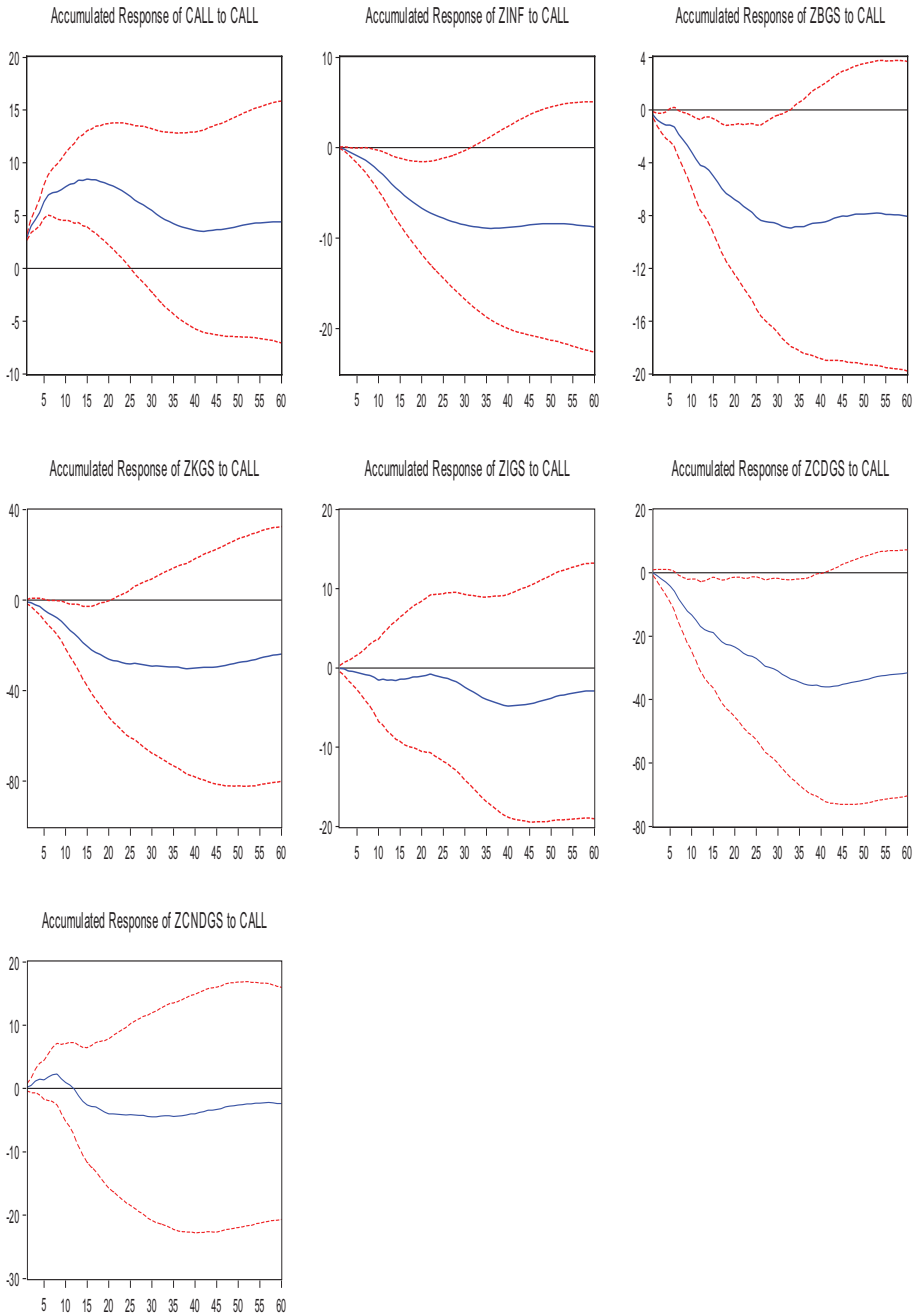Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Accumulated Response of CALL to CALL

Accumulated Response of ZINF to CALL

Accumulated Response of ZBGS to CALL

Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL

# Annex 6

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.



Accumulated Response of CALL to CALL

Accumulated Response of ZINF to CALL

Accumulated Response of ZBGS to CALL

Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL

# Annex 7

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.



Accumulated Response of CALL to CALL

Accumulated Response of ZMNF to CALL

Accumulated Response of ZBGS to CALL

Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL
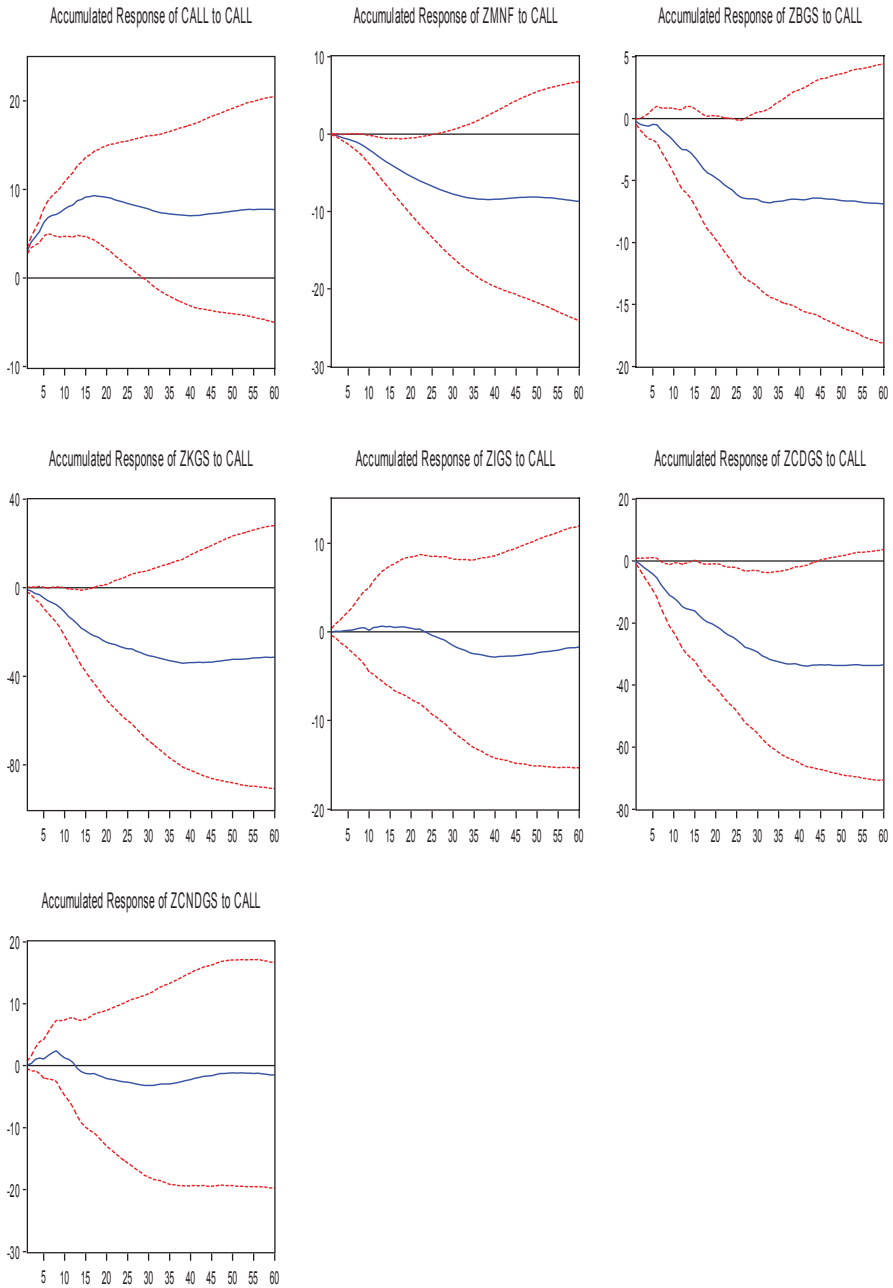
# Annex 8

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.



Accumulated Response of CALL to CALL

Accumulated Response of ZMNF to CALL

Accumulated Response of ZBGS to CALL

Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL
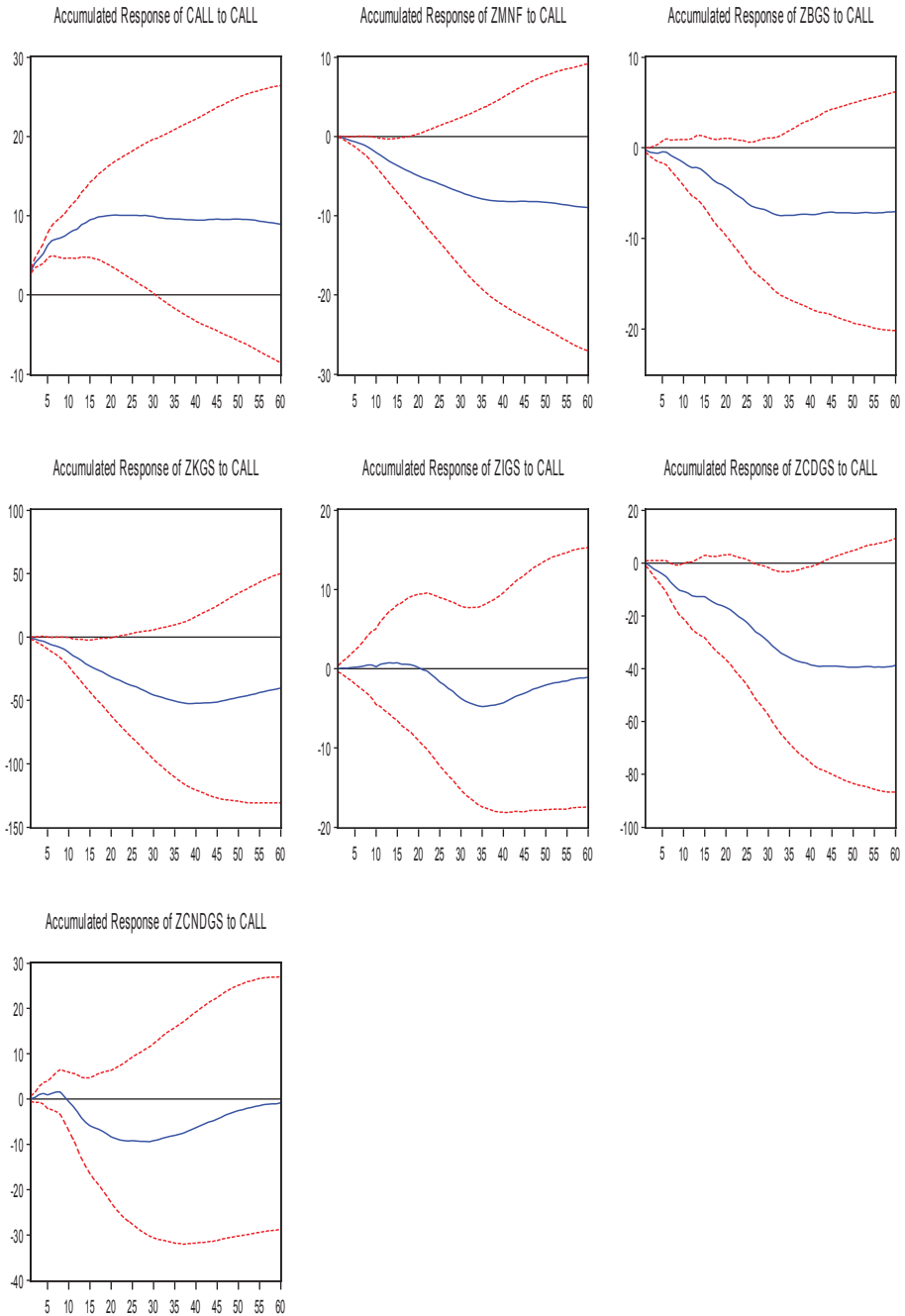
# Annex 9a

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Accumulated Response of CALL to CALL

Accumulated Response of ZINF to CALL

Accumulated Response of ZBGS to CALL

Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL
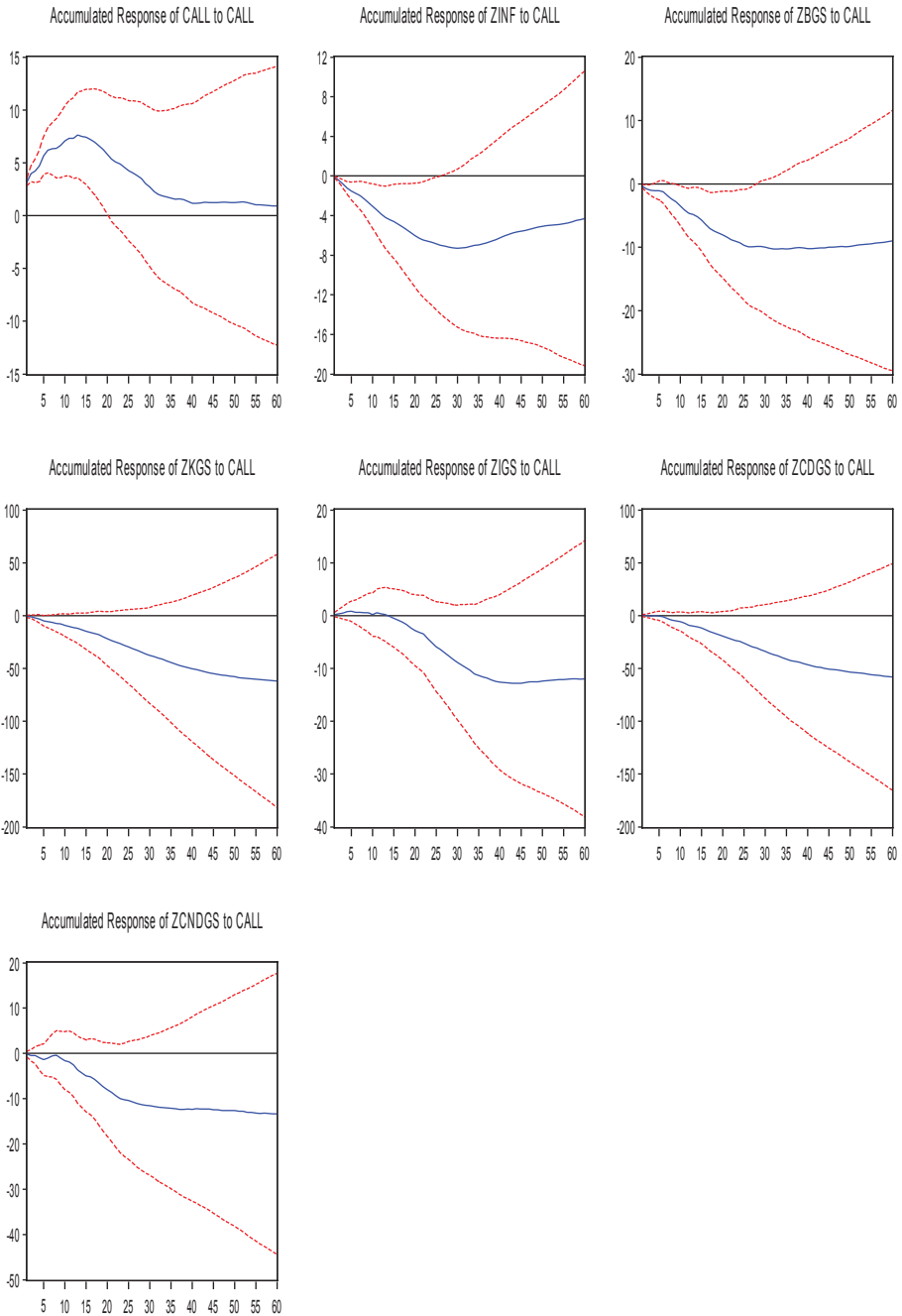
# Annex 9b

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.

Accumulated Response of CALL to CALL

Accumulated Response of ZINF to CALL

Accumulated Response of ZBGS to CALL

Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL
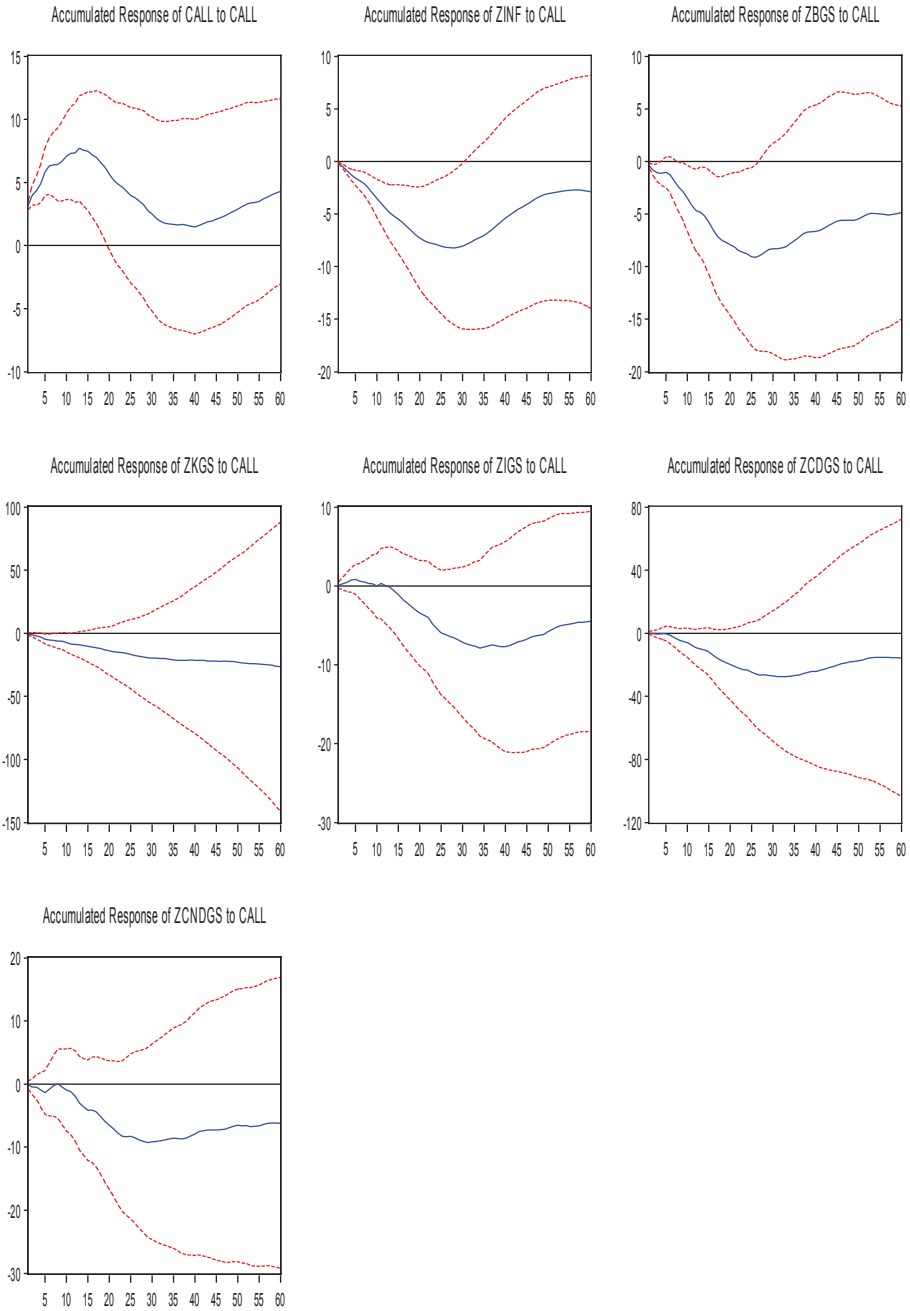
# Annex 9c

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.



Accumulated Response of CALL to CALL

Accumulated Response of ZMNF to CALL

Accumulated Response of ZBGS to CALL

Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL
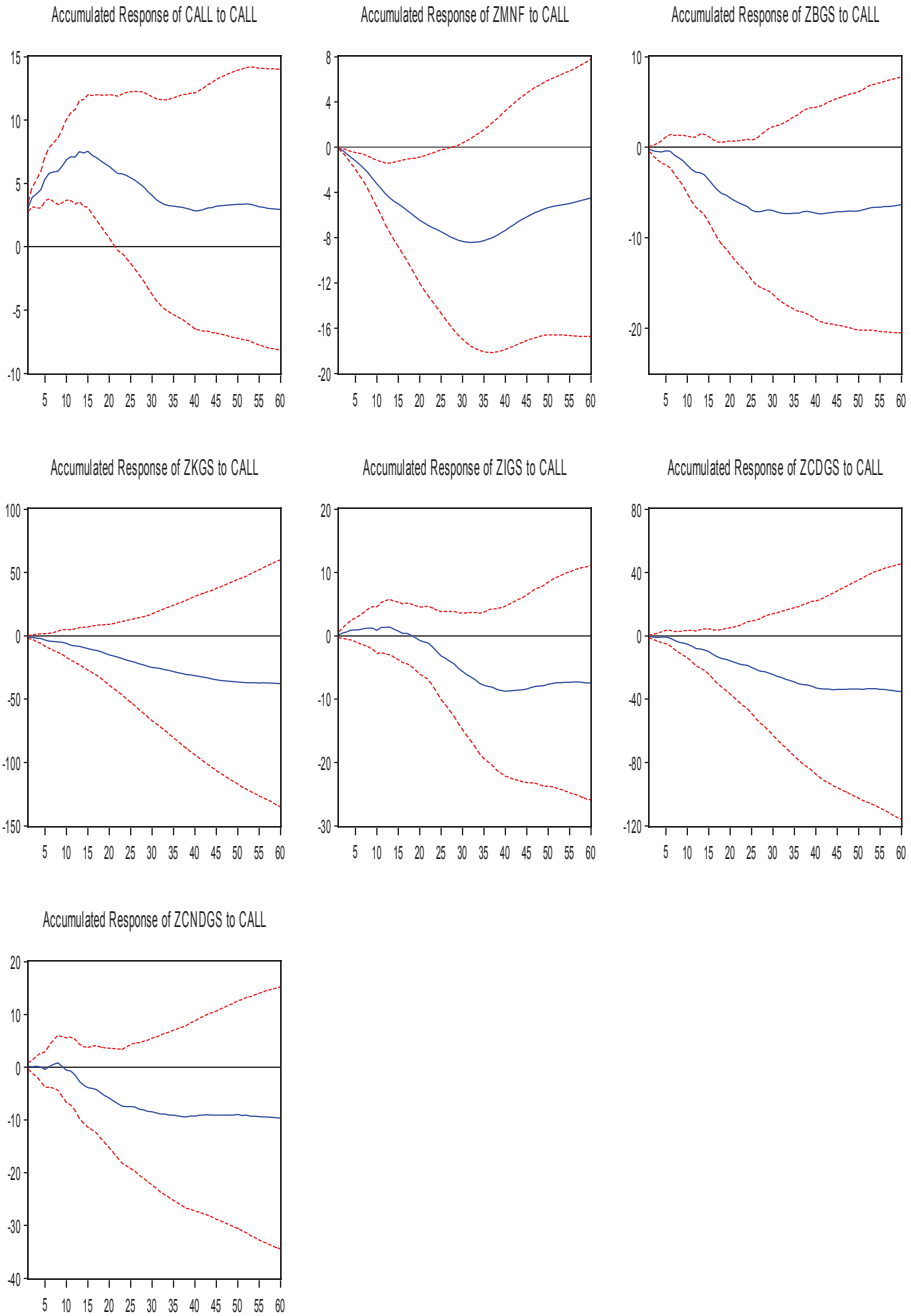
# Annex 9d

Accumulated Response to Generalized One S.D. Innovations ± 2 S.E.



