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Monetary Policy Transmission in Financial Markets: Evidence from the First Stage

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Abstract: Our study examines the first stage of the monetary policy transmission dynamics in India over two distinct monetary policy regime., Multiple Indictaor targeting regime(1990-2016) and the Flexible Inflation Targeting Regime(2016-2023) in India. We find the call money market and overnight MIBOR rates to be significantly impacted by most of the monetary policy instruments during both the regimes However, exchange rates and the stock market index remain unresponsive to all the monetary policy instruments. Expectedly, 91-day treasury bill rates and the government bond respond significantly to all the monetary policy instruments. Broadly, these evidences are suggestive of the fact that the monetary policy transmission is instantaneous in the short-term money markets and thus highlights the necessity of effective monetary policy signalling and the importance of the interbank money market in the transmission dynamics

Keywords: Monetary Policy Transmission Money Markets Exchange Rates Stock Prices India

1. Introduction

Monetary policy affects real economic activity through its influence on key financial variables such as interest rates, exchange rates, asset prices, and credit aggregates, which together constitute the Monetary Policy Transmission Mechanism. The transmission of monetary policy to real economic variables is a three-stage process. During the first stage of transmission, policy rate changes are transmitted to the entire spectrum of interest rates, i.e., the money, forex, and bond markets, which influence the investment and consumption choices of individuals and firms. In the second stage, these policy rates transmit from the gamut of market interest rates to the credit markets spectrum, influencing banks' deposit and lending rates. The third stage of the transmission dynamics involves the transmission of policy impulses from these financial market variables and credit aggregates to real economic variables such as output and inflation.

Bernanke and Gertler (1995), however, have raised concerns about the lack of understanding of transmission dynamics and remarked that despite

voluminous empirical literature highlighting the impact of monetary policy on output, the same literature remains largely taciturn on what happens in the interim. In well-developed markets, monetary policy signals are expected to be transmitted instantaneously to the full continuum of the financial market spectrum, i.e., market interest rates, exchange rates, and stock market indices. However, developing economies such as India are characterised by market imperfections and long transmission lags that hinder the transmission of policy rates to financial markets. In addition, it is difficult to isolate the impact of monetary policy shocks from other macroeconomic shocks that are likely to impact the financial market variables in the interregnum.

After the 1990s, the Indian economy witnessed considerable changes in its monetary policy stance characterised by regime shifts in its operating framework. Accordingly, an array of policy instruments, namely the bank rate, cash reserve rate, repo rate, marginal standing facility, and standing deposit facility, have been used by the Reserve Bank of India (RBI) as tools of monetary policy signalling. The monetary authority signals its police stance through these instruments that are slated to have an immediate impact on market interest rates, i.e., 91-day treasury bills, 10-year government bond rates, and the call money market rate. These market rates serve as signalling benchmarks for policy transmission to the stock and exchange markets.

Despite sound theoretical premise and robust empirical literature discerning the third stage of transmission dynamics for economies in general and India in particular, there remains a paucity of relevant research that examines how varied policy instruments affect financial market variables in the interregnum. The presence of long transmission lags together with market imperfections impose considerable challenges in deciphering the actual magnitude and timing of the impact of these monetary policy instruments. There also remains a paucity of relevant literature on whether these monetary policy instruments have any instantaneous impact on financial market variables. Taking India as a case study, the only study that has made an attempt in this regard is that by Goyal (2020), which uses an event-study approach to estimate the instantaneous impact of repo rate changes on money markets within a regression model. Even though studies based on event methodology are successful in unravelling the policy impact on announcement days and mitigating endogeneity issues, they are marred by outliers in the dataset. In addition, ambiguity prevails on the choice of the most potent monetary policy instrument to assess the signalling effect of policy rate changes on various financial market variables.

Likewise, reviewing the scare empirical literature on the impact of policy rate changes on stock market indices for the Indian economy, we

find that most studies have either examined the impact of a single monetary policy instrument on stock market indices on days of monetary policy announcements (Agarwal, 2007; Sasidharan, 2009; Ray & Prabu, 2013) or have analysed the dynamic interlinkages between