Accumulated Response of CALL to CALL

Accumulated Response of ZMNF to CALL

Accumulated Response of ZBGS to CALL

Accumulated Response of ZKGS to CALL

Accumulated Response of ZIGS to CALL

Accumulated Response of ZCDGS to CALL

Accumulated Response of ZCNDGS to CALL
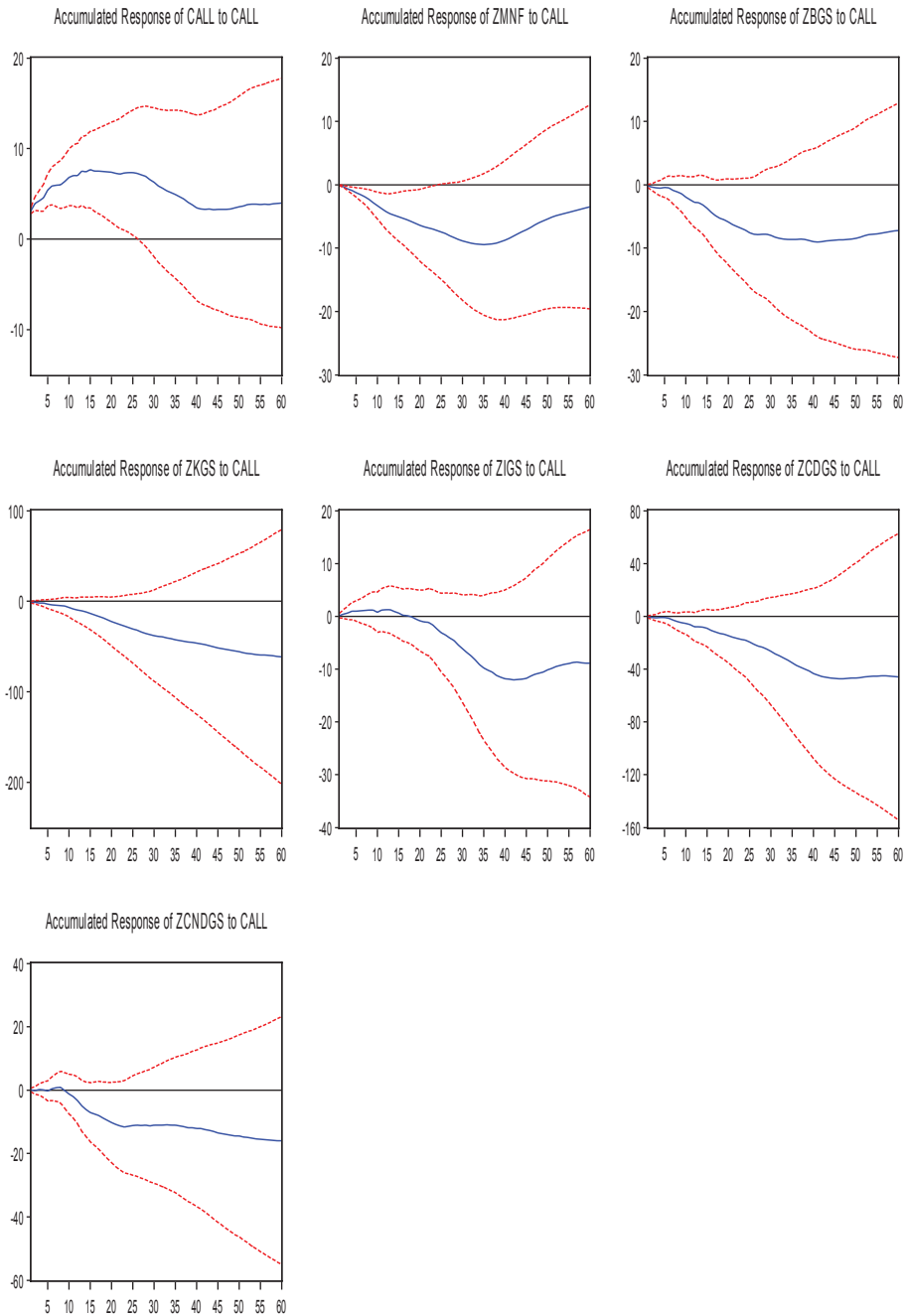
# *Estimating Value at Risk (VaR) using Filtered Historical Simulation in the Indian capital market*

## Indrajit Roy*

The paper estimates Value at Risk (VaR) of the daily return of Indian capital market (SENSEX/NIFTY) using Filtered Historical Simulation (FHS). It uses GARCH framework to model the volatility clustering on returns and examines the usefulness of considering lag values of return (on S&P 500, INR-EURO INR-USD exchange rate, gold price) as proxies of global financial condition in the specification of the mean equation. In general, VaR is calculated using (i) Historical Simulation approach which imposes no structure on the distribution of returns except stationarity and (ii) Monte Carlo simulation approach which assumes parametric models for variance and subsequently a large sample of random members is drawn from this specific distribution to calculate the VaR. FHS approach attempts to combine the model-based approach with the model-free approaches. The VaR is estimated based on two approaches. In the first approach, the mean equation of daily return in Indian capital market is captured by its own lag and daily return of S&P-500, INR-EURO, INR-USD exchange rate and gold price; while volatility is modeled by GARCH model and finally the VaR is estimated through FHS. In the second approach, the mean equation is being captured by ARMA model, while volatility is modeled by GARCH model and finally the VaR is estimated through FHS. It is observed that VaR estimated using (a) GARCH with suitable mean specification, outperforms method (b) based on ARMA-GARCH.

**JEL classification** : G1, C52

**Keywords** : Capital market, value at risk, GARCH

## Introduction

Globalisation and financial sector reforms in India led to a greater integration of Indian stock market with the advanced economies and also to the exchange rate movements. In the early 1960s, Eugene Fama

*Director, Modeling and Forecasting Division, Department of Statistics and Information Management, Reserve Bank of India, C-8, Bandra-Kurla Complex, Bandra(E), Mumbai – 400051. email: iroy@rbi.org.in. The views expressed in this paper are those of the author's alone and not of the institution to which he belongs.

developed efficient market hypothesis (EMH) which describes financial market as informational efficient. In an efficient market, actual price of a security will be a good estimate of its intrinsic value. Fama illustrated three forms of market efficiency, *i.e.*, weak form, semi-strong form and strong form of market efficiency based on the availability of information. According to weak form of EMH, all past market prices and data are fully reflected in securities prices. In other words, technical analysis cannot be used to predict and beat a market. The semi-strong form of EMH assumes that all publicly available information is fully reflected in securities prices which essentially implies that fundamental analysis is of no use. Strong form of EMH assumes that market reflects even hidden/inside information. In other words, according to strong form of EMH, even insider/hidden information is of no use. The weak form of market efficiency hypothesis has been tested by Fama (1970) for U.S., Dryden (1970) for U.K., Conrad and Juttner (1973) for Germany, Jennergren and Korsvold (1975) for Norway and Sweden, Lawrence (1986) for Malaysia and Singapore, Andersen and Bollerslev (1997) for European markets. These studies provided indecisive results. The developed markets were found to be weak form efficient. On the other hand, evidence from emerging markets indicated rejection of the weak form market efficiency hypothesis. Therefore, question arises whether the returns in these emerging markets are predictable. Apart from the form of efficiency, it is the volatility prevailing in the market which influences the return to a large extent. Volatility, which refers to the degree of unpredictable change over time and can be measured by the standard deviation of a sample, often used to quantify the risk of the instrument of portfolio over that time period. Equity return volatility may be defined as the standard deviation of daily equity returns around the mean value of the equity return and the stock market volatility is the return volatility of the aggregate market portfolio. Engle (1982) introduced the concept of Autoregressive Conditional Heteroscedasticity (ARCH) which became a very powerful tool in the modelling of high frequency financial data. ARCH models allow the conditional variances to change through time as functions of past errors. Bollerslev (1986) made significant improvement on ARCH and introduced the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) process. Further, many more

variations were introduced such as Integrated GARCH (IGARCH) by Engle and Bollerslev (1994) and the exponential GARCH (EGARCH) by Nelson (1991), where different re-specification of variance equation was studied.

In financial risk management, VaR is widely used as the risk measure and is defined as the maximum potential loss that would be incurred at a given probability p for a financial instrument or portfolio during a given period of time. In general, VaR is calculated either based on Historical Simulation (HS) approach, which imposes virtually no structure on the distribution of returns except stationarity, or using Monte Carlo simulation (MCS) approach which assumes parametric models for variance and subsequently large sample of random numbers is drawn from this specific distribution to calculate the desired risk measure. Filtered Historical Simulation (FHS) approach attempts to combine the best of the model-based with the best of the model-free approaches in a very intuitive fashion.

There have been some significant empirical studies on stock return volatility in emerging markets like India in recent years. However, there is hardly any study which estimated VaR following Filtered Historical Simulation approach using GARCH model with suitable mean specification, in the context of Indian capital market. Pattanaik and Chatterjee (2000) used ARCH/GARCH models to model the volatility in Indian financial market. Agarwal and Du (2005) using BSE 200 data found that the Indian stock market is integrated with the matured markets of the World. Raj and Dhal (2008) investigated the financial integration of India's stock market with that of global and major regional markets. They used six stock price indices, *i.e.*, the 200-scrip index of BSE to represent domestic market, stock price indices of Singapore and Hong Kong to represent the regional markets and three stock price indices of U.S., U.K. and Japan to represent the global markets. Based on daily as well as weekly data covering end-March 2003 to end-January 2008, they found that Indian market's dependence on global markets, such as U.S. and U.K., was substantially higher than on regional markets such as Singapore and Hong Kong, while Japanese stock market had weak influence on Indian market.

The paper examines the financial integration of Indian capital market (BSE-SENSEX and NSE-NIFTY) with other global indicators and its own volatility using daily returns covering the period January 2003 to December 2009. The paper specifies a GARCH framework to model the phenomenon of volatility clustering on returns and examines the usefulness of considering lag values of returns (on S&P 500, INR-EURO INR-USD exchange rate, gold price) as proxies to global financial conditions in the specification of the mean equation. The paper also estimates VaR of return in the Indian capital market based on two composite methods, *i.e.*, (a) using univariate GARCH model where in the mean equation we have used lag values of return on (S&P 500, INR-EURO & INR-USD exchange rate, Gold price) and following the filtered historical simulation (FHS) approach (b) using ARMA for mean equation, GARCH for volatility and FHS for VaR estimation, *i.e.*, ARMA-GARCH-FHS methods; and finally compares the performance of both the VaR estimates.

The rest of the paper is organised as follows. Section II describes the portfolio model using GARCH specifications, section III describes estimate of VaR based on HS, MCS and FHS. Section IV discusses the data and focuses on VaR calculation and summarising the results. Finally, section V concludes.

## Section II
## The Portfolio Model

In the financial literature, it is well documented that variance of asset returns, in general, changes over time and GARCH models are popular choice to model these changing variances. Let $r_t$; $t = 1, \ldots, T$, represents the continuously compounded rate of returns of a stock price index (for holding the portfolio for one day) at time $t$. If $p_t$ is the stock price index then $r_t = l_n(p_t) - l_n(p_{t-1})$, where '$l_n$' is the natural logarithm. The model can be written as:

$$r_{t+1} = c + \phi_1 r_t + \phi_2 r_{t-1} + .. + \phi_k r_{t+1-k} + \psi_1 x_{1,t+1} + \psi_2 x_{2,t+1} + .. + \psi_s x_{s,t+1} + \sigma_{t+1} \eta_{t+1} ;$$
$$\sigma^2_{t+1} = \omega + \alpha Resid^2_t + \beta \sigma^2_t ; t=1,2 \ldots T \quad \textbf{(1)}$$

where $Resid_t = (r_t - c - \Sigma \phi_i r_{t-l} - \Sigma \psi_j x_{j,t})$; innovation $\{\eta_t\}$ is white noise process, with zero mean and unit variance and $\alpha + \beta < 1$, $X_1 .. X_s$ are the external factors influencing $r_t$.

## Section III
## Value at Risk

Value at Risk is being widely used as measure of market risk of an asset or of a portfolio. The Parametric VaR model imposes a strong theoretical assumption on the underlying properties of data; frequently Normal Distribution is assumed because it is well understood and can be defined using the first two moments (mean and standard deviation). Other probability distributions may be used, but at a higher computational cost. However, empirical evidence indicates that asset price changes, in particular the daily price changes, often do not follow normal distribution. In the presence of excess kurtosis, failure rate increases when the VaR is estimated by the Gaussian distribution. The $100\alpha\%$ one day ahead VaR ($\lambda_{\alpha,t}$) is defined as $P[r_t <= \lambda_{\alpha,t} \mid r_{t-1}] = \alpha$. In general, VaR techniques are based on non-parametric, parametric or mixture of parametric and non-parametric statistical methods. The family of Historical Simulation (HS) models is a non-parametric approach. The FHS as developed by Barone-Adesi *et al* (1998) and Barone-Adesi *et al* (1999, 2000) is a mixture of parametric and non-parametric approach.

### Historical Simulation

Apart from stationarity of the returns, HS method does not require any statistical assumption in particular to the volatility. In HS method we consider the availability of a past sequence of daily portfolio returns for m days; $r_t$ t=1,2…m. The HS technique simply assumes that the distribution of tomorrow's portfolio returns, $r_{t+1}$, is well approximated by the empirical distribution of the past *m* observations-that is, $\{r_{t+1-\tau}\}_{\tau=1..m}$. In other words, the distribution of $r_{t+1}$ is captured by the histogram of $\{r_{t+1-\tau}\}_{\tau=1..m}$. Thus, we simply arrange the returns in $\{r_{t+1-\tau}\}_{\tau=1..m}$ in ascending order and choose the $VaR^p_{t+1}$ to be a number such that only $100p\%$ of the observations are smaller than the $VaR^p_{t+1}$.

### Monte Carlo Simulation (MCS)

MCS can be explained better through an example. Let us consider GARCH(1,1) model as defined in equation (1), *i.e.:*

$r_{t+1} = c + \phi_1 r_t + \phi_2 r_{t-1} + .. + \phi_k r_{t+1-k} + \psi_1 x_{1,t+1} + \psi x_{2,t+1} + .. + \psi_s x_{s,t+1} + \sigma_{t+1} \eta_{t+1}$ ;

$t = 1,2 \ldots T$ $\sigma^2_{t+1} = \omega + \alpha Resid^2_t + \beta \sigma^2_t$

where $Resid_t = (r_t - c - \Sigma\phi_i r_{t-I} - \Sigma\psi_j x_{j,t})$; innovation $\{\eta_t\}$ is white noise process, with zero mean and unit variance and $\alpha + \beta < 1$. Although in the case of daily asset returns, generally, $\eta_t$ does not follow normal distribution but using other probability distributions is computionally very costly, let us assume $\eta_t$ follows Normal Distribution $N(0,1)$.

Based on the above specified GARCH model, at the end of day 't' we can calculate the variance of day 't+1', *i.e.*, $\sigma^{^2}_{t+1.}$

Let $\{\eta^{^}_{i,1}; i=1,2\ldots L)$ be a set of large number of random numbers drawn from the standard Normal Distribution $N(0,1)$. From these random numbers $\{\eta_{i,1}; i=1,2\ldots L\}$, we can calculate a set of hypothetical returns for day 't+1' as

$r^{^}_{i,t+1} = c + \Sigma\phi_i r_{t+1-i} + \Sigma\psi_j x_{t+1-j} + \sigma^{^}_{t+1} \eta_{i,1}^{^}$ ; $i=1,2\ldots L$

$Resid_{i,t+1} = (r^{^}_{i,t+1} - c - \Sigma\phi_i r_{t+1-i} - \Sigma\psi_j x_{t+1-j})$

Given these hypothetical estimated returns $(r^{^}_{i,t+1})$ for day 't+1', we can compute the hypothetical variances for the 't+2' day as :

$\sigma^{^2}_{t+2} = \omega + \alpha Resid^2_{t+1} + \beta \sigma^{^2}_{t+1}$

Similarly, to estimate the hypothetical return $(r^{^}_{i,t+2})$ on day t+2, a large number of pseudo random numbers is drawn again from the *N(0, 1)* distribution, *i.e.,* $\{\eta_{i,2}; i=1,2\ldots L\}$

$r^{^}_{i,t+2} = c + \Sigma\phi_i r_{t+2i} + \Sigma\psi_j x_{t+2j} + \sigma^{^}_{t+2} \eta_{i,2}^{^}$ ; $i=1,2\ldots L$

$Resid_{i,t+2} = (r^{^}_{i,t+2} - c - \Sigma\phi_i r_{t+2-i} - \Sigma\psi_j x_{t+2-j})$

and variance is now updated by

$\sigma^{^2}_{t+3} = \omega + \alpha Resid^2_{t+2} + \beta \sigma^{^2}_{t+2}$

Similarly, we can get the hypothetical return of 't+k' day

$r^{^}_{i,t+k} = c + \Sigma\phi_{i*} r_{i,t+k-1} + \Sigma\psi_{j*} x_{j,t+k-1} + \sigma^{^}_{t+k-1*} \eta_{i,k}^{^}$ ; $i=1,2\ldots L$

Therefore, hypothetical $K^{th}$ return can be written as:

$$\hat{r}_{i,t+1:t+k} = \Sigma_k \hat{r}_{i,t+k}; \; i=1,2\ldots L$$

If we collect these L hypothetical *K*-day returns in a set $\{ \hat{r}_{i,t+1:t+k}; i=1,2\ldots L\}$, then the *K*-day VaR can be calculated as the 100p percentile, *i.e.:*

$$VaR^p_{t+1:t+k} = - Percentile \; [\{ \hat{r}_{i,t+1:t+k}; i=1,2\ldots L\},100p\}]$$

## Filtered Historical Simulation (FHS)

As we have discussed that non-parametric approach such as HS does not assume any statistical distribution of returns, whereas parametric approach such as the Monte Carlo simulation (MCS) takes the opposite view and assumes parametric models for variance, correlation (if a disaggregate model is estimated), and the distribution of standardised returns. Random numbers are then drawn from this distribution to calculate the VaR. Both of these extremes in the model-free/model-based spectrum have pros and cons. MCS is good if the assumed distribution is fairly accurate in description of reality. HS is sensible as the observed data may capture features of the returns distribution that are not captured by any standard parametric model. The FHS approach, on the other hand, attempts to combine the best of the MCS with the best of the HS.

Let us assume that we have estimated a GARCH-type model of our portfolio variance given in equation (1). Although we may be comfortable with our variance model ($\sigma$), we may not be comfortable in making a specific distributional assumption about the ($\eta$), such as a Normal or a *t* distribution. Instead of that, we might like the past returns data ($r_t$) to determine the distribution directly without making further assumptions.

Given a sequence of past returns and estimated GARCH volatility, $\{ r_{t+1-\tau}, \hat{\sigma}_{t+1-\tau;} \tau =1,2\ldots m\}$ calculated past standardised returns are given by $\hat{\eta}_{t+1-\tau} = (\hat{r}_{t+1-\tau} - E(r_{t+1-\tau}))/ \hat{\sigma}_{t+1-\tau}; \tau =1,2\ldots m$

Instead of drawing random $\hat{\eta}$s from a specific probability distribution as it is done in MCS, in FHS method samples are drawn with replacement from $\{\eta^{\hat{}}_{t+1-\tau}; \tau =1,2\ldots m\}$. Thereafter, we can get the hypothetical return of 't+k' day as:

$\hat{r}_{i,t+k} = c + \Sigma \phi_{i*} r_{i,t+k-1} + \Sigma \psi_{j*} x_{j,t+k-1} + \hat{\sigma}_{t+k-1*} \hat{\eta}_{i,k} \; ; i=1,2\ldots L.$

Therefore, hypothetical *K*-day return can be written as :

$\hat{r}_{i,t+1:t+k} = \Sigma_k \hat{r}_{i,t+k}; \; i=1,2\ldots L$

The *K*-day VaR can be calculated based on L estimated k-day returns $\{\hat{r}_{i,t+1:t+k}\}$ as the 100p percentile, *i.e.,*

$VaR^p_{t+1:t+k} = - \; Percentile\; [\{ \; \hat{r}_{i,t+1:t+k}; i=1,2\ldots L\}, 100p]$

## Section IV
## VaR Model Selection: Statistical Tests

Lopez (1998, 1999) formalised the use of loss functions as a means of evaluating VaR models and risk managers prefer the VaR model which maximises the utility function (minimises loss). Therefore, using utility functions in the evaluation of alternative VaR estimators is more effective than other nonparametric test such as Christoffersen's (1998) "conditional coverage" test. Lopez (1998,1999) proposed three loss functions, *viz*. the binomial loss function, the magnitude loss function and the zone loss function. Sharma, Thomas and Shah (2002) used a regulatory loss function to reflect the regulatory loss function (RLF), and a firm's loss function (FLF) which reflects the utility function of a firm. The regulatory loss function linked to the objectives of the financial regulator and the firm's loss function primarily focused in measuring the opportunity cost of firm's capital. Let $r_t$ be the change in the value of a portfolio over a certain horizon and $v_t$ is the VaR estimate at (1-p) level of significance.

**Regulatory Loss Function (RLF)**

It penalises failure differently from the binomial loss function, and pays attention to the magnitude of the failure.

$$l_t = \begin{cases} (rt - vt)^2 & if & rt < vt \\ 0 & otherwise \end{cases}$$

**Firm's Loss Function (FLF)**

There is a conflict between the goal of safety and goal of profit maximisation for an organisation which uses VaR for internal risk

management. There is an opportunity cost of capital for the firm which uses a particular VaR model which specifies a relatively high value of VaR as compared to other VaR model. The FLF is defined as :

$$l_t = \begin{cases} (rt - vt)^2 & \text{if} \quad rt < vt \\ -\alpha v_t & \text{otherwise} \end{cases}$$

Where $\alpha$ measures the opportunity cost of capital.

Let $z_t = l_{it} - l_{jt}$, where $l_{it}$ and $l_{jt}$ are the values of a particular loss function generated by model i and model j respectively, for the day t. If $\theta$ is the median of distribution of $z_t$ then the superiority of model *i* over model *j* with respect to a certain loss function can be tested by performing one-sided sign test.

$H_0 = \{\theta = 0\}$

$H_1 = \{\theta < 0\}$

Let $\psi_t = \begin{cases} 1 & \text{if} \quad z_t \geq 0 \\ 0 & \text{otherwise} \end{cases}$ and $Sij = \sum_{t=1}^{T} \psi_t$

The test statistics is

$$S_{ij}{}^a = \frac{S_{ij} - 0.5T}{\sqrt{.25T}} \sim N(0,1) \text{ asymptotically.}$$

If $S_{ij}{}^a < $ -1.66, $H_0$ is rejected at 5 percent level of significance, which would imply that model i is significantly better than model j.

The Diebold-Mariano test (1995) aims to test the null hypothesis of equality of expected forecast accuracy against the alternative of different forecasting ability across models. Let $\{y_t\}$ denote the series to be forecast and let $y^1_{t+h|t}$ and $y^2_{t+h|t}$ denote two competing forecasts of $y_{t+h}$. The forecast errors from the two models are :

$\varepsilon^1_{t+h|t} = y_{t+h} - y^1_{t+h|t}$

$\varepsilon^2 t+h|t = y_{t+h} - y^2_{t+h|t}$

Some common loss functions are :

Squared error loss: $L(\varepsilon^i_{t+h|t}) = (\varepsilon^i_{t+h|t})^2$

Absolute error loss: $L(\varepsilon^i_{t+h|t}) = |\varepsilon^i_{t+h|t}|$

The Diebold-Mariano test is based on the loss differential, *i.e.,*

$$d_t = L(\varepsilon^1_{t+h|t}) - L(\varepsilon^2_{t+h|t})$$

The null of equal predictive accuracy is then :

$$H_0 : E[d_t] = 0$$

The Diebold-Mariano test statistic is

$$S = \frac{\bar{d}}{\sqrt{(asymp\_variance(\bar{d}))}} = \frac{\bar{d}}{\sqrt{(LR\hat{V}_{\bar{d}}/T)}}$$

where $\bar{d} = \frac{1}{T_0}\sum_{t=t_0}^{T} d_t$

$$LRV_{\bar{d}} = \gamma_0 + 2\sum_{j=1}^{\alpha}\gamma_j = \text{cov}(d_t, d_{t-j})$$

$LR\hat{V}_{\bar{d}}$ is a consistent estimate of the asymptotic (long-run) variance of $\sqrt{T}\ \bar{d}$.

Diebold and Mariano (1995) show that under the null of equal predictive accuracy $S \sim N(0, 1)$ asymptotically.
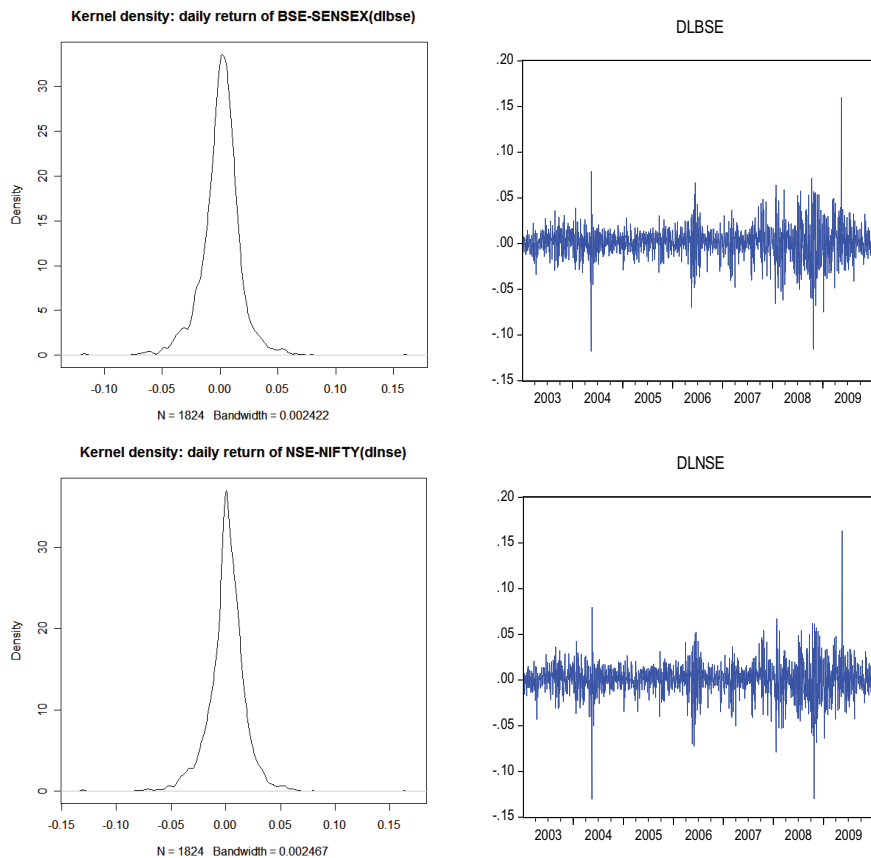
## Section V
## Empirical Results

In the study, we have used daily data of two stock price indices, *viz.,* BSE-SENSEX (BSE) and NSE-NIFTY (NSE) covering the period from January 2003 to December 2009. We have estimated 1-day VaR for daily returns of two price indices using univariate GARCH model with proper mean specification and following the FHS approach for VaR estimation. We have also estimated VaR of return using ARMA-GARCH-FHS model and compare the performance of both the VaR estimate. We have used daily S&P500 stock price (SP), daily exchange rate of INR-USD (usd), INR-EURO (euro) and also the gold prices in INR/ounce (gold) for the same period as explanatory variable of the mean equation of the stock prices return. Unit root tests (ADF, PP test)

suggest that level series of all the six data series are non-stationary. However, continuous daily return, *i.e.,* log differences of the series (dlbse, dlnse, dlsp, dlusd, dleuro and dlgold) are stationary.

## Stylised facts

Continuous daily return (log difference) and kernel density of returns on BSE-SENSEX, NSE-NIFTY, S&P500, INR-USD exchange rate, INR-EURO exchange rate and gold prices for the reference period are given in Chart 1 and descriptive statistics are given in table 1. There is a clear presence of fat tails in the return distribution of all the six data series. Various normality test (such as Anderson Darling normality test, Cramer-Von Mises normality test) suggests that the return distributions are not Gaussian normal.

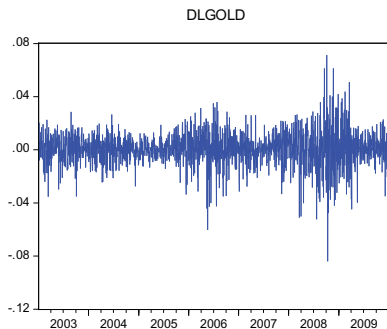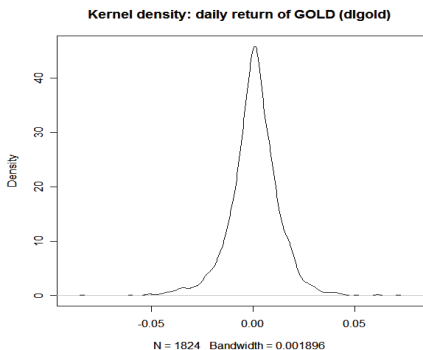### Chart 1: Plot of daily returns and kernel density of Modelling Volatility
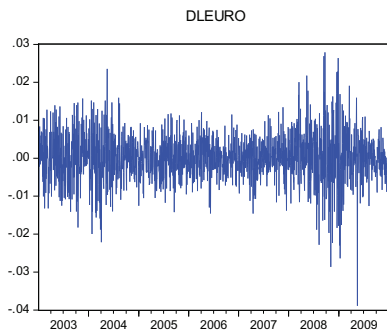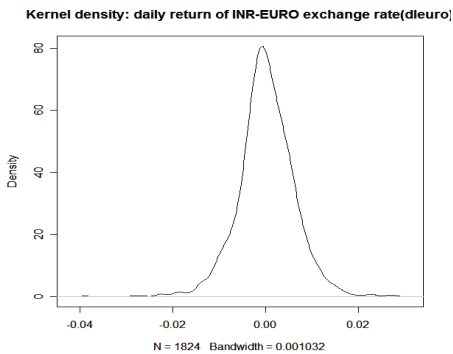
Kernel density: daily return of S&P 500 stockprices(dlsp)



DLSP



Kernel density: daily return of INR-USD exchange rate(dlUSD)



DLUSD



Kernel density: daily return of INR-EURO exchange rate(dleuro)



DLEURO



Kernel density: daily return of GOLD (dlgold)
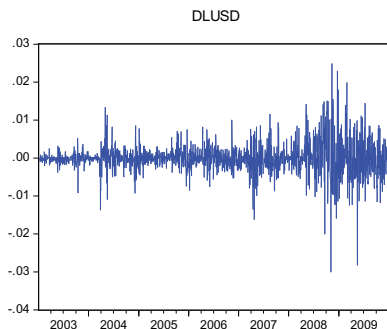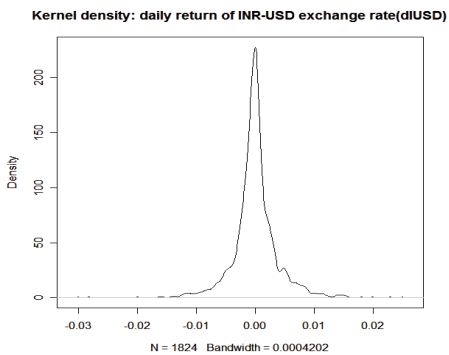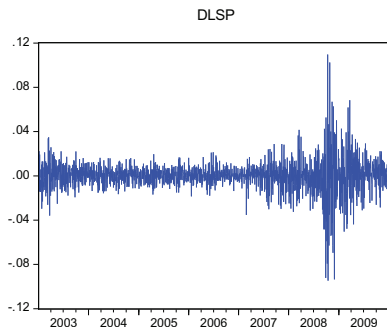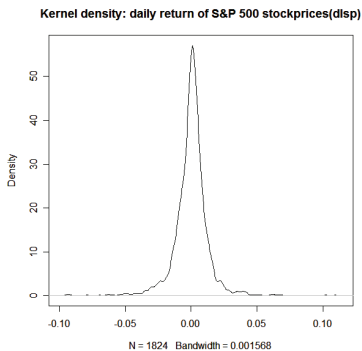


DLGOLD

## Table 1: Descriptive statistics

|             | DLNSE    | DLBSE    | DLSP     | DLUSD    | DLEURO   | DLGOLD   |
|-------------|----------|----------|----------|----------|----------|----------|
| Mean        | 0.000804 | 0.000849 | 0.000105 | -2.02E-05 | 0.000134 | 0.000617 |
| Median      | 0.001078 | 0.001614 | 0.000799 | 0        | 0        | 0.000865 |
| Maximum     | 0.163343 | 0.1599   | 0.109572 | 0.024903 | 0.0279   | 0.071278 |
| Minimum     | -0.13054 | -0.11809 | -0.0947  | -0.03007 | -0.03889 | -0.08396 |
| Std. Dev.   | 0.017498 | 0.017166 | 0.013291 | 0.003855 | 0.006085 | 0.012485 |
| Skewness    | -0.31933 | -0.11242 | -0.23195 | -0.02245 | -0.14065 | -0.30721 |
| Kurtosis    | 12.07311 | 11.0435  | 15.13967 | 10.82578 | 5.58351  | 6.944578 |
| Jarque-Bera | 6370.147 | 4985.629 | 11364.19 | 4715.852 | 520.0318 | 1211.227 |
| Sum         | 1.485895 | 1.569306 | 0.193701 | -0.03735 | 0.24755  | 1.126134 |
| Sum Sq. Dev.| 0.56552  | 0.544288 | 0.326289 | 0.027452 | 0.068397 | 0.284156 |
| Observations| 1848     | 1848     | 1848     | 1848     | 1848     | 1824     |

Equations (2) and (3) present the estimated portfolio model where lag values of (dlbse, dlsp, dlusd, dleuro and dlgold) are used in the mean equation of the GARCH(1,1) model of BSE and NSE, respectively.

Eq (2):

D(LOG(BSE)) = 0.00152 + 0.32558*D(LOG(SP500(-1))) +
          (0.00027)            (0.02662)
0.16716*D(LOG(SP500(-2))) + 0.13393*D(LOG(SP500(-3))) +
(0.026299)                        (0.029617)
0.10005*D(LOG(SP500(-4))) - 0.06044*D(LOG(BSE(-2))) −
(0.027628)                        (0.025798)
0.04891*D(LOG(BSE(-3))) + 0.05722*D(LOG(GOLD(-2))) +
(0.020935)                        (0.023705)
0.15824*D(LOG(EURO(-3))) - 0.24620*D(LOG(USD(-3))) +
(0.053619)                        (0.088501)
0.15767*D(LOG(USD(-4)))
(0.084305)

GARCH = 5.049e-06 + 0.1527939*RESID(-1)^2 + 0.83803454*
GARCH(-1)
          (5.05E-06)      (0.152794)            (0.838035)

Eq (3):

D(LOG(NSE)) = 0.00134 + 0.32468*D(LOG(SP500(-1))) +
$\quad\quad$ (0.000292) $\quad\quad$ (0.027540)
0.16821*D(LOG(SP500(-2))) + 0.10268*D(LOG(SP500(-3))) –
$\quad\quad$ (0.027508) $\quad\quad\quad$ (0.030620)
0.03877*D(LOG(NSE(-2))) + 0.06159*D(LOG(GOLD(-2))) +
$\quad\quad$ (0.026039) $\quad\quad\quad$ (0.025277)
$\quad$ 0.17716*D(LOG(EURO(-3))) - 0.34938*D(LOG(DOLLAR(-3))) +
$\quad\quad$ (0.051925) $\quad\quad\quad$ (0.088119)
0.19060*D(LOG(DOLLAR(-4)))
$\quad\quad$ (0.087568)

GARCH = 5.52699e-06 + 0.13072*RESID(-1)^2 + 0.85739*GARCH(-1)
$\quad\quad$ (5.53E-06) $\quad\quad$ (0.130725) $\quad\quad\quad$ (0.857389)

Equation (4) and (5) presents the estimated portfolio model using ARMA-GARCH model of BSE and NSE respectively.

Eq (4):

D(LOG(BSE)) = 0.00161 + [AR(1)=0.52534,AR(2)= -0.87026,
$\quad\quad$ (0.000314) $\quad\quad$ (0.062328) $\quad\quad$ (0.061490)
MA(2)=0.79823,MA(3)=0.12583,MA(1)=-0.42263]
$\quad$ (0.066763) $\quad\quad$ (0.026230) $\quad\quad$ (0.066514)

GARCH = 6.28919e-06 + 0.15594*RESID(-1)^2 + 0.83073*GARCH(-1)
$\quad\quad$ (6.29E-06) $\quad\quad$ (0.155941) $\quad\quad\quad$ (0.830730)

Eq (5):

D(LOG(NSE)) = 0.00160+ [AR(2)=-0.45572,AR(4)=-0.6135
$\quad\quad$ (0.000317) $\quad\quad$ (0.084090) $\quad\quad$ (0.096555)
AR(1)=0.49844,MA(2)=0.42253,MA(4)=0.67288,MA(1)=-0.43386]
$\quad$ (0.134215) $\quad\quad$ (0.079148) $\quad\quad$ (0.092978) $\quad\quad$ (0.127459)

GARCH = 7.61169e-06 + 0.13774*RESID(-1)^2 + 0.84330*GARCH(-1)
$\quad\quad$ (1.12E-06) $\quad\quad$ (0.011880) $\quad\quad\quad$ (0.012652)

**Note:** *Values given in brackets are the standard error.*

## Value at Risk: Results

We have estimated 5 percent 1-day-VaR for both BSE-SENSEX and NSE-NIFTY daily return using univariate GARCH model with proper mean specification as estimated in section 4.2 and following the FHS approach for VaR estimation (Model A). We have also estimated 5 percent VaR for both BSE-SENSEX and NSE-NIFTY daily return using ARMA-GARCH-FHS model (Model B). To estimate the model parameter we have used the daily data from $2^{nd}$ January 2003 to $30^{th}$ October 2009 and forecasted dynamically 1-day VaR for the period $2^{nd}$ November 2009 to $24^{th}$December 2009, *i.e.,* for 39 days. Actual returns and forecasted VaR based on both Model A and Model B for BSE-SENSE and NSE-NIFTY are given in Chart 2 and Chart 3, respectively. Out of 39 forecasts of VaR for BSE and NSE, only in one occasion, actual return was less than the VaR estimate (failure rate 1/39) for both model A and model B. However, dispersion of VaR from actual returns is not the same. Let the dispersion of VaR at 5 percent significant level based on model A ($^{A}VaR_{t}^{.05}$) from the actual return ($r_{t}$) be $D^{A}=\Sigma(r_{t}-{}^{A}VaR_{t}^{.05})^{2}$ and $D^{B}=\Sigma(r_{t}-{}^{B}VaR_{t}^{.05})^{2}$ for mode B. It is observed that for both BSE-SENSEX and NSE-NIFTY price indices dispersions are less for model A than model B ($D^{A}_{BSE}$ =0.02483, $D^{B}_{BSE}$ =0.03022), ($D^{A}_{NSE}$ = 0.02603, $D^{B}_{NSE}$ =0.03049).



**Chart 2: Daily return on BSE and corresponding VaR based on Model A and Model B**
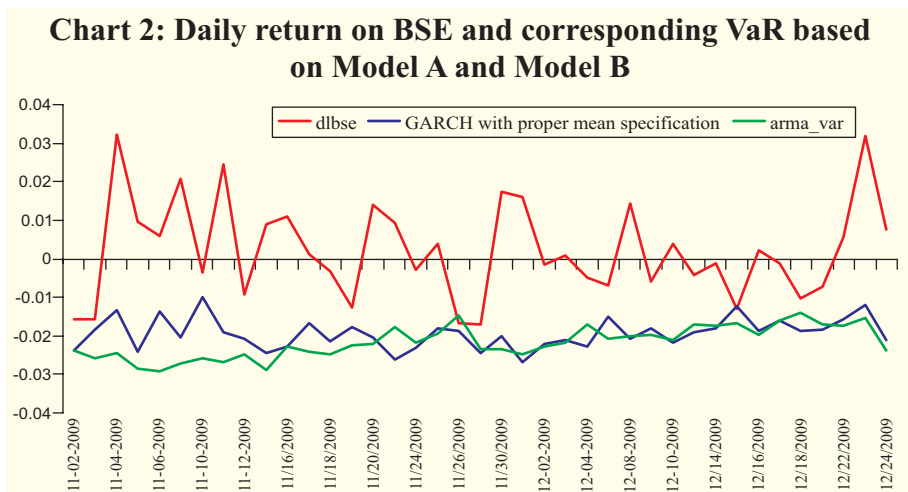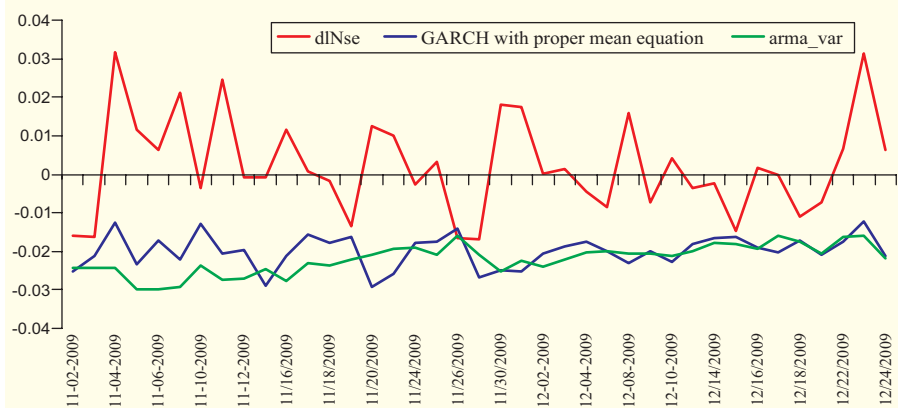
**Chart 3: Daily return on NSE and corresponding VaR based on Model A and Model B**



RLF and FLF based test as outlined by Sharma, Thomas and Shah (2002) suggests that at 1 percet level of significance, Model A performs better than model B for both BSE-SENSEX and NSE-NIFTY. Diebold-Mariano (1995) test, as outlined in section IV, to test whether losses are statistically significantly different, also indicates that performance of model A is significantly (10 per cent level of significance) better than model B for both the indices BSE-SENSEX and NSE-NIFTY.

## Section VI
## Conclusion

The paper estimates 1-day VaR taking into consideration the financial integration of Indian capital market (BSE-SENSEX and NSE-NIFTY) with other global indicators and its own volatility using daily return covering the period January 2003 to December 2009. The paper specifies a GARCH framework to model the phenomena of volatility clustering on returns and examines the usefulness of considering lag values of return on (S&P 500, INR-EURO and INR-USD exchange rate, gold price) as proxies to global financial condition in the specification of the mean equation. The paper estimates the VaR of return in the Indian capital market based on two composite methods, *i.e.,* (a) using univariate GARCH model wherein the mean equation uses lag values of return on (S&P 500, INR-EURO & INR-USD exchange rate, gold price)

and following the FHS approach (b) using ARMA (for mean equation)-GARCH (to model volatility)-FHS(to estimate VaR) and compare the performance of both the VaR estimates. It is observed that global financial situation (lag values of return on S&P 500, INR-EURO and INR-USD exchange rate, gold price used as proxies to global financial condition) has significant impact on Indian capital market and VaR (as estimated in FHS framework) of return in the Indian capital market based on GARCH method with suitable mean specification outperforms the ARMA-GARCH model of daily return of Indian capital market.

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# Regional Inequality in Foreign Direct Investment Flows to India:
# The Problem and the Prospects

## Atri Mukherjee[*]

*Following the liberalisation of the foreign direct investment (FDI) policy in India in the early 1990s, FDI to India has increased significantly in the last decade. However, the growth in FDI flows has been accompanied by strong regional concentration thereby depriving a large number of Indian states from the benefits of a liberalised FDI regime. In view of this, the paper examines what are the major determinants affecting regional distribution of FDI flows in India. The analysis reveals that market size, agglomeration effects and size of manufacturing and services base in a state have significant positive impact on FDI flows. The impact of taxation and cost of labour is negative. While the impact of quality of labour is ambiguous, infrastructure, however, has significant positive influence on FDI flows. With the presence of a strong agglomeration effect, it is essential to have a conscious and coordinated effort at the national and the state government level to make the laggard states more attractive to FDI flows. The efforts may include special thrust on the manufacturing, services and the infrastructure sectors, or direct policy efforts like in the case of China or a combination of both.*

## Introduction

In the era of globalisation and financial integration, foreign direct investment (FDI) has emerged as one of the most important forms of capital flows to developing countries. FDI is often preferred over other forms of capital flows by the policy makers as it is considered to be of a more stable nature and also it does not form a part of the host country's external debt stock. Apart from constituting a mode of finance, FDI also tends to enhance economic growth through spill over

of technology and knowledge in the host country. There is, however, large inequality in the distribution of FDI flows within the emerging market and developing economies. While some countries like China, India and Brazil have attracted bulk of the FDI flows, most of the others have failed to achieve the same.

FDI flows to India picked up in the 1990s, after the economic reforms and liberalisation of the FDI policies. As per the IMF's Global Financial Stability Report, April 2012, India has emerged as one of the major recipients of FDI flows among the emerging market economies in the last few years. Composition of FDI flows to India reveals that over the years automatic route has emerged as the most important channel of FDI flows to India, followed by reinvested earnings and acquisition of shares. FDI through government approval route, on the other hand, has declined over time, which is in line with the policy reforms. The sectoral composition of FDI to India has undergone significant changes since the 1990s. The bulk of the FDI flows in the pre-liberalisation period were directed towards the manufacturing sector. In the recent years, however, much of the FDI flows have moved into the services sector. Mauritius has emerged as the most important source of FDI to India over the last decade.

Destination wise, economically advanced states have attracted the lion's share of FDI flows to India. The top six Indian states, *viz*., Maharashtra, Delhi, Karnataka, Tamil Nadu, Gujarat and Andhra Pradesh together accounted for over 70 per cent of FDI equity flows to India during the period April 2000 to June 2012 reflecting distinct signs of FDI concentration at the state level. The FDI policy in India was liberalised in the early 1990s as a part of economic reforms to attract the foreign capital and also to take advantage of the spill over of technology and knowledge. It is, therefore, essential to derive maximum benefit from the FDI flows and ensure that the rising FDI flows do not lead to an increase in regional inequality. In view of this, an attempt has been made in this paper to examine the major determinants affecting regional distribution of FDI flows to India. In light of the findings, the paper also makes an attempt to list out the possible policy implications for the national and the state governments.

The paper has been organised as follows: Section I sets out a brief theoretical background relating to the reasons for inter-regional differences in FDI flows. Section II provides a survey of select empirical literature on the determinants of regional distribution of FDI flows in the international as well as in the Indian context. Section III presents some stylised facts on distribution of FDI flows in India. Section IV describes the rationale behind selection of variables. The methodology and the empirical results are furnished in Section V. The policy implications are drawn in Section VI.

## Section I

## The Theoretical Background

Traditionally, the FDI has moved from developed to other developed or developing countries preferably in sectors like mining, tea, coffee, rubber, cocoa plantation, oil extraction and refining, manufacturing for home production and exports, *etc.* Gradually their operations have also included services such as banking, insurance, shipping, hotels, *etc.* As regards location choice, the Multi National Enterprises (MNEs) tend to set up their plants in big cities in the developing countries, where infrastructure facilities are easily available. Therefore, in order to attract FDI flows, the recipients countries/regions were required to provide basic facilities like land, power and other public utilities, concessions in the form of tax holiday, development rebate, rebate on undistributed profits, additional depreciation allowance and subsidised inputs, *etc.*

Dunning (1998) indicated that the strategies and location choice of MNEs had undergone significant changes between the 1970s and the 1990s. He identified some major developments in the world economy which have been instrumental in changing location decision of MNEs during this period. The first major development is the growth of intellectual capital which was reflected in higher expenditure on information technology, increase in the knowledge component of the manufacturing goods and increase in the share of skilled workers in the labour force. The growing significance of these non-material knowledge-intensive assets was led by tremendous growth of the services sector, particularly knowledge and information oriented services. Secondly, the location of creation and use of these knowledge intensive assets

have been increasingly influenced by the presence of immobile clusters of complementary value-added activities. Spatial bunching of firms engaged in related activities have benefited from the presence of one another and of having access to localised support facilities, shared service centres, distribution networks, customised demand patterns and specialised factor inputs. This has given rise to "alliance capitalism", in which the main shareholders in the wealth sharing process need to collaborate more actively and purposefully with each other. Third, there is increasing evidence that except for some labour or resource oriented investment in developing countries, MNEs are increasingly seeking locations which offer the best economic and institutional facilities for core competence to be efficiently utilized. Fourth, the renaissance of market economy and the consequent changes in the macroeconomic policies and macro-organizational strategies of many national governments have also contributed significantly to the economic and political risk assessment of FDI by MNEs.

The "agglomeration" factor has emerged as one of the most important determinants of regional distribution of FDI flows within a country during the last two decades. Agglomeration economies emerge when there are some positive externalities in collocating near other economic units due to the presence of knowledge spillovers, specialised labor markets and supplier network (Krugman 1991). Statistical results from several studies focusing on developing economies strongly buttress the argument that foreign investors are inclined to favour such locations that could minimise information costs and offer a variety of agglomeration economies (He Canfei 2002). A common finding in recent studies is that regions with a relatively higher existing stock of foreign investment are more likely to attract further investments, which confirms the importance of positive agglomeration externalities.

Therefore, it emerges that while globalisation suggests that the location and ownership of production should become geographically more dispersed, other economic forces are working towards a more pronounced geographical concentration of such activity both within particular regions and countries. In the above theoretical backdrop, a survey of the empirical literature has been carried out highlighting select country experiences and the experiences in the Indian context.

## Section II

## Survey of Select Empirical Literature

Internationally, there is a host of literature analysing the inter-country differences in FDI flows. Those studies have identified a number of factors affecting the location choice of the foreign direct investors. However, many of those determinants are country-specific and would not apply to state/provincial level movement of FDI flows. The literature on regional distribution of FDI flows within a country, on the other hand, is relatively scarce. Most of the available studies relating to FDI flows at the state/ provincial level relate to the US, the European Union and China. There are few analytical studies on inter-state differences in FDI flows in India.

In the context of the United States, Coughlin, Terza and Aromdee (1989) found that the number of potential sites, state per capita income, manufacturing density within a state, better transportation infrastructure, higher unemployment rates and higher expenditures to attract FDI were positively linked to FDI flows. On the other hand, higher wages and higher tax rates had negative impact on FDI flows. Fisher and Peters (1998) found that incentives offered by various states had a positive impact on investment flows to the US. Incentives considered in their study include job credits, property tax abatements, sales tax exemptions, grants, loan guarantees, firm specific job training and infrastructure subsidies. Within the European Union member states, the long term trends point out the existence of a negative relationship between taxation and FDI inflows. Santis, Mercuri and Vicarelli (2001) found that FDI flows within the European Union member states were more influenced by the total fiscal wedge on labour than corporate tax rates. This suggests that multinationals, while making their location choices, focus their attention more to the overall tax burden than on single corporate tax rates, which provide only partial information. Apart from tax burden, bilateral degree of trade openness and infrastructure also play an important role to attract FDI. Wolff (2006) found that within the European Union, the different sub-components of FDI (equity, re-invested profits and other investments) react differently to taxes. Contrary to the public belief that high corporate tax rates act as the key

reasons for low investment rates from abroad, the author found that after controlling for unobserved country characteristics and common time effects, the top statutory corporate tax rate of both, source and host country, turned insignificant for total FDI and investment into equity. There were, however, definite indications that high source country taxes increased the probability of firms to reinvest profits abroad. However, overall experience revealed that global companies give more importance to the simplicity and stability of a country's tax system than generous tax rebates. Chidlow and Young (2008) found that Polish regions differed substantially in attracting foreign capital and the regional characteristics mattered in the selection of location. Using survey data from an online questionnaire and a multinomial logit model incorporating investor specific characteristics, they showed that knowledge-seeking factors alongside market and agglomeration factors, acted as the main drivers of FDI to Mazowieckie region (including Warsaw), while efficiency (low input cost, availability of labour and resources) and geographic factors encouraged FDI to the other areas of Poland.

In the Chinese context, based on panel data covering 98 hinterland cities of China for the years 1999 to 2005, Luo *et al* (2008) found that well established factors such as natural resources and low labour costs were not important in determining FDI flows to China's hinterland. Instead, policy incentives and industrial agglomerates were the most important determining factors for FDI flows. Using panel dataset of the areas at provincial level in China during the period of 1998-2007, Xu *et al* (2008) found that agglomeration economies influenced the location choices of FDI in China, and cumulative FDI in an area had crucial demonstration effect on the decision making of the new FDI entrants. The study also indicated that although labour costs continued to remain one crucial element for location choices of FDI, however, labour quality was playing an increasingly important role in attracting FDI from the US and the European countries. The analysis of core-periphery framework suggested that the two mega cities of Hong Kong and Shanghai as the cores of agglomeration had significant influence on location choices of FDI in China. For FDI from different sources, there exist country specific features. This implies that previous cumulative foreign investments led to concentration of new investments from

same source country. Boermans *et al* (2009) found that in line with the theoretical predictions, foreign investors preferred to invest more in provinces with better institutions, lower labour cost and larger market size. The effect of market size on FDI was larger in provinces with better institutions. Sub-sample study confirmed the existence of a large disparity between East and West. In the poorer large western provinces, FDI was strongly driven by the geographical factors, in contrast to the east of China, where institutions played a significant role to build up the 'factory of the world'. Robustness tests indicated that two sub-dimensions of institutions, *viz*., infrastructure and governance, were important to determine the location choice of FDI in China.

Siddharthan (2006) found that the determinants of regional distribution of FDI flows in China and India were very similar to the pattern influencing inter-country FDI flows. In those two countries, much of the FDI flowed to relatively developed regions, while regions that were poor in physical, institutional and social infrastructure received very little FDI. In China, Eastern zone provinces with high per capita income, better socio-economic indicators, better infrastructure facilities in terms of electricity, road and rail network and higher international orientation in terms of their per capita international trade, also attracted higher FDI flows. Similarly, in India, the states with high per capita income, high industrial output, and situated at the coasts attracted high levels of FDI. Moreover, the regions that received low FDI flows were also the regions that attracted lower domestic investment.

In the Indian context, Goldar (2007) found that by and large, the same set of factors influenced the location decision of plants of local companies as that of foreign companies. His econometric analysis of plant location across 100 largest cities in 17 states of India revealed that city-size was an important factor influencing location decisions of industrial plants. The presence of a metropolitan city in a state also had a favourable influence, which probably captured the advantage in 'headquartering' the country operations of the MNEs. The location decisions of plants of foreign companies were found to be influenced by the investment climate and availability of educated workers in the state, and the availability of civic amenities in the cities. Morris (2007) argued that in India, the regions with the metropolitan cities had the

advantage in 'headquartering' the country operations of MNEs and therefore, attracted bulk of the FDI flows. Nunnenkamp and Stracke (2007) found significant positive correlation of FDI with per capita income, population density, per capita bank deposits, telephone density, level of education and per capita net value added in manufacturing in India. FDI, on the other hand was negatively correlated with state population, and had insignificant relation in respect of availability of electricity and unemployment rate. Aggarwal (2005) found that rigid labour markets in Indian states discourage FDI. The effect of labour market rigidities and labour cost, however, was more pronounced for the export-oriented as compared to the domestic market seeking FDI. The study also pointed out that the presence of EPZ worked as a relevant pull factor for export oriented FDI. Econometric evidence found in the study suggested that infrastructure, regional development and human development were also key factors in attracting higher FDI both in the export and domestic market sectors. In a study on business environment, clustering and industry location in the Indian Cities, using firm level data collected in the 2003 round of the Investment Climate Survey (ICS) for India, Lall and Mengistae (2005) found that the local business environment had significant bearing on location decisions. Predatory enforcement of business regulations reduced the probability of a business locating in a city. In comparison, better access to finance and land and greater availability of infrastructure attracted firms to a city. However, firms were also attracted by agglomeration economies from clustering of firms in their own industry. This means that new firms will choose to locate production in areas that are already established centers in their line of business.

Ramachandran and Goebel (2002) pointed out that Tamil Nadu had emerged as one of the most favoured investment destination in India on account of a number of advantages *viz*., strong and stable government with pro-active government policies, investor-friendly and transparent decision making process, sound diversified industrial infrastructure, comfortable power situation, abundant availability of skilled manpower, harmonious industrial relations and absence of labour unrest, high quality of work culture and peaceful life, best incentives package in the country, highly cosmopolitan composition and high proportion of English speaking population. FDI in Tamil Nadu is dominated by investments in the IT sector.

Overall, the theory and the empirical literature suggest that the most important determinants of the regional distribution of FDI flows within a country include the size and growth of the local market, the level of industrial activity, the growth of the services sector, the availability and quality of physical infrastructure, labour market conditions and quality of labour, policy environment and tax incentives, business climate and the presence of agglomeration economies.

## Section III

## FDI Flows to India: Some Stylised Facts

FDI flows to India have picked up significantly in the recent years. India has emerged as the second largest recipient of FDI flows among the emerging market economies after China in 2009 and 2010 (Table 1).

**Table 1: Emerging Market External Equity Financing**

(in million US dollars)

|  | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|
| **Sub-Saharan Africa** | **884** | **1,237** | **2,841** | **1,476** |
| **Central and Eastern Europe** | **1,105** | **3,836** | **7,502** | **3,733** |
| **Commonwealth of Independent States** | **4,087** | **1,258** | **6,998** | **11,164** |
| Russia | 2,850 | 956 | 5,454 | 10,794 |
| **Developing Asia** | **21,441** | **61,078** | **86,923** | **38,013** |
| China | 11,974 | 39,854 | 45,448 | 23,499 |
| **India** | **6,008** | **16,223** | **26,179** | **7,016** |
| Indonesia | 2,213 | 1,286 | 6,317 | 2,229 |
| Malaysia | 660 | 3,604 | 5,818 | 2,972 |
| Pakistan | 109 | — | 93 | — |
| Philippines | 125 | 0 | 960 | 596 |
| Thailand | 257 | 111 | 1,991 | 1,554 |
| **Middle East and North Africa** | **3,832** | **917** | **1,695** | **182** |
| **Latin America and the Caribbean** | **12,719** | **15,416** | **27,139** | **18,983** |
| Argentina | — | — | 73 | 3,576 |
| Brazil | 10,435 | 12,963 | 24,633 | 9,029 |
| Chile | — | 32 | 1,214 | 2,340 |
| Colombia | — | 619 | 296 | 3,598 |
| Mexico | 2,127 | 1,567 | 662 | 441 |
| **Total FDI Flows** | **44,067** | **83,740** | **1,33,098** | **73,552** |

**Note:** — indicates that the figure is zero or less than half of the final digit shown
**Source:** Global Financial Stability Report, April 2012, International Monetary Fund

The rise in FDI flows to India has been accompanied by strong regional concentration (Table 2 and Chart 1). The top six states, *viz*., Maharashtra, New Delhi, Karnataka, Gujarat, Tamil Nadu and Andhra Pradesh accounted for over 70 per cent of the FDI equity flows to India

**Table 2: FDI Equity Inflows to Indian States**

| | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2008-09 | 2009-10 | 2010-11 | 2011-12 |
|---|---|---|---|---|---|---|---|---|
| | (US $ million) | | | | (Per cent to Total) | | | |
| Maharashtra | 12,431 | 8,249 | 6,097 | 9,553 | 45.5 | 31.9 | 31.4 | 26.2 |
| Delhi | 1,868 | 9,695 | 2,677 | 7,983 | 6.8 | 37.5 | 13.8 | 21.9 |
| Karnataka | 2,026 | 1,029 | 1,332 | 1,533 | 7.4 | 4.0 | 6.9 | 4.2 |
| Gujarat | 2,826 | 807 | 724 | 1,001 | 10.3 | 3.1 | 3.7 | 2.7 |
| Tamil Nadu | 1,724 | 774 | 1,352 | 1,422 | 6.3 | 3.0 | 7.0 | 3.9 |
| Andhra Pradesh | 1,238 | 1,203 | 1,262 | 848 | 4.5 | 4.7 | 6.5 | 2.3 |
| West Bengal | 489 | 115 | 95 | 394 | 1.8 | 0.4 | 0.5 | 1.1 |
| Chandigarh | 0 | 224 | 416 | 130 | 0.0 | 0.9 | 2.1 | 0.4 |
| Goa | 29 | 169 | 302 | 38 | 0.1 | 0.7 | 1.6 | 0.1 |
| Madhya Pradesh | 44 | 54 | 451 | 123 | 0.2 | 0.2 | 2.3 | 0.3 |
| Kerala | 82 | 128 | 37 | 471 | 1.3 | 0.5 | 0.2 | 1.3 |
| Rajasthan | 343 | 31 | 51 | 33 | 0.3 | 0.1 | 0.3 | 0.1 |
| Uttar Pradesh | 0 | 48 | 112 | 140 | 0.0 | 0.2 | 0.6 | 0.4 |
| Orissa | 9 | 149 | 15 | 28 | 0.0 | 0.6 | 0.1 | 0.1 |
| Assam | 42 | 11 | 8 | 1 | 0.2 | 0.0 | 0.0 | 0.0 |
| Bihar | 0 | 0 | 5 | 24 | 0.0 | 0.0 | 0.0 | 0.1 |
| Region not indicated | 4,181 | 3,148 | 4,491 | 12,782 | 15.3 | 12.2 | 23.1 | 35.0 |
| Total | 27,332 | 25,834 | 19,427 | 36,504 | 100.0 | 100.0 | 100.0 | 100.0 |
| Top 6 States | 22,113 | 21,757 | 13,444 | 22,340 | 80.9 | 84.2 | 69.2 | 61.2 |
| Top 2 States | 14,299 | 17,944 | 8,774 | 17,536 | 52.3 | 69.5 | 45.2 | 48.0 |

**Note:** 1. FDI equity inflows include 'equity capital component' only.
2. Maharashtra includes Maharashtra, Dadra & Nagar Haveli and Daman & Diu.
3. Delhi includes New Delhi and part of UP and Haryana.
4. Tamil Nadu includes Tamil Nadu and Pondicherry.
5. West Bengal includes West Bengal, Sikkim, and Andaman & Nicobar Islands.
6. Chandigarh includes Chandigarh, Punjab, Haryana and Himachal Pradesh.
7. Madhya Pradesh includes Madhya Pradesh and Chhattisgarh.
8. Kerala includes Kerala and Lakshadweep.
9. Uttar Pradesh includes Uttar Pradesh and Uttaranchal.
10. Assam includes Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

**Source:** Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce and Industry, Government of India.

**Chart 1: Cumulative FDI Inflows to Indian States (April 2000-June 2012)**
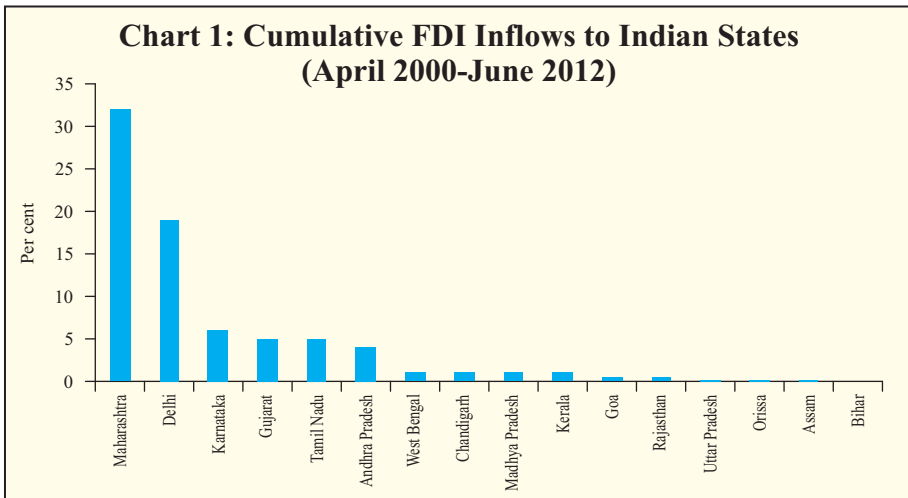


between 2008-09 and 2011-12. The top two states, i.e., Maharashtra and Delhi accounted for over 50 per cent of FDI flows during this period. Maharashtra alone accounted for over 30 per cent of FDI flows to India during the same period.

Despite impressive growth rates achieved by most of the Indian states as well as aggressive investment promotion policies pursued by various state governments, the concentration of FDI flows across a few Indian states continues to exist.

## Section IV

## Selection of Variables

*Market Size*

The theory as well as the empirical literature revealed that the size of the local market, generally represented by the scale and growth of a region, acts as one of the most important determinants of location choice of FDI as it provides an idea about the potential demand for a foreign firm's output. The attractiveness for large markets is related to larger potential for local sales. Local sales are generally more profitable than exports especially in large countries, where economies of scale may be eventually reaped. Despite significant changes in the location choice of MNEs in the recent period, large and growing domestic

market continues to remain a major determinant of market-seeking FDI flows. Empirical studies conducted in the context of the US, European Union, China and India have taken into account a number of variables to represent the market size, *viz*., GDP, growth rate of GDP, per capita income, personal income, population size, population density, population growth, consumption level, number of potential sites in a state, *etc*.

In view of this, in this study, an attempt has been made to test the hypothesis that size of the local market has important implications for regional distribution of FDI flows to India. In this paper, the 'size of the local market' is represented by two most commonly used indicators, *viz*., per capita net state domestic product (NSDP) and population density of each state.

*Industrial Linkages*

Dunning (1993) suggested that natural resource seeking FDI looks for foreign locations that possess natural resources and related transport and communication infrastructure, tax and other incentives. Natural resources include oil, mineral, raw materials and agricultural products. It is also often argued that regions with a more established industrial base are more attractive to foreign investment (Luo *et al* 2008). In the Indian context, Siddharthan (2006) found that the states with higher industrial output have attracted high levels of FDI. The location choice by MNEs in the 1990s, however, has been influenced to a large extent by the availability of non-material knowledge-intensive assets mainly driven by the tremendous growth of the services sector, particularly knowledge and information oriented services (Dunning, 1998). The sectoral break-up of FDI flows in India also reveals that the services sector has attracted a large share of FDI flows in the recent period (Table 3). It may be observed from Table 3 that financial and non-financial services alone accounted for 19 per cent of the cumulative FDI flows to India since April 2000. Taking into account telecommunication, computer hardware & software, construction and other services activities, overall, the services sector in India has attracted around 50 per cent of FDI flows during the same period.

**Table 3: Sectoral Orientation of FDI Equity Flows to India**

|  | 2008-09 | 2009-10 | 2010-11 | 2011-12 | Cumulative Inflows (April '00 –April '12) | Percentage of Total Inflows (April '00 -April'12) |
|---|---|---|---|---|---|---|
|  | (US $ million) | | | | | |
| Services Sector (Financial & non-financial) | 6,138 | 4,353 | 3,296 | 5,216 | 33,428 | 19 |
| Construction Development |  |  | 1,227 | 731 | 21,088 | 12 |
| Telecommunications | 2,558 | 2,554 | 1,665 | 1,997 | 12,560 | 7 |
| Computer Software & Hardware | 1,677 | 919 | 780 | 796 | 11,286 | 6 |
| Drugs & Pharmaceuticals |  | 213 | 209 | 3,232 | 9,659 | 6 |
| Power | 985 | 1,437 | 1,272 | 1,652 | 7,444 | 4 |
| Automobile Industry | 1,152 | 1,208 | 1,299 | 923 | 6,965 | 4 |
| Metallurgical Industry | 961 | 407 | 1,098 | 1,786 | 6,374 | 4 |
| Total |  |  |  |  |  | 62 |

**Source:** Department of Industrial Policy and Promotion (DIPP), Government of India.

In view of the above, in this paper, an attempt has been made to test the following three hypotheses:

- Indian states rich in natural resources are more attractive to FDI flows;

- Indian states with strong industrial base tend to attract more FDI flows;

- Indian states with higher services sector activity attract more FDI flows.

The explanatory variables considered in this context are the per capita mining output, per capita manufacturing output and per capita services output of each state.

*Infrastructure*

It is commonly argued in the economic literature that development and availability of superior infrastructural facilities have a positive effect on the location choice of FDI firms. As argued by Dunning (1998), that though much of the FDI in developing countries is prompted by traditional factors, such as market-size, lower input/labour cost and availability and prices of natural resources, yet even there, where the

firms have a choice, physical and human infrastructure, together with the macroeconomic environment and institutional framework of the host country tend to play a more decisive role. Availability of transportation facilities to reach the nearest port or output markets have historically been considered as an important determinant of setting a business in a particular place. Most commonly used variables to represent transport infrastructure includes the presence of major ports, close to the coast location, availability and quality of road and rail network. Apart from transport, physical infrastructure in the form of availability of power, telephone density, access to finance, availability of civic amenities and degree of urbanisation were also found to be important in the empirical studies.

In order to test the hypothesis that "states with better infrastructure attract higher FDI flows compared to others", two indicators for infrastructure, *viz*., road route density (road length per square kilo meter of state area) and railway route density (railway length per square kilo meter of state area) have been considered in this study.

*Labour Conditions*

The theory suggests that other things being equal, efficiency seeking foreign firms are expected to prefer lower wage locations to minimise their cost of production. Over time, however, foreign investors have started attaching importance to local labour quality. Dunning (1998) indicated that while labour cost was one of the major variables influencing the location of MNEs in the 1970s, it was the availability and the price of skilled and professional labour that influenced the decision making of the MNEs in the 1990s. Since higher wage levels reflect higher labour productivity or higher quality of human capital, therefore an investing firm which is looking for high quality and skilled labour may be attracted by the higher wage rate. It has been observed that higher the production technology level and technological content in the product, labour quality would assume higher importance.

In this paper, wages per worker in Indian states have been used as an indicator of labour cost. Quality of labour is generally judged in terms of educational qualification of the workforce. In order to assess the quality of labour, literacy rate and per capita number of educational institutions for higher studies (degree and above) in each state have been considered in the analysis.

*Policy Environment*

The local policy environment is mainly characterised by policies towards foreign direct investment, tax structure and investment incentives provided by the local government to attract FDI. Over the past few decades, many local governments all over the world have been actively involved in improving the policy environment for promoting their countries as attractive destination for foreign investors. Those governments have adopted a host of measures *viz*., liberalisation of laws and regulations for the admission and establishment of foreign investment projects, provision of guarantees for repatriation of investment and profits, establishing mechanism for the settlement of investment disputes and extending tax incentives to facilitate and attract foreign investment flows to their countries.

In India, as a part of economic reform, many of the states are simplifying the rules and procedures for setting up and operation of the industrial units. Single Window System is now in existence in most of the states. In addition, most of the states provide various kinds of incentives for attracting investment in the new industrial units as well as the existing ones. The incentives may be sector-specific or region-specific. While it is common among the Indian states to offer incentives to the IT/ITeS, biotechnology, tourism and the micro, small and medium enterprise (MSME) sectors, at times special incentives are also offered in industries such as textile, food, fisheries, film, healthcare, electricity generation, *etc.* Most of the sector-specific incentives in India take the form of exemption from stamp duty, registration fee, electricity duty and various types of taxes. Special Economic Zones (SEZ) also enjoy various incentives mainly in the form of various duty exemptions. The direct tax benefits include exemption from commercial tax, sales tax, value added tax (VAT), entry tax, special entry tax, luxury tax, entertainment tax, property tax, purchase tax, *etc.*, depending on the industry in concern. Exemption of entertainment taxes is common for the tourism sector.

Empirical evidence in the context of European Union revealed that multinationals, while making their location choices, focus their attention to the overall tax burden rather than on single corporate tax rates, which provide only partial information (Santis, Mercuri and

Vicarelli, 2001). In view of this, in this study, the state's own tax revenue as per cent of NSDP has been used to assess the impact of tax structure on FDI flows.

*Agglomeration Economies*

As countries begin to industrialise, there is a tendency for industries to concentrate initially in areas where physical infrastructure is readily available and subsequently, for related industries, to gravitate closer together, thereby taking advantage of inherent synergies. In the process, industry clusters are formed, with each geographical area specialising in certain activities, leading to spatial diffusion of industries. This clustering of firms, which is also known as the "agglomeration" factor has emerged as an important determinant of regional distribution of FDI flows within a country during the last two decades. The reduction in spatial transaction cost due to liberalisation of cross-border market and the changing characteristics of the economic activity has favoured the spatial bunching of firms engaged in related activities, so that each may benefit from the presence of the others, and of having access to localised support facilities, shared service centers, distribution networks, customised demand pattern and specialised factor inputs (Dunning 1998). Statistical results from several studies focusing on developing economies strongly buttress the argument that foreign investors are inclined to favor such locations that could minimise information costs and offer a variety of agglomeration economies (He Canfei 2002). The presence of agglomeration economies is reflected in terms of prior foreign investment presence, prior concentration of manufacturing plants, number of enterprise in a region, presence of various economic zones (SEZ, EPZ *etc.*), industrial parks, industrial clusters, *etc.*

In this study, one period lagged value of per capita stock of FDI in a state has been considered as independent variable to capture these agglomeration effects. A positive and significant coefficient of this variable means the presence of agglomeration economies.

Based on the above analysis, a list of explanatory variables selected for the study is presented in Table 4.

**Table 4: List of Explanatory Variables Selected for the Study**

| Type of factor | Variables | Expected Sign |
|---|---|---|
| A.   Market size | 1.   Per capita NSDP (PCY);<br>2.   Population Density (PD): | +<br>+ |
| B.   Industrial Orientation | 3.   Per capita manufacturing output (MANP);<br>4.   Per capita mining output (MINP);<br>5.   Per capita services output (SERP); | +<br>+<br>+ |
| C.   Infrastructure | 6.   Road route density (ROAD);<br>7.   Railway route density (RAIL); | +<br>+ |
| D.   Labour Conditions | 8.   Wages per worker (WAGE);<br>9.   Literacy rate (LIT);<br>10.   Per capita number of higher educational institutes (EDUP); | -<br>+<br><br>+ |
| E.   Policy Environment | 11.   State's own tax revenue as per cent of NSDP (TAX) | <br>- |
| F.   Agglomeration Effects | 12.   Per capita FDI stock (STOCKP) | + |

In addition to the above, there may be many other factors having an influence on foreign firms' investment decision. It has been observed that multiple factors, *viz*., pro-active government policies, transparent and investment friendly decision making process, political and legal environment, harmonious industrial relations and the quality of governance institutions together build the investment climate in a state (Globerman and Shapiro, 2003; Lall and Mengistae, 2005; Ansari and Ranga, 2010). The "Doing Business" Reports jointly published by the World Bank and International Financial Corporation consider seven parameters to determine the business environment in a state, *viz*., 'ease of starting business', 'ease of dealing with construction permit', 'ease of registering property', ' ease of paying taxes', 'ease of enforcing a contract', 'ease of trading across borders' and 'ease of closing a business'. In addition to these, the legal structure, security of property rights and level of corruption in a state, reflected in terms of the quality of justice mechanism may also have some impact on FDI flows. The regulation of labour and business is another factor, which is known to have significant influence on foreign investors' sentiments. The number of strikes and industrial disputes that take place in the economy portray the amount of control an entrepreneur has over his business. The prevalence of strong labour unions and large number of industrial disputes in the states of West Bengal and Kerala reflect the stringent

labour laws and pro-labour government policies in those states. Due to such industrial disputes, large number of mandays are lost, which seriously hampers the profitability of the manufacturer and, therefore, has adverse impact on foreign investment.

It has also been observed that the countries or regions that are politically risky with a history of expropriating FDI, endemic corruption, autocratic governments, poor law and order situation or ethnic tension tend to receive lower FDI flows. The Indian experience reveals that various political factors such as political stability of a state or the state government's political relation with the central government have also played an important role in attracting FDI flows. Political instability resulting from naxalite movements, various corruption and scandals has prevented FDI flows to certain states of India in the recent period. However, in the absence of consistent and uniform cross-sectional as well as time series data, these factors have been left out of the empirical analysis carried out in the study.

## Section V
## The Methodology and Empirical Results

The empirical analysis carried out in this paper is based on state-level panel dataset of India over the period 2000-01 to 2010-11 covering 31 states and Union territories, *viz*., Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Puducherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttaranchal and West Bengal. The dependent variable in this study is the per capita annual flow of FDI to each of the 31 Indian states during the 10 years period of 2001-02 to 2010-11. The annual state-level FDI flows data released by the Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce and Industry, Government of India, however, has certain limitations. First, the state-level annual FDI flows data published by DIPP are available only from 2008-09 onwards. Second, as noted in Table 2, the data on FDI flows to certain states are not available at the disaggregated level. In view of this, in this study, the help of Centre for Monitoring Indian

Economy (CMIE) database has been taken to calculate disaggregated annual FDI flows data for each of the 31 Indian states which is important to ensure one-to-one correspondence in definition of a 'State' in the FDI statistics and the explanatory variables, while studying the regional determinants of FDI. The data on annual FDI flows to Indian states from 2008-09 onwards have been directly taken from the DIPP database with CMIE data used for disaggregation. Annual FDI flows to Indian states during the earlier years have been calculated based on the new and outstanding foreign investment database of the CMIE consistent with the cumulative FDI flows to those states as published by the DIPP. The sample period of 2001-02 to 2010-11 has been chosen mainly on account of the fact that FDI flow to India started picking up only in the 2000s and also DIPP has published region-wise data on FDI flows (cumulative) to Indian states only since April 2000. The annual data on population of each state have been worked out based on the Census data on state population and the average annual exponential growth rate of population.

Multiple sources have been used to obtain the data on the various explanatory variables used for the empirical analysis. Information on per capita income and variables relating to economic structure is obtained from the National Accounts Statistics (NAS) published by the Central Statistics Office (CSO) of the Government of India (GoI) and the Handbook of Statistics on the Indian Economy published by the Reserve Bank of India. The data on the infrastructural variables are obtained from the CMIE state-level database. The data on annual wages per worker have been taken from the Annual Survey of Industries (ASI) published by CSO, GoI. The data on literacy rates and population density are worked out from the Census of India. The data on number of higher educational institutes in a state has been compiled from various issues of the Economic Survey of the GoI and the Indian Brand Equity Foundation (IBEF) Reports. The data on tax revenue of the Indian states have been taken from various issues of the Report on 'State Finances: A Study of Budgets' published by the Reserve Bank of India. The sources for state-level data on FDI stocks, which are measured in terms of cumulative FDI flows, are the DIPP and CMIE state-level database.

## Table 5: Regional Inequality among India States

| States | Per Capita FDI Flows (Rs) | Area ('000 Sq Km) | Per Capita NSDP (Rs) | Population Density (Persons per sq. km) | Rail Route Density (Km per 1000 sq. km) | Literacy Rate (Per cent) | Annual Wages per Worker (Rs) | State's Own Tax Revenue as per cent to NSDP |
|---|---|---|---|---|---|---|---|---|
|  | 2010-11 | 2011 | 2010-11 | 2011 | 2008-09 | 2011 | 2009-10 | 2010-11 |
| A & N Island | 0.0 | 8.2 | 76,883 | 46 | 0.0 | 86.3 | 65,831 | Na |
| Andhra Pradesh | 679.5 | 275.0 | 62,912 | 308 | 18.9 | 67.7 | 61,007 | 8.9 |
| Arunachal Pradesh | 0.0 | 83.7 | 55,789 | 17 | 0.0 | 67.0 | Na | 2.6 |
| Assam | 11.9 | 78.4 | 30,569 | 397 | 29.1 | 73.2 | 49,332 | 6.3 |
| Bihar | 2.4 | 94.1 | 20,708 | 1,102 | 37.3 | 63.8 | 43,362 | 5.2 |
| Chhattisgarh | 0.0 | 135.1 | 41,167 | 189 | 8.8 | 71.0 | 82,983 | 8.0 |
| Delhi | 7,274.0 | 1.4 | 1,50,653 | 11,297 | 123.7 | 86.3 | 69,820 | 6.7 |
| Goa | 9,424.7 | 3.7 | 1,68,572 | 394 | 18.7 | 87.4 | 1,26,788 | 7.3 |
| Gujarat | 545.5 | 196.0 | 75,115 | 308 | 27.2 | 79.3 | 76,316 | 7.8 |
| Haryana | 655.6 | 44.2 | 94,680 | 573 | 35.1 | 76.6 | 90,347 | 7.2 |
| Himachal Pradesh | 0.0 | 55.6 | 65,535 | 123 | 5.1 | 83.8 | 65,255 | 7.6 |
| Jammu & Kashmir | 0.0 | 222.2 | 37,496 | 124 | 1.1 | 68.7 | 57,579 | 8.3 |
| Jharkhand | 0.0 | 79.7 | 29,786 | 414 | 24.7 | 67.6 | 1,49,847 | 6.4 |
| Karnataka | 1,003.3 | 191.7 | 60,946 | 319 | 15.7 | 75.6 | 83,219 | 10.5 |
| Kerala | 50.0 | 38.8 | 71,434 | 859 | 27.0 | 93.9 | 54,994 | 8.9 |
| Madhya Pradesh | 288.3 | 308.2 | 32,222 | 236 | 16.1 | 70.6 | 82,730 | 8.8 |
| Maharashtra | 2,462.3 | 307.6 | 83,471 | 365 | 18.2 | 82.9 | 1,03,406 | 7.8 |
| Manipur | 0.0 | 22.3 | 29,684 | 122 | 0.0 | 79.9 | 35,356 | 3.0 |
| Meghalaya | 0.0 | 22.4 | 50,427 | 132 | 16.0 | 75.5 | 72,652 | 3.5 |
| Mizoram | 0.0 | 21.0 | 48,591 | 52 | 0.1 | 91.6 | Na | 2.1 |
| Nagaland | 0.0 | 16.5 | 52,643 | 119 | 0.8 | 80.1 | 19,880 | 2.0 |
| Orissa | 16.2 | 155.7 | 40,412 | 269 | 15.3 | 73.5 | 91,921 | 6.3 |
| Puducherry | 0.0 | 0.2 | 98,719 | 2,598 | 22.9 | 86.6 | 73,191 | 9.9 |
| Punjab | 83.0 | 50.3 | 69,737 | 550 | 42.4 | 76.7 | 59,388 | 8.5 |
| Rajasthan | 33.5 | 342.2 | 42,434 | 201 | 17.1 | 67.1 | 65,995 | 6.7 |
| Sikkim | 0.0 | 7.1 | 81,159 | 86 | 30.9 | 82.2 | 58,900 | 4.6 |
| Tamil Nadu | 847.7 | 130.0 | 72,993 | 555 | 31.6 | 80.3 | 68,422 | 10.0 |
| Tripura | 0.0 | 10.4 | 44,965 | 350 | 14.4 | 87.8 | 22,267 | 3.8 |
| Uttar Pradesh | 25.8 | 240.9 | 26,355 | 828 | 36.1 | 69.7 | 68,048 | 7.7 |
| Uttarakhand | 0.0 | 53.4 | 66,368 | 189 | 6.5 | 79.6 | 78,353 | 6.6 |
| West Bengal | 46.6 | 88.7 | 48,536 | 1,029 | 43.8 | 77.1 | 71,626 | 4.9 |

**Note:** Na indicates not available.
**Source:** The Census of India 2011; the CSO, GoI; the DIPP, GoI; the Reserve Bank of India; the CMIE; and the author's own calculations.

Significant regional inequality across the Indian states may be observed in terms of per capita FDI flows and various geographic and socio-economic indicators considered in the study (Table 5). The land area across the states varies from 3,42,240 square km in the largest state of Rajasthan to only around 300 square km in the union territory of Puducherry. Population density in the national capital region of Delhi is as high as 11,297 persons per square km as compared to only 17 persons per square km in the north eastern hill state of Arunachal Pradesh. Per capita NSDP varies between Rs. 1,68,572 in Goa and Rs. 20,708 in Bihar reflecting wide regional disparity in income. Kerala has the highest literacy rate of 94 per cent, whereas Bihar has a literacy rate of only 64 per cent. While Delhi has the best rail connectivity in India followed by West Bengal, there is hardly any railway network in the north eastern hill states of India and the Andaman and Nicobar Island. Wage rates also vary substantially across the states with annual wages per worker being the highest in Jharkhand (Rs. 1,49,847) and the lowest in Nagaland (Rs. 19,880). There is also significant difference across the states in terms of taxation. The State's own tax revenue as a per cent of NSDP is the highest for Karnataka at 10.55 per cent and the lowest for Nagaland at 2.03 per cent.

The estimation method used in this study is fixed effect pooled least squares. Four model specifications have been considered in this study and the estimation results are reported in Table 6. In all the models, the dependent variable is per capita FDI flows to Indian states. All regional characteristics as explained in terms of explanatory variables are lagged by one year, given the reasoning that FDI flows in particular year is determined by the economic conditions prevailed in the previous year.

The estimation results indicate that the signs of estimated coefficients for most of the explanatory variables are in accordance with the *a priori* expectation with only a few exceptions. As regards the market size, the coefficient of state per capita NSDP is positive and significant at 1 per cent level in Model 1. Per capita NSDP has an explanatory power both as an indicator of regional purchasing power

and the level of economic development in a state. The coefficient of population density is positive and significant at 1 per cent level in Model 1, Model 2 and Model 3. This clearly indicates that the FDI flows to India are market seeking in nature. This is in confirmation with

**Table 6: Regression Results**

| Explanatory Variables | Model Specification 1 | Model Specification 2 | Model Specification 3 | Model Specification 4 |
|---|---|---|---|---|
| C | -597.49 (-0.58) | -3249.58 ** (-1.98) | -510.27 (-0.13) | -5380.34 *** (-4.59) |
| PCY | 0.05 *** (4.23) | | | |
| PD | 4.02 *** (5.86) | 3.83 *** (5.79) | 4.98 *** (8.04) | |
| MANP | | | 0.14 *** (2.69) | |
| MINP | | | | 0.09 (1.58) |
| SERP | | 0.11 *** (7.02) | | |
| ROAD | 0.01 (0.02) | | | |
| RAIL | | 128.86 ** (2.4) | | 260.86 *** (4.99) |
| WAGE | -0.03 ** (-2.54) | -0.04 *** (-3.97) | | -0.01 -0.99 |
| LIT | | | -21.11 (-0.41) | |
| EDUP | | | 0.08 (0.05) | |
| TAX | -294.01 ** (-2.39) | -286.44 ** (-2.42) | -296.15 ** (-2.30) | |
| STOCKP | | | | 0.27 *** (17.83) |
| Total pool (balanced) observations | 310 | 310 | 310 | 310 |
| R-squared | 0.56 | 0.60 | 0.55 | 0.73 |
| Adjusted R–squared | 0.50 | 0.55 | 0.49 | 0.70 |

**Note:** Figures in the parentheses represent the respective t values. ***, ** and * denote significance at 1%, 5% and 10% level, respectively.

the results of earlier studies by Kumar (2002), Banga (2003), Goldar (2007), Nunnenkamp and Stracke (2007) and Dhingra and Sidhu (2011), where market size was found to be an important determinant of FDI flows to India.

The estimation results confirm the hypothesis that economic structure of a state reflected in terms of industrial orientation plays an important role in attracting FDI flows. For example, per capita manufacturing output, which is an indicator of the level of industrial activity in a state, has a strong positive influence on FDI flows (Model 3). This supports the view that new investments move to regions with strong industrial linkages. Similarly, the coefficient of per capita services output is positive and significant at 1 per cent level in Model 2 indicating states which have higher services sector activity attract higher FDI flows. This is in confirmation with the trend observed in the sectoral distribution of FDI flows to India. The impact of per capita mining output on FDI flows is, however, insignificant though its coefficient is positive in Model 4.

The impact of infrastructure on FDI flows to India is positive. The railway connectivity has a strong positive impact on FDI flows in Model 2 and Model 4. The positive contribution of road transportation, however, lacks statistical significance in Model 1. The level of infrastructure was found to play an important role by some of the earlier studies, *viz*., Kumar (2002), Mukim and Nunnenkamp (2010) and Dhingra and Sindhu (2011).

As regards labour conditions, wages seem to have a negative impact on FDI flows, the coefficient of annual wages per worker being significant in Model 1 and Model 2. This is in line with the theoretical expectation that FDI flows are attracted by lower cost of labour. In comparison to cost of labour, the impact of quality of labour on FDI flows seems to be less important. The variable representing per capita number of higher educational institutes in a state has a positive impact on FDI flows but lacks statistical significance (Model 3). In the same model, the coefficient of literacy rate is negative, indicating the level of basic education in a state has little role to play in attracting FDI flows. This reflects the fact that some of the states with very high literacy

rates *viz*., Andaman & Nicobar Islands, Himachal Pradesh, Mizoram, Puducherry, Sikkim and Tripura do not attract much FDI flows.

The coefficient of state's own tax revenue as per cent of NSDP is negative and significant in Model 1, Model 2 and Model 3, which supports the argument that FDI prefer states with lower tax rates. Earlier Kumar (2002) found that a country's ability to attract FDI is affected by policy factors such as tax rates, investment incentives, performance requirements, *etc.* Empirical evidence in the context of the US and the EU also revealed that the regions with higher tax rates attract lower FDI flows (Coughlin, Terza and Aromdee, 1989; Mercuri and Vicarelli, 2001).

One period lagged value of per capita FDI stock has a strong positive impact on FDI flows, indicating the importance of agglomeration effects (Model 4). This confirms the hypothesis that cumulative FDI flows in a state has important demonstration effect on decision making of new FDI entrants, i.e., new foreign investment tends to enter into areas with already high levels of FDI flows. There are, however, cases, where MNEs have shown investment interest in states with lower FDI penetration, such as, POSCO and Arcelor-Mittal in Orissa and Bhatinda refinery (a joint venture of Hindustan Petroleum Corp (HPCL) and Mittal Energy Investment Pte Ltd) in Punjab.

## Section VI

## Policy Implications

FDI to India has increased significantly in the last decade. However, the growth in FDI flows has been accompanied by strong regional concentration. The findings of the study reveal that market size, agglomeration effects and size of manufacturing and services base in a state have significant positive impact on the regional distribution of FDI flows in India. The impact of taxation and cost of labour is negative. While the impact of quality of labour is ambiguous, infrastructure, however, has a significant positive impact on FDI flows. Mining has a positive influence on FDI flows, but lacks statistical significance.

The presence of strong agglomeration effect indicates that the states already rich in FDI flows tend to receive more of them which make it more difficult for the other states to attract fresh investments. In

view of this difficulty, a conscious and coordinated effort at the national and the state government levels would be essential to make the laggard states more attractive to FDI flows. The direct method to achieve this objective may be to design the national FDI policy in such a way that a sizable portion of FDI flows to India move into the laggard states. The indirect way is to provide a boost to the overall economy of the less advanced states, with special thrust on the manufacturing, services and the infrastructure sectors so that they themselves become attractive to foreign investors.

First, as regards the direct method, it has been observed in the Chinese context, that after liberalising the FDI flows in the 1970s, China faced with somewhat similar sort of experience like India. Since the introduction of China's coastal preference open door policy in 1978, the regional disparity between the coastal belt and China's interior had increased (Luo *et al* 2008). This resulted into concentration of a few world class industrial clusters located in five coastal Chinese provinces at the expense of the Chinese hinterland. Subsequent FDI to China has favoured regions that were opened earlier over the hinterland. In view of this, one important policy changes enacted by the Chinese government was to raise the entry requirements for FDI into coastal belt designed to secure high value investments, while encouraging labour intensive investments in the interior. Accordingly, since the late 1990s, most MNEs in China have made fundamental changes to their business strategies and operational policies to adjust to changes in policy, market conditions and the regulatory environment. In view of the Chinese experience, similar set of policies may be considered in the Indian context to direct part of the FDI flows to the states, which are not receiving much of FDI flows at present.

Second, as regards the indirect method, it has been observed that size of the manufacturing sector has a significant positive impact on FDI flows. This implies foreign investors' preference for states with a strong industrial base. Therefore, it is essential for the less industrially developed states to catch up with the developed ones to attract larger share of FDI flows. The National Manufacturing Policy (NMP), recently announced by the Government of India is a welcome step and may help

in this direction if properly implemented. The equity and distributive justice would be best fulfilled if under the NMP, the Government gives top priority to the states with lower industrial base to give them a chance of catching up with the others.

Third, the services sector has attracted a large share of FDI flows to India in the recent period. The econometric analysis also reveals that services sector has a significant positive impact on FDI flows. In addition, growth of the services sector can create more employment for skilled, semi-skilled and unskilled people. It has been observed that in the recent period, it is the IT/BPO services which has created the largest job opportunity in India and not the manufacturing industries. Therefore, apart from providing a boost to the manufacturing sector, it is equally important to provide a boost to the services sector, which spans the value chain from low-end localised services to the most sophisticated globally-competitive intellectual property based services. Accordingly, the manufacturing policy in India needs to be complemented by a compatible services policy.

Fourth, the impact of the mining sector on FDI flows was found to be less important in the study. FDI in mining in the recent period has confronted with a number of socio-economic problems. The operations of two of the mega FDI steel projects - POSCO India and Arcelor Mittal have been delayed due to seemingly intractable problems, mostly surrounding socio-economic issues like acquisition of land, forest and environment clearances, rehabilitation and resettlement of the project-affected people, Naxalite movements in Chhattisgarh, Jharkhand, Orissa and West Bengal, non-allocation of adequate captive mines, and supply of raw materials. Given the large potential for FDI in mining due to the Central Government's thrust towards development of the infrastructure sector, and with a number of large FDI projects in mining in the pipeline (POSCO India steel projects in Orissa and Karnataka, Arcelor Mittal steel projects in Orissa, Jharkhand and Karnataka, BP-Reliance oil and gas project in Andhra Pradesh, Lafarage cement project in Himachal Pradesh *etc.*), it is essential for the central and the state governments to take coordinated policy efforts towards creating a more favourable policy environment by simplifying the land acquisition procedure and reducing the delay in the approval mechanism.

Finally, of late, there has been a lot of debate about the merits and demerits in liberalising FDI in retail, insurance, pension and aviation sectors in India. With the issue of FDI still hot, it is important for the government to take due care in formulating its FDI policies so as to reduce the regional disparity rather than aggravating it.

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# *Financial Inclusion - IT as enabler*

## Sanjeev Kumar Gupta *

The Indian banking sector today is grappling with the issue of financial inclusion. Operating cost of providing financial inclusion and charges levied on the users are important dimensions of the process of financial inclusion. Technology can play an important role in reducing operating cost of providing banking services, particularly in the rural and unbanked areas. There are technologies that could drive the growth in financial inclusion. Against this backdrop, this paper outlines major steps which have been taken so far by the Reserve Bank and Government of India to enable financial inclusion for weaker sections of Indian society. The efforts made by the Reserve Bank in this direction so far, role of Information and Communications Technology (ICT) with focus on Mobile Banking and finally the Unique Identification (UID) number are discussed in detail in this paper.

## Introduction

The Information Technology (IT) saga in Indian Banking sector commenced from the mid eighties when the Reserve Bank of India (RBI) took upon itself the task of promoting computerisation in banking to improve customer services, book keeping, Management Information System (MIS) to enhance productivity. RBI has played the guiding role which helped banks in achieving various objectives such as the introduction of MICR based cheque processing, Implementation of the electronic payment system such as RTGS (Real Time Gross Settlement), Electronic Clearing Service (ECS), Electronic Funds Transfer (NEFT), Cheque Truncation System (CTS), Mobile Banking System *etc*. The Payment and Settlement Systems Act, 2007 (effective from August 12, 2008) designates the RBI as the authority for regulation and supervision of payment systems in India. With increase in reach, size

and significance of payment systems, the RBI is committed to assuring safe and efficient functioning of payment systems by identifying various risks, addressing risk-reduction by putting in place risk-mitigation measures and mandating appropriate risk. The RBI has also encouraged the setting up of National Payments Corporation of India (NPCI) to act as an umbrella organisation for operating Retail Payment Systems (RPS) in India.

Under the aegis of RBI, the Institute for Development and Research in Banking Technology (IDRBT), was set up in Hyderabad as a research and technology centre for the banking sector for excellence and advancement in technology. This resulted in the commissioning of the INdian FInancial Network (INFINET) as a Closed User Group based network for the exclusive use of the Banking Sector with state-of-the-art safety and security; Certification Authority (CA) functions for ensuring that electronic banking transactions get the requisite legal protection under the Information Technology Act, 2000; Implementation of the National Financial Switch (NFS) to ensure inter-connectivity of shared ATMs and to provide for fund settlement across various banks (now managed by NPCI). IDRBT also provides a platform for transmission of electronic messages across banks using common standards, for facilitating 'Straight Through Processing ' (STP) in the form of Structured Financial Messaging System (SFMS), which is similar to the Society for Worldwide Interbank Financial Telecommunication (S.W.I.F.T) messaging pattern.

Recognising the need for upgrading the country's financial infrastructure in respect of Clearing and Settlement of debt instruments and forex transactions, The Reserve Bank of India initiated the move to set up the Clearing Corporation of India Ltd. (CCIL). The country's largest bank, State Bank of India, took the lead in setting up of the CCIL. The other core promoters of CCIL are LIC, IDBI, ICICI Bank, HDFC Bank, and Bank of Baroda. CCIL is the country's first clearing house for Government Securities, Repos, Forex and other related market segments.

## Section II

## Financial Inclusion - Concept and Definition

There is no clear definition of financial inclusion. A few definitions in the literature are mentioned as under:
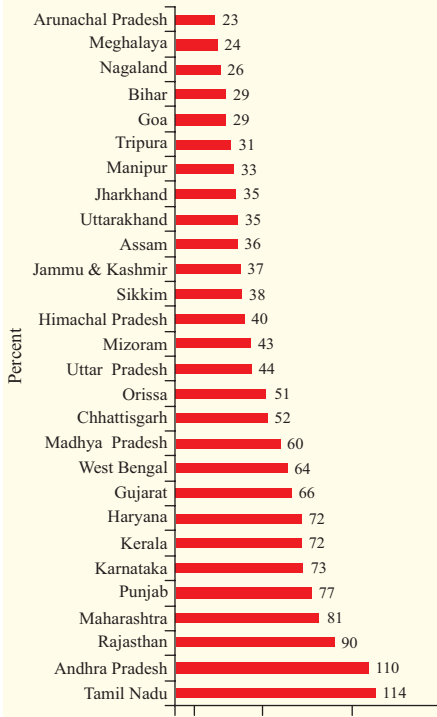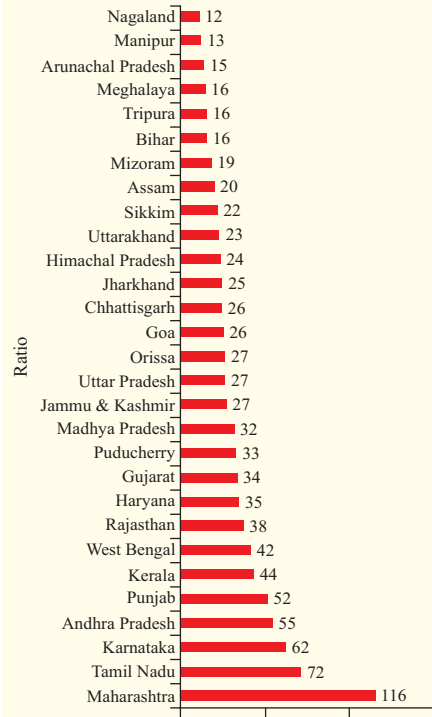
Financial inclusion means delivery of financial services at affordable costs to sections of disadvantaged and low income segments of the society. Defining financial inclusion is considered crucial for identifying the factors that lead to low level of access to the financial system. As measuring inclusion is perceived to be difficult, financial inclusion is generally defined in terms of exclusion from the financial system. However, financial inclusion is not just about physical access caused by the changing topography of financial services. Therefore, the debate has now broadened to include all types of people who make little or no use of financial services and the processes of financial exclusion (Ford and Rowlingson, 1996; Kampson and whyley, 1998).

"The process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low income groups at an affordable cost"-The Committee on Financial Inclusion (Chairman: Dr. C. Rangarajan, 2008)

In most developing countries, a large population particularly of low income, has very little access to financial services. As a consequence, many of them have to necessarily depend either on their own or informal sources of finance and generally at an unreasonably high cost. A report of the National Sample Survey Organisation (NSSO) mentions that 76 per cent of the rural households in the country depend on loans from moneylenders as their source of finance.

Financial inclusion, as far as banks are concerned, seems to be geographically limited to some parts of the country. In order to analyse the spread of banking services, two ratios *i.e.* (i) State wise Banks Credit - deposit ratio (Chart I) and (ii) amount of bank credit with the State GDP (Chart II) are calculated.

In some states, the credit-deposit ratios are very low, implying *inter alia,* that their funds are not being used by the state. Perhaps the

**Chart I: Bank Credit/Deposit as on March 2011**

| State | Percent |
|---|---|
| Arunachal Pradesh | 23 |
| Meghalaya | 24 |
| Nagaland | 26 |
| Bihar | 29 |
| Goa | 29 |
| Tripura | 31 |
| Manipur | 33 |
| Jharkhand | 35 |
| Uttarakhand | 35 |
| Assam | 36 |
| Jammu & Kashmir | 37 |
| Sikkim | 38 |
| Himachal Pradesh | 40 |
| Mizoram | 43 |
| Uttar Pradesh | 44 |
| Orissa | 51 |
| Chhattisgarh | 52 |
| Madhya Pradesh | 60 |
| West Bengal | 64 |
| Gujarat | 66 |
| Haryana | 72 |
| Kerala | 72 |
| Karnataka | 73 |
| Punjab | 77 |
| Maharashtra | 81 |
| Rajasthan | 90 |
| Andhra Pradesh | 110 |
| Tamil Nadu | 114 |

**Chart II: Bank Credit/ State GDP (current) as on March 2011**

| State | Ratio |
|---|---|
| Nagaland | 12 |
| Manipur | 13 |
| Arunachal Pradesh | 15 |
| Meghalaya | 16 |
| Tripura | 16 |
| Bihar | 16 |
| Mizoram | 19 |
| Assam | 20 |
| Sikkim | 22 |
| Uttarakhand | 23 |
| Himachal Pradesh | 24 |
| Jharkhand | 25 |
| Chhattisgarh | 26 |
| Goa | 26 |
| Orissa | 27 |
| Uttar Pradesh | 27 |
| Jammu & Kashmir | 27 |
| Madhya Pradesh | 32 |
| Puducherry | 33 |
| Gujarat | 34 |
| Haryana | 35 |
| Rajasthan | 38 |
| West Bengal | 42 |
| Kerala | 44 |
| Punjab | 52 |
| Andhra Pradesh | 55 |
| Karnataka | 62 |
| Tamil Nadu | 72 |
| Maharashtra | 116 |

root cause may be the financial exclusion. This also indicates that banks are reluctant in giving credit to these states due to variety of reasons. The credit - deposit ratios of some states are Tamil Nadu (114 percent), Maharashtra (81 percent), Utter Pradesh (44 percent) and lowest is in Arunachal Pradesh. Thus it is clear that some parts of the country are under-banked especially the north-east. On the other hand, the southern states are known to have a strong bank branch network and hence their CD ratio is high.

If we take the gross domestic product of the states and compare with the amount of bank credit, the ratio should be more or less the same. That would mean that banks are lending their funds in proportion to the size of the state economy. But there are wide variations in the credit/state GDP ratio. North-East states are at the bottom with credit/ state GDP is less than 18 percent. For Bihar too, this percentage is as

low as 16 percent. At the other end, Maharashtra, credit/state GDP ratio at 116 percent and ratio is similar for the states of Tamil- Nadu and Karnataka. From the analysis, it is clear that states such as Uttar Pradesh, Bihar, Chhattisgarh and the North-East states are receiving far less bank credit than warranted by the size of the state economy.

**Main factors affecting access to financial services:** The financial inclusion can be seen to have two categories of barriers, *viz.*, demand and supply side barriers. The factors that drive these barriers are listed as under:

**Demand Side Barriers:** The barriers arising out of the demand side factors may be characterized by the following features**:**

Complexity: The excluded sections of the society find financial services complex in nature. They see no reason to go to the banks for conducting small transactions, which in their opinion, are time consuming and perplexing

Place of living: Generally commercial banks operate only in commercially profitable areas and it would not be viable for banks to open branches in the remote villages. People who live in under developed areas find it very difficult to reach the nearest bank due to transportation cost and wages lost in travelling to the bank

Limited literacy: Financial illiteracy and lack of basic education are prohibiting factors leading to non-access of financial services.

Convenience and affinity towards informal sector: The excluded section of the society finds informal sector (such as the money lender or the pawn-broker) more user-friendly and accessible and as such, they develop an affinity which always drives them to approach this sector for their credit needs.

**Supply Side Barriers:** The supply side of barriers though not many, may be characterised by the following features:

Legal identity: Inability to provide a legal identity such as voter id, residence proof, birth certificates, *etc.* often exclude women and migrants from accessing financial services.

Outreach Issue: Very often, even if a person is bankable, the distances are too long for services & supporting the accounts at reasonable costs.

## Section III

## Technological Developments in Banks

Developments in the field of Information Technology (IT) strongly support the growth and inclusiveness of the banking sector, thereby facilitating inclusive economic growth. IT not only enhances the competitive efficiency of the banking sector by strengthening back-end administrative processes, it also improves the front-end operations and helps in bringing down the transaction costs for the customers. It has the potential of furthering financial inclusion by making small ticket retail transactions cheaper, easier and faster for the banking sector as well as for the small customers. The Reserve Bank has, thus, been actively involved in harnessing technology for the development of the Indian banking sector over the years.

A major technological development in banking sector is the adoption of the Core Banking Solutions (CBS). CBS is networking of branches, which enables customers to operate their accounts and avail of banking services from any branch of the Bank on CBS network, regardless of where the customer maintains his/her account. The customer is no more the customer of a Branch as he becomes the Bank's customer. Thus, CBS is a step towards enhancing, customer convenience through, Any-where, Anytime Banking. It is important to leverage on to this technological advancement to look at areas beyond CBS that can help in not just delivering quality and efficient services to customers but also generating and managing information effectively.

Another major technological development, which has revolutionised the delivery channel in the banking sector, has been the growth of Automated Teller Machines (ATMs). The banking space has seen considerable growth through the ATMs, (approximately 87000 ATMs at present) but the same has been restricted principally to the urban/metro areas. As per the existing rules/regulations, only banks are being permitted to set up ATMs in urban/metro areas. Tier III to VI unbanked/under banked areas have not witnessed much ATM presence.

In the above context, RBI has reviewed the extant policy on ATMs and it has been decided to permit non-banks to set up, own and operate ATMs to accelerate the growth and penetration of ATMs in the country. Such ATMs will be in the nature of White Label ATMs (WLA) and would provide ATM services to customers of all banks. Non-bank entities proposing to set up WLAs have to make an application to RBI for seeking authorisation under the Payment and Settlement Systems Act 2007.

Development of National Payment Systems: The payment system could be broadly divided in two segments:

Paper-based Payments: Use of paper-based instruments (like cheques, drafts etc.) account for nearly 60 percent of the volume of total non-cash transactions in the country. In value terms, the share is presently around 11 percent. Reserve Bank had introduced Magnetic Ink Character Recognition (MICR) technology for speeding up and bringing in efficiency in processing of cheques. Recent developments in paper-based instruments include launch of Speed Clearing (for local clearance of outstation cheques drawn on core-banking enabled branches of banks) and introduction of cheque truncation system (to restrict physical movement of cheques and enable use of images for payment processing).

Electronic Payments: The overall thrust is to reduce the use of paper for transactions and move towards electronic mode. Following are various electronic payment services available in the country:

Electronic Clearing Service (ECS)/National ECS (NECS): ECS is an electronic mode of payment / receipt for transactions that are repetitive and periodic in nature. ECS is used by institutions for making bulk payment of amounts towards distribution of dividend, interest, salary, pension, *etc.*, or for bulk collection of amounts towards telephone / electricity / water dues, cess / tax collections, loan installment repayments, periodic investments in mutual funds, insurance premium *etc*. Essentially, ECS facilitates bulk transfer of monies from one bank account to many bank accounts or vice versa.

National Electronic Funds Transfer (NEFT): NEFT is a payment system facilitating one-to-one funds transfer. Under this, individuals, firms and corporate can electronically transfer funds from any bank branch to any individual, firm or corporate having an account with any other bank branch in the country participating in the Scheme. Thus, this is an interbank fund transfer system.
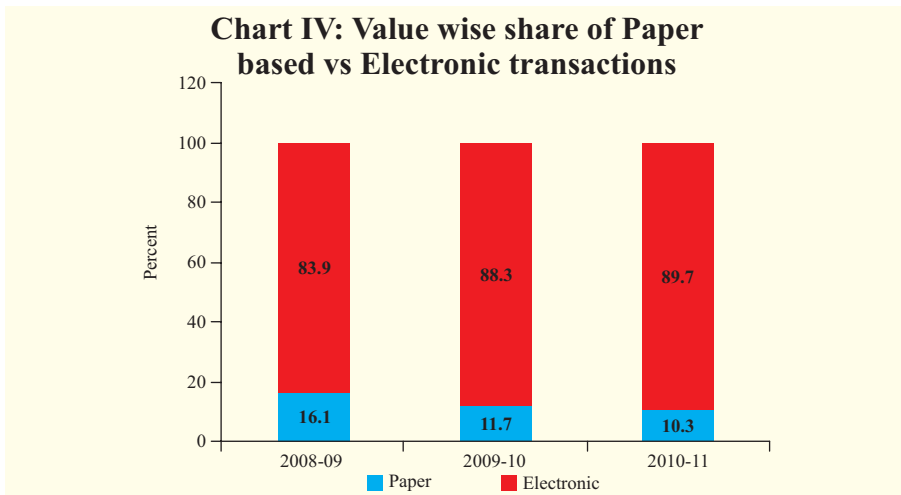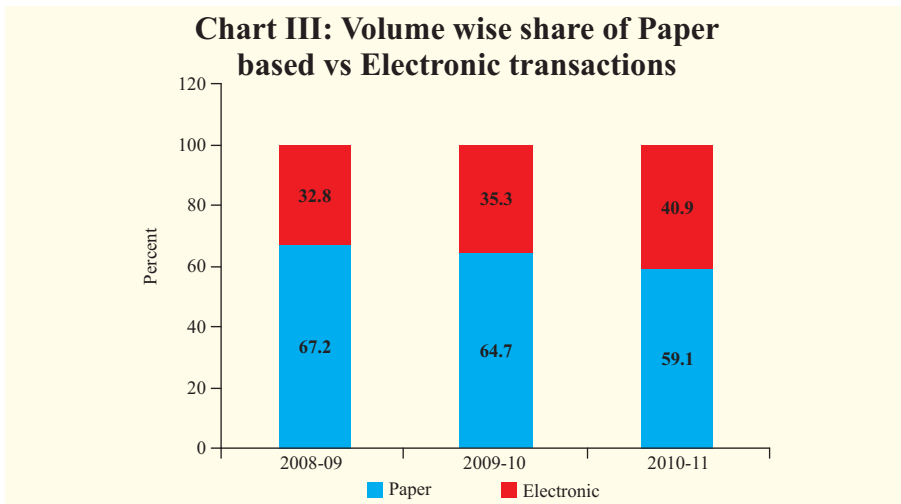
Real Time Gross Settlement (RTGS) System:

This Real Time Gross Settlement is a continuous (real-time) settlement of funds transfer individually on an order by order basis (without netting). 'Real Time' means the processing of instructions at the time they are received rather than at some later time. 'Gross Settlement' means the settlement of funds transfer instruction occurs individually (on an instruction by instruction basis). Considering that the funds settlement takes place in the books of the Reserve Bank of India, the payments are final and irrevocable.

Pre-paid Payment Systems: Pre-paid instruments are payment instruments that facilitate purchase of goods and services against the value stored on these instruments. The pre-paid payment instruments can be issued in the form of smart cards, magnetic stripe cards, internet accounts, internet wallets, mobile accounts, mobile wallets, paper vouchers, etc.

Point of Sale (POS) Terminals / Online Transactions: There are over five lakh POS terminals in the country, which enable customers to make payments for purchases of goods and services by means of credit/debit cards. To facilitate customer convenience the Bank has also permitted cash withdrawal using debit cards issued by the banks at POS terminals.

The efforts of RBI aimed at promoting electronic payment systems *vis-à-vis* paper based payments are evident, with both the value and volumes of these systems registering impressive growth rates as shown in the following charts III and IV.

**Chart III: Volume wise share of Paper based vs Electronic transactions**

| | 2008-09 | 2009-10 | 2010-11 |
|---|---|---|---|
| Electronic | 32.8 | 35.3 | 40.9 |
| Paper | 67.2 | 64.7 | 59.1 |

Percent

■ Paper   ■ Electronic

**Chart IV: Value wise share of Paper based vs Electronic transactions**

| | 2008-09 | 2009-10 | 2010-11 |
|---|---|---|---|
| Electronic | 83.9 | 88.3 | 89.7 |
| Paper | 16.1 | 11.7 | 10.3 |

Percent

■ Paper   ■ Electronic

## Section IV

## RBI's Efforts for Financial Inclusion

The brief outline of the efforts pursued by the RBI for financial inclusion are:

No frills accounts: The Annual Policy Statement of April 2005, while recognising the concerns in regard to the banking practices that tend to exclude rather than attract vast sections of population, urged banks to review their existing practices to align them with the objective

of financial inclusion. In many banks, the requirement of minimum balance and charges levied, although accompanied by a number of free facilities, deter a sizeable section of population from opening / maintaining bank accounts. In this context, with a view to achieving the objective of greater financial inclusion, all banks were advised to make available a basic banking 'no-frills' account either with 'nil' or very low minimum balances as well as charges that would make such accounts accessible to vast sections of population.

Easier credit facility: RBI asked banks to introduce a General Credit Card (GCC) facility up to ₹ 25,000, for their constituents in rural and semi-urban areas, with a view to providing credit card like facilities in rural areas with limited point-of-sale (POS) and limited automated teller machine (ATM) facilities, based on the assessment of income and cash.

Simpler Know Your Customer (KYC) norms: In a country, where most of the low income and poor people do not have any identity proof or proof of address, it is very difficult to have KYC norms that insist on production of such documents. In order to ensure that people belonging to low income group in urban and rural areas do not encounter difficulties in opening bank account, the KYC procedure for opening accounts was simplified for those accounts with balances not exceeding ₹ 50,000 and credit thereto not exceeding ₹ 100,000 in a year.

Bank branch and Automated Teller Machines (ATM) expansion liberalization: In the October 2009 Policy Review, RBI took a further big step by freeing branch opening in towns and villages with population below 50,000. Domestic scheduled commercial banks (other than RRBs) are now free to open branches in towns and villages with less than 50,000 population and are enjoined to ensure that at least one-third of such branch expansion happens in the underbanked areas. This will be one of the criteria in the Reserve Bank's consideration of proposals by banks to open branches in major city (tier 1) centres. In order to ensure fair pricing and enhanced access of the ATMs which have already gained prominence as a delivery channel for banking transactions in India, RBI under its "Free ATM access policy" since April 01, 2009

ensures that no charges are payable for using other banks' ATM for cash withdrawal and balance enquiry. However, banks can restrict the number of such free transactions to a maximum of five per month.

Business correspondent (BC)/ Business Facilitators (BF) model - Branchless banking:

With the objective of ensuring greater financial inclusion and increasing outreach of the banking sector, the Reserve Bank, in January 2006 permitted banks to use intermediaries as Business Facilitators (BF) / Business Correspondents (BC) for providing financial and banking services leveraging upon the Information and Communication Technology (ICT). The BCs were allowed to conduct banking business as agents of the banks at places other than the bank premises. The categories of entities that could act as BCs were also specified.

The Business Facilitators (BFs) may be used for facilitation services which may include identification of borrowers, collection and preliminary processing of loan applications, creating awareness about bank products and education and advice on managing money and debt counseling, processing and submission of application to banks, promotion of Self Help Groups/ Joint Liability Groups, post sanction monitoring, follow up for recovery, *etc*. No approval of RBI is required for using business facilitators for the services mentioned above.

Individual BCs / Institutional BCs, apart from the above services can disburse small value credit, recover principal/ collect interest, collect small value deposits, sell micro insurance/mutual fund products/ pension products/other third party products, receive and deliver small value remittance / other payment instruments. While banks may pay reasonable commission/ fee to the BFs / BCs, bank's agreement with the BFs / BCs should specifically prohibit them from charging any fee to the customers directly for services rendered by them on behalf of the bank. In order to establish itself, the BC Model had to overcome three hurdles that are common to any new payments system which are discussed below.

Trust/Brand: Banks should ensure that the customers are comfortable and have confidence and reliability in the new system

which may increase strong customer sense of affinity with and trust in the operator. Banks need to constitute Grievance Redressal Machinery within the bank for redressing complaints about services rendered by BFs /BCs and give wide publicity about it through electronic and print media. Banks should also provide the environment to BC like his own employee and redress their problems so as to motivate them to work sincerely.

Outreach and education: The value to the customer of a payment system depends on the number of people connected to and actively using it. So the presence of the BC is required in the area so that either he can visit the person or person can approach him in case of any transaction. In order to retain BC reasonable remuneration and incentive pay is required. RBI may ensure interoperability of BCs so that people may have the choice to choose them for the business transcations.

Viable business model/pricing: The viability of the BC model has remained the most critical issue which has led to the model not taking off as envisaged. A majority of no-frill accounts opened by BCs have remained non-operational. As such, opening of the accounts to provide deposit services to begin with and subsequently widen the coverage of activities, with a view to making these accounts profitable, have not made the desired progress. In order to ensure that accounts are operational there is a need for legislation from the Government making it mandatory to transfer all the social benefits through these accounts. Once this is done the banking habit will start developing.

Monitoring of BCs - role of ICT - In order to achieve the above, banks should closely monitor the BCs during their course of their periodical visits to the branches. Banks may devise an Off-Site Real Time Monitoring system, a mobile-based IT initiative which uses a combination of GPS (Global Positioning System) and GPRS (General Packet Radio Services) technologies through cell phones for monitoring the same. Banks have to invest one-time cost for software package development, procurement of cell phones and charges for GPRS connectivity. The GPRS technology allows cell phones to capture real time images of BC at work with the date and time of the picture as well as

the stamp of latitude and longitude alongside the image, superimposed on a Google map layer.

The facility to register a complaint through SMS against BC which should go to the concerned officials under that jurisdiction, time line for redressal, should also be fixed. This will build confidence in the business model and make it a success.

## Section V

## Mobile Banking: Why a Requirement of a New Banking Channel?

Nowadays, more than 60 percent of the population is in possession of a mobile phone. This includes a large section of the rural population. People have started understanding the value, convenience and ease of owning a mobile phone. Mobile banking has come in handy because of little or no infrastructure cost to the bank and no additional investment from customers. So this may be a useful channel where most of the population is unbanked. Mobile Phone, a Personal Device, which increases security though Second Factor Authentication, may also be added. On comparing mobile banking with branch banking and internet banking mobile, mobile banking could be most accessible with lowest cost of services

What exactly is a mobile based payment? With mobile devices becoming integral to people's lives, banks are seeking to leverage the ubiquity of mobile phones to create a cost-effective distribution channel, rapidly innovate, extend reach across segments and improve convenience and security of use. However, due to consumer concerns regarding security, the adoption of this channel for value-based transactions has been limited. One of the issues with mobile payments in the market today is the lack of clear and shared information across the industry.

Mobile based payment: Mobile based payment is defined as a payment (transfer of funds) where the mobile phone is involved in the initiation and confirmation of the payment. The location of the payer is not important: he may or may not be 'mobile' or 'on the move' or at a Point of Sale. The mobile payment would make use of cash redundant.

One could pay a vegetable vendor/ *kirana* shop payment, who displays a mobile Number and MMID at shop, instantaneously. In India, it has been decided to adopt the bank-led model.

National Payments Corporation of India (NPCI), a company under Companies Act, incorporated in December 2008 is facilitating the Interbank Mobile Payment Service (IMPS). IMPS is a money transfer system in which one can send money to other bank accounts instantly, the sender should use mobile banking to send money, the receiver mobile number should be registered with his bank and the money is credited to receivers account instantly .

For registration the Remitter must register for mobile banking and get Mobile Money Identifier (MMID) & Mobile Banking Pin (MPIN) for initiation of a transaction. MMID is a 7 digit number, to be issued by the bank to the customer upon registration and the Beneficiary must Register his / her mobile number with the bank account and get MMID. A remitter can initiate an IMPS transaction by sending a SMS to his bank typing the Beneficiary Mobile Number, Beneficiary MMID and Amount. The receiver will get a SMS confirmation for the credit of his account.

## Section VI

## Unique Identification Number (UID): Why a New ID?

A challenge for residents in India, particularly the underprivileged, is the lack of documentation that they have to make available to establish their identity. Many of India's poorest residents do not have basic identity documentation such as a birth certificate, or a proof of address such as an electricity bill. These residents are consequently unable to access services and resources – such as opening a bank account – since they are unable to fulfil the KYC (Know Your Customer) requirements these agencies have. The challenges increase when people migrate, since most identification documentation in India is provided by local administration and invalid when the person crosses state lines.

UID, *i.e.,* Aadhaar is a 12-digit unique number issued by the Unique Identification Authority of India (UIDAI) to all Indian residents after

collecting and verifying their demographic (*e.g.,* location) and biometric (*e.g.,* fingerprint, iris) data. The information in the database will be used only for authentication purpose. If anyone seeks to authenticate the identity of another person using the *Aadhaar* database, he/she will only receive a response in the affirmative or the negative. The Aadhaar database will not transmit information or share data with anyone.

*Aadhaar* will become the single source of identity verification. Residents would be spared the hassle of repeatedly providing supporting identity documents each time they wish to access services such as obtaining a bank account, passport, driving license and so on. By providing a clear proof of identity, *Aadhaar* will also facilitate entry for poor and underprivileged residents into the formal banking system and the opportunity to avail services provided by the government and the private sector.

*AADHAAR* enabled bank accounts will be opened for every resident, with his consent. It is envisaged that disbursement of social security benefits like pension, scholarships, MGNREGS wages, *etc.* would be through *Aadhaar* enabled bank account. UIDAI is actively working with states/central ministries to designate *Aadhaar* enabled accounts for disbursal of all social security benefits. The individual would be able to access his/her *AADHAAR* enabled bank account through a low cost interoperable micro-ATM network which will have large geographical reach .

MICRO ATM and role of UID

With the government keen on expanding financial inclusion, the Indian Banks' Association (IBA) is working out a strategy to facilitate branchless banking in villages. Remote villages with a population of just 2,000 could get micro Automatic Teller Machines (ATM) for banking transactions, which would effectively meet a promise to this effect in Budget 2010-11. Finance Minister Pranab Mukherjee had said in his Budget speech that all villages with a population in excess of 2,000 would get banking facilities by March 2012.

Micro ATM meant to be a device that is used by a million Business Correspondents to deliver basic banking services. The platform will

enable Business Correspondents (who could be a local *kirana* shop owner and will act as 'micro ATM') to conduct instant transactions.

The micro platform will enable function through low cost devices (micro ATMs) that will be connected to banks across the country. This would enable a person to instantly deposit or withdraw funds regardless of the bank associated with a particular BC. This device will be based on a mobile phone connection and would be made available at every BC. Customers would just have to get their identity authenticated and withdraw or put money into their bank accounts. This money will come from the cash drawer of the BC. Essentially, BCs will act as bank for the customers and all they need to do is verify the authenticity of customer using customers' UID. The basic transaction types, to be supported by micro ATM, are Deposit, Withdrawal, Fund transfer and Balance enquiry

## Section VII

## Could Post Office Network be used for Financial Inclusion?

India Post is largest in the world Post network which covers over 1.55 lakh branches which is larger than all commercial banks in India put together. As on 31st March 2010, the number of rural post offices in the country was 1, 39,182 (89.81 per cent) and number of urban post offices 15,797 (10.19 per cent). The existing set up where 89.81 per cent branches are in rural area most suited to the mission of financial inclusion. On an average 7,176 people served by the post offices; 5,682 in rural and 20,346 in the urban areas. Average area served by one post office is 21 km.

While appointing individuals as BCs, banks have to ensure that these individuals are permanent residents of the area in which they propose to operate as BCs and also institute additional safeguards as appropriate to minimise agency risk. However, in case the post office lead model is chosen, the above issue would be resolved automatically.

Indian post needs no introduction and it provides the cheapest reliable services to the citizen of the country. The network of Indian post by and large covers entire nation especially the rural areas. Post

offices are already connected with lease line/broadband *etc* with the power backup and it is easy to enhance further capacity rather than creating a new setup. Post offices are providing remittance facility and citizen can track the status of the transaction through the branch. It has established Grievance redressal mechanism. The improvement in the performance level of the identified post offices has been carried by external audit, enchasing trust in the organisation.

The engagement of BCs by banks for delivery of banking services exposes banks to multiple types of risks: (i) credit risk (ii) operational risk (iii) legal risk (iv) liquidity risk and (v) reputational risk. To mitigate such risk banks need to take appropriate action. In case of post office, risk management will be robust.

Almost all BC transactions are cash based; the flow of cash with BCs has been highlighted as the biggest issue. Besides the logistics of handling large volumes of cash, it leads to increased costs and added operational risks. Since post offices are already managing the Post Office Savings Bank accounts, the risk of cash handling would be mitigated. Banks may have agency arrangement with the post offices which may benefit the both. Though the viability of the BC model is still questionable, the chances of success of the post office model are positive.

Given the vast network of the post office across country, Indian post offers the facility to collect consumer's bills on behalf of service providers from telephone /electricity /mobile phone *etc.*, through retail post. Also it provides various retail services to the citizens of the country. The Post Office Saving Bank (POSB) is the oldest and largest banking institution in the country. It operates 240 million saving accounts. POSB is a agency function performed by the Department of Post on behalf of ministry of finance, Government of India. Presently eight saving schemes are operated across country. These are saving account, Recurring Deposit, Time Deposit, Monthly Income Scheme, Public Provident Fund, Kisan vikas Patras, National Saving Certificates and Senior citizen saving scheme.

In order to leverage the vast network, Provident Fund Development Regulatory Authority (PFRDA) of India has entered into a MoU with the

Department of post for retailing of the new pension scheme at various post offices. As regards the BCs, the scope of activities that could be undertaken include (i) disbursal of small value credit, (ii) recovery of principal / collection of interest (iii) collection of small value deposits (iv) sale of micro insurance/ mutual fund products/ pension products/ other third party products and (v) receipt and delivery of small value remittances/ other payment instruments. All these services are already taken care of by the postal department, so it would be a viable model in case post department can also be given partnership in the financial inclusion initiatives.

## Section VIII

## Conclusion

The entire emphasis of the Government, RBI and banks is to open more accounts. However, mere opening the account will not help furthering the cause of financial inclusion. The people working in unorganised sector who often deal through middleman and fall into traps/ clutches of private money lenders need to be targeted to include them under financial inclusion. There is a need that the payment for social schemes should be done through account payment so that issue of money pilferage will be plugged. Financial inclusion requires consistent efforts which will come at a cost, as banks are profit making organisations, The Government should make a budgetary provision for the cost and reimburse banks accordingly. Banks should also provide doorstep banking services to them as an incentive so that other people also join the inclusion programme of banks.

In the existing system, the cash is drawn from the BCs drawer and simultaneously the account of the BC in the bank is credited. Once BC model gathers popularity, there may be an issue in management of cash with BC at hand and needs to be addressed for the success of the BC model. The cash availability, consumer protection and quality of service delivery could be assured with the promotion and encouragement of Institutional BCs.

For the real success of the BC model, the salary/ charges to the BC should be rationalized. There is also a need to incentivise BC for good

work. The banks should show interest to recruit business correspondents (BCs) and this may create employment opportunities for rural youth, including women. There is a need for constant monitoring of the services of the BCs which should be ensured through social audit that BCs should not take any commission/charges from the persons.

One of the reasons for slow progress in financial inclusion is absence of reach and coverage by banks. This gap now can be bridged through the user of information and communication technology. Mobile banking / Micro ATM offers one of the most promising options for providing financial services to the unbanked population. Mobile banking has taken off from an urban prospective where an existing client of the bank is getting additional avenues to access his bank account and doing banking transactions. Till now the potential of achieving financial inclusion through mobile banking appears to be missing completely for rural customers.

The main reason for slow inclusion by banks is the absence of delivery model and products designed to satisfy the low income families. The provision of uncomplicated, small, affordable products will help to bring the low income families into the formal financial sector. Banks have limitations to reach directly to the low income consumers. The use of technology and using economies of scale will, however bring down the cost of transaction to the banks and it will be a win - win position for both banks and customers.

Financial inclusion and the extension of financial services to every citizen of the country is a priority for the Government. The goal of financial inclusion cannot be achieved without the help of technology. The enrolment to UID and UID enabled bank account will be a game changer in the entire process of financial inclusion plan.

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**The New Gold Standard: Rediscovering the Power of Gold to Protect and Grow Wealth**, Paul Nathan, John Wiley & Sons: New Jersey, USA, 2011; pp XIX+204, $ 39.95.

The year 2008 will be remembered as a crisis year that saw *Fannie Mae* and *Freddie Mac* went down, followed by *Lehman Brothers* and a host of others. Then everything else to do with financial markets went topsy-turvy. Not unrelated, but relatively less commented on, was the skyrocketting in gold prices. The gold had seen rising earlier, too, but this one had a much larger in comparison with the financial world that is often inadequately explained. Financial analysts while dissecting the reasons for such a rise in gold prices rarely tell the full story, choosing to throw the dart on the growing demand from India and China. A full time private investor in gold by profession, Paul Nathan had recommended for accumulating gold and gold stocks since 2000, and he made profit in 9 years out of 10, with a 40 per cent and 80 per cent of profit in 2008 and 2009, respectively, during which it is estimated that 95 per cent of investors lost money. In 2010, he began commentary and investment website: <*paulnathan.biz*>. In 2011, he published this book "The New Gold Standard" a part of the *John Wiley & Sons* has successfully attempted to unravel the mystery around the gold. He tells a story that is refreshingly different from the standard financial analysts.

The author starts with the narration of the history of gold demand in USA (from 1935 to 1975) - it was illegal for Americans to own gold with the exception of jewellery or dental fillings. The most famous economist of the twentieth century, John Maynard Keynes, called gold a *barbaric relic*. Many scholars blame the gold standard of the years in between the world wars for causing the *Great Depression*. When somebody is in the gold vault, there's nothing unreasonable about gold. It's not barbaric. It's not just a hunk of metal. It is real wealth. It's real value. It's real money. It's just plain real, says the author of the book.

The question of re-adopting gold as money always arises because inflation has persisted for some time, prices of almost everything, including gold, have risen, and the savings of the people have been eroded. Some gold

standard proponents want to return to the pre-inflation gold/money ratio. Others want to raise the gold price to some arbitrary figure and allow the monetary expansion to play 'catch-up'. Still others say that the least disruptive way would be to discover the current market gold/money ratio and redefine dollar on that basis.

It is aptly mentioned in the book that there is no utopia – not in economies, not in politics, and not in investing. Gold is what it is: a rare and precious metal with particular qualities that make it an effective medium of exchange. It is argued in the book that there is no reason, technically or economically, why the world today, even with its countless wide-ranging and complex commercial transactions, could not return to the gold standard and operate with gold money. The major obstacle is ideological.

*Ideological Obstacle*

Many people believe that it would be impossible to return to the gold standard. There are just too many people in the world now and the economy is too complex. Many others look on a return to the gold standard as an almost magical solution to today's major problems - big government, the welfare state, and inflation. What is the truth of the matter?

It is argued that, for a country prepared to go on a gold standard, it would have to carry out many reforms. The federal government would really have to stop inflating, balance its budget, and abandon welfare state programs. Most voters are not ready for such reforms. And politicians, pressurised by voters and special interest groups for favours, hesitate to pass them. Thus the major stumbling block to monetary reform is *ideological*. If this basic obstacle could be overcome, however, a return to gold money would become a realistic possibility.

The writer of the book having argument: let's consider possible ways for transforming our present monetary system, based on fractional reserve banking, into a gold standard. There may be better ways and worse ways.

Several methods have been suggested for returning to a gold standard. All gold standard advocates agree that the goal must be to re-introduce gold as money, while making it possible to continue honouring outstanding contracts. The principal point on which they differ is with respect to the price that should be set for gold and how any existing paper currency should be defined.

Great Britain suspended specie payments in 1797 and inflated during the Napoleonic Wars. Great Britain finally returned to the gold standard in 1821, 24 years later. Britain abandoned the gold standard again in World War I. Before 1914, London had been the world's financial center. When the war started in August, shipments to England of gold, silver, and goods from all over the world were immediately disrupted. The shortage of funds put London's banks and stock exchange in crisis and they closed down for a few days. When they reopened, a debt moratorium was declared and the Bank Charter Act of 1844, fixing the gold/pound ratio and tying the quantity of paper pounds issued to the gold bullion reserves, was suspended. As the war continued and the government's costs increased, the government inflated more and more. By 1920, after the war was over, inflation had proceeded to such an extent that prices had tripled and the gold value of the British pound had fallen 10 percent on world markets.

*The Proposal*

The goal of returning to a gold standard must be: (1) to reintroduce gold and gold coins as money, without producing deflation and without causing a shock to the economy, while permitting the fulfillment of outstanding contracts, and (2) to arrange for the transfer of gold from the government's holdings into private hands, so that gold coins would be in circulation daily. As pointed out above, before this can happen, there must be a major ideological shift in the climate of opinion. The voters must be willing to be more self-reliant and accept personal responsibility for their actions.

Advocates of the gold standard should not be deterred by the three reasons given by critics who believe a gold standard could not work: that there isn't enough gold to serve the needs of the world, with its increasing population and its expanding production and trade; that gold would be an unstable money; and that a gold standard would be expensive.

In the first place, there is no shortage of gold. The size of the world's population, and the extent of production and trade are immaterial; any amount of money will always serve all needs of the society. Actually, people don't care about the number of dollars, francs, marks, pesos, or yen, they have in their wallets or bank accounts; what is important to them is purchasing power. And if prices are free and flexible, the available quantity of money, whatever that

may be, will be spread around among would-be buyers and sellers who bid and compete with one another until all the goods and services being offered at any one time find buyers. In this way, the available quantity of money would adjust to provide the purchasing power needed to purchase all available goods and services at the prevailing competitive market prices.

In the second place, gold would be a much more stable money than most paper currencies. The purchasing power of government- or bank-issued paper currency may fluctuate wildly, as the quantity is expanded or contracted in response to the "needs" of business and/or political pressures, causing prices to rise or fall sharply. Under a gold standard, there would be some slight cash-induced price increases when the quantity of gold used as money rose, as more gold was mined, refined, and processed; and there would be some slight cash-induced price declines as the quantity of gold used as money fell, when gold was withdrawn from the market to be devoted to industry, dentistry, or jewellery. However, under a gold standard, price changes due to such shifts in the quantity of money would be relatively minor and easy to anticipate, and the purchasing power per unit of gold would be more stable than under an unpredictable paper currency standard.

In the third place, although it would cost more to introduce gold into circulation than a paper currency that requires no backing, in the long run a gold standard is not at all expensive as compared to paper. Again and again throughout history, paper moneys had proven extremely wasteful and expensive; they distorted economic calculation, destroyed people's savings, and wiped out their investments. Yale economist William Graham Sumner (1840-1910), writing long before the world had experienced the disastrous inflations of 20th century, estimated that "our attempts to win [cheap money] have all failed, and they have cost us, in each generation, more than a purely specie currency would have cost, if each generation had had to buy it anew".

Once it is agreed that the introduction of a market gold money standard is the goal, here are the steps to take:

First: All inflation must be stopped as of a certain date. That means calling a halt also to all expansion of credit through the Federal Reserve and the commercial banks.

Second: Permit gold to be actively bought, sold, traded, imported, exported. To prevent the U.S. government from exerting undue influence, it should stay out of the market for the time being.

Third: Oscillations in the price of gold would diminish in time and the "price" would tend to stabilize. At that point a new dollar-to-gold ratio could be established and a new legal parity decreed. No one can know what the new dollar-to-gold ratio would be. However, it is likely that it would stabilize a little above the then-current world price of gold, whatever that might be.

Fourth: Once a new legal ratio is established and the dollar is newly defined in terms of gold, the U.S. government and the U.S. Mints may enter the market, buying and selling gold and dollars at the new parity, and minting and selling gold coins of specified weights and fineness. Gold might well circulate side by side with other moneys, as it did during the fiat money inflation time of the French Revolution, so that parallel moneys would develop, easing the transition to gold.

Fifth: The U.S. Mint should mint gold coins of certain agreed-upon fineness and of various weights—say one-tenth of an ounce, one-quarter, one-half, and one ounce, etc.—and stand ready to sell these gold coins for dollars at the established parity and to buy any gold offered for minting. As old legal tender dollars were turned in for gold, they should be retired, so that gold coins would gradually begin to appear in circulation.

Sixth: The financing of the U.S. government must be divorced completely from the monetary system. Government must be prevented from spending any more than it collects in taxes or borrows from private lenders. Under no condition may the government sell any more bonds to the Federal Reserve to be turned into money and credit; monetization of the U.S. government's debt must cease! A 100 percent reserve must be held in the banks for all future deposits, i.e., for all deposits not already in existence on the first day of the reform.

Seventh: The outstanding U.S. government bonds held by non-U.S. government entities, must be fulfilled as promised.

Eighth: To avoid deflation, there should not be any contraction of the quantity of money currently in existence. Thus prices and outstanding debts would not be adversely affected. U.S. government bonds held by the Federal Reserve as "backing" for Federal Reserve notes may be retained, but should not be used as the basis for further issues of notes and/or credit. No bank may be permitted to expand the total amount of its deposits subject to check or the balance of such deposits of any individual customers, whether private citizen or the U.S. Treasury, otherwise than by receiving cash deposits in gold, legal tender banknotes from the public or by receiving a check payable by another bank subject to the same limitations.

Ninth: The funds collected over the years from employees and employers, ostensibly for Social Security, were spent as collected for the government's general purposes. Thus the U.S. government bonds held as a bookkeeping ploy in the so-called Social Security Trust Fund are mere window-dressing.

*Summing Up*

Those who think that a gold standard would place such rigid limits on the market that money lending would no longer be possible should remind that what fully convertible money precludes is not moneylending per se. Individuals and banks would, of course, still be able to lend, but no more than the sums savers had accumulated and were willing to make available. What the gold standard prevents is the involuntary lending by savers, who are deprived in the process of some of the value of their savings, without having any choice in the matter. Fully convertible money under the gold standard prevents more than one claim to the same money from being created; while the borrower spends the money borrowed, the savers forgo spending until the borrower pays it back.

Under the gold standard, banks would have to return to their original two functions: serving as money warehouses and as money lenders, or intermediaries between savers and would-be borrowers. These two functions—money-warehousing and money-lending—should be kept entirely separate. But that will not preclude a great deal of flexibility in the field of banking. With today's modern developments, computerized record-keeping, electronic money transfers, creative ideas about arranging credit transactions, credit cards, ATM machines, and so forth, lending and borrowing, the transfer of funds and money clearings could continue to take place rapidly and smoothly under the gold standard and free banking, even as they do now. However, under a market gold standard people need no longer fear the ever-impending threat of inflation, price distortions, economic miscalculations, and serious mal-investments

All of us are struggling to understand where we have gone wrong, why our institutions have failed us, how we should direct ourselves as a nation, and how to insure our financial futures against inflation, deflation, credit crises, debt defaults, panics, stock market plunges, and real estate declines. All good questions, but where to start? Let's start from the beginning of this particular book.

Narayan Chandra Pradhan*

* Assistant Adviser, Department of Economic and Policy Research, RBI, Mumbai.

**Borderless Economics: Chinese Sea Turtles, Indian Fridges and the New Fruits of Global Capitalism, authored by Robert Guest (Palgrave Macmillan: New York), 2011; pp 250, US$ 27.00.**

In the economic history of last 100 years, international migration is a topic of unsettled debate among economists, policy makers, leaders, *etc*. There is a group of academicians, which views that international migration will lead to decline in overall welfare of poor countries and it will be beneficial to rich countries only. Their line of argument is that migration of scarce human resource to developed economies will reduce the supply of skilled manpower in underdeveloped economies. They argued that poor countries have to invest very large amount of financial resources in training the local labour. However, due to migration, fruits of their knowledge are reaped by the developed economies, which are in a position to pay higher prices for their skills / capabilities. Another view is labour migration does not augur well both for source and destination economies for a number of reasons. In destination economy, critics say that migration increases the burden on ongoing social welfare schemes; it replaces domestic labour with cheap imported labour and hence effectively increases the unemployment among the youth. It also creates tension in the established social fabric of the country. There is, however, a second line of thought which claims that migration has proved very beneficial to source as well as destination economies. In fact, a number of supranational organisations, like the World Bank, have established specific divisions to conduct research on this topic.

Like any other topic of economics, research on migration is also based on the analysis of past data, which attempts to make an inference on the behaviour of important macroeconomic variables, *viz*., production, wages, prices, inequality, *etc.* The book, "**Borderless Economics: Chinese Sea Turtles, Indian Fridges and the New Fruits of Global Capitalism**" by Robert Guest provides a new insight on the multidimensional impacts of migration on global economy. Author of the book is the business editor of the weekly magazine "The Economist". During his association of more than two decades with 'The Economist', he had the opportunity to work in about 70

countries. The content of this book is an imprint of his vast travelling around the world and understanding about the subject, *i.e.*, "global migration". In this book, the author has used stories of individuals and their ideas to illustrate the phenomenal changes which have been occurring in global economy. Author seem to emphasise that globalisation actually means migration of people which can have economic and political implications as well.

Use of statistics in the book is limited to corroboration of stories only. Title of the book also resonates this fact. Chinese 'Sea Turtles' is a term which is used for those Chinese who migrate to developed countries for higher education and after completing their studies return to China and occupy higher positions in the society. Similarly, the term "Indian Fridges" symbolises the innovative spirit of Indians. According to the author, two Indian students of Harvard University have made the cheapest fridge in the world, which costs only US$ 69 and that can be run without electricity. They are trying to commercialise it with the help of an Indian consumer goods manufacturing behemoth. The book has made very strong comments about the social and political systems prevailing in some of the very important countries of the world. It says that migrants are helping China's smooth transition to democracy. The book has also tried to paint the emerging scenario in social and political arena of the global geo-politics

In addition to introduction and conclusion chapters, the book has eight chapters. Every chapter consist a number of stories. Overall theme of the book may be divided into some broad frames, *viz.*, theoretical platform, impact on emerging economies, impact on developed economies, particularly on the United States of America and ill-effects of migration.

**Theoretical Platform**

Migration from the country of birth to other countries is a very old phenomenon in the evolution of human civilisation. It was fuelled by economic inequality prevailing among countries, risk taking appetite of migrants, improved means of transportation and communication, wars and social strife, *etc*. At times migration was forced by the political masters also, like British Masters forced large numbers of Indians to migrate to East Africa and East Asia to work as coolies and in other low paying jobs. In recent period, due to a number of technological breakthroughs, it has become very easy to migrate from a country without breaking the native contacts. Technology has made

it easier to send remittances, share knowledge, and make networks. These developments have very dramatic impact on both source and destination economies. Networking makes it easy for new entrepreneurs to search for new avenues of investment and raise cheap finance to fund their activities. This reduces the cost of due diligence while recruiting staff, as in general, people have more confidence while dealing with people of their own tribe *vis-à-vis* strangers.

Economic impact of migration is direct and very effective unlike foreign aid which is marred with unwarranted leakages and wastages. According to the author, countries like China and India have benefited immensely from their diaspora. A few important examples of trading diasporas are the Chinese in Southeast Asia, Indians in East Africa and Lebanese in Latin America. These networks have emerged stronger in the last three decades due to reduction of tariff and non-tariff barriers. Developments in technologies of transportation and communication have led to one very significant difference in the pattern of migration, it has become circular unlike linear migration, *i.e.*, from developing country to developed country only. People are going to one country for education and then to another country for job and finally they go to another country for doing business and investment.

**Impact on Emerging Economies**

Most populated emerging economies, particularly China and India, have largest number of migrants in the world and have received enormous benefits from their diaspora. India is the largest recipient of remittance income, and about three fourth of foreign direct investment in China is made by the Chinese diaspora. However, the author argues that the benefits of diaspora are not limited to the economic benefits only but are also spread to political and cultural arena. Migration empowers individuals and creates networks that are outside the control of the state. The author, in Chapter 3, 'Diaspora Politics', has concluded that Chinese diaspora is helping to bring democracy in China. The author bases his argument on the following reasons, a) the diaspora provides a safe haven for dissidents and a hub for democratic ideas, b) the number of mainland Chinese who study abroad has increased, c) the diaspora helps make China more prosperous through investments and d) links with the diaspora help spread of new communication technology around China.

In case of India also, migrants are changing country in multiple ways. India is a unique country, it is home of largest number of poor in the world. But these poor people, unlike any other country, are highly mobile. Besides that Indian government runs a number of welfare programmes for eradication of poverty. The present circumstances, however, make it literally impossible for poor to prove their identity and avail these benefits. With a determination to improve this scenario, Indian government has launched a world's largest unique identity programme under the leadership of one of the most successful information technology entrepreneurs. Along with political and administrative issues, this programme is a huge technological challenge due to the sheer size of data involved. According to the author, along with helping the Government of India in rolling out of its ambitious unique identification project, migrants are changing Indian economy in number of ways, *i.e.*, by reducing cost of modern health services and by inventing cheaper instruments for use in industry.

In Chapter 5, author has discussed a long debated subject related to migration, *i.e.*, brain drain. The author has concluded that rather than doing harm to emerging economies, brain drain has helped countries to reduce global poverty. Migration makes poor countries better off in many ways, *viz*., a) the prospect of earning higher salaries working abroad spurs more people to acquire marketable skills, b) migrant workers from poor countries who work in rich ones send money home. Author has provided a comprehensive list of empirical studies conducted in many developing economies of Asia, Africa and Latin America, which concluded that remittance money led to increase in household expenditure on education and health, investment in small businesses and farms, *etc*.

**Impact on Developed Economies**

An important feature of this book is that it has covered the impact of migration on developed countries also, although it is restricted mainly to the USA. The book does not cover other developed countries may be because USA is the largest recipient of migrants in world. Chapter 7 (A Ponzi Scheme that Works) and Chapter 8 (The Hub of the World) have covered the effects of migration on the US economy. In these two chapters, the author has attempted to answer two very pertinent questions a) why migrants choose USA? and b) why USA will remain still number one? One reason can be the fact that the

USA provides cultural diversity, huge market for selling goods and ideas. In the US, since laws also vary according to provinces so one can choose a suitable state. Present fertility rate in the US is 2.1, which is exactly the replacement rate. This indicates that population of the US will neither grow nor shrink. But if one adds migration, the scenario changes considerably. Author is of the opinion that migration will lead to increase in working age population in the US economy and will save it from the problem of high dependency of old age population unlike China. Besides this, migration provides US a platoon of unofficial ambassadors, deal brokers, and recruiters, *etc*. Diaspora bring to the US not only the best ideas from all over the globe but they serve as vehicles for spreading American ideas and ideals back to their homeland hence increasing the United States' soft power.

**Side Effects**

Like every economic phenomenon, global migration also has its own pitfalls. Chapter 6, 'Networks of Hate', gives a detailed account of the negative outcome of the global migration. Due to migration and increased means of communication, spreading ideologies of terrorism has become easy. Chapter provides detailed accounts of some of the terror groups, active in India and have links in countries like the USA, Middle East, and Pakistan, *etc*. Economic liberalisation started by the national governments has fuelled the growth of legal trades but it has also provided sufficient ammunition for illegal trading activities. The spread of cheaper and safer mode of communication has made it easier for them to coordinate their activities without being caught by law enforcing agencies. Increase in global financial flows has created a huge opportunity for money launderers also.

The book has concluded that global migration is a boon for emerging as well as developed countries and shall be promoted by the global leadership. The author sees it as more efficient way of tackling the global poverty as compared to foreign aid. It will also help the developed countries to fight the problem of ageing population. Like any other economic phenomenon global migration also has drawbacks, which needs to be overcome globally by joint efforts, as they are equally harmful to all. In short, it can be said that the book celebrates free movement of people, ideas and resources. In fact, to compare this model of free mobility of resources with an alternative model of closed economy, the author has started this book with a very apt

example of North and South Korea. While North Korea has followed a model of closed economy and permitted bare minimum movement of its people outside its borders, South Korea has adopted a liberal outward oriented model of development. Consequences of these models, in terms of developments, are well known to the world. The book gives a good reading experience to reader and has done justice with subject raised. However, it has a few shortcomings. While reading, the reader may become very optimistic and may think that migration is panacea for many of the problems. Furthermore, the book could have covered the impact of migration on Western Europe. But probably, it is not possible for a single book or single author to cover each and every aspect relating to this vast topic. Nevertheless, the book is well reported with facts and provides valuable insights on the subject of migration.

**Avdhesh Kumar Shukla**[*]

* Research Officer, Department of Economic and Policy Research, Reserve Bank of India, Ahmedabad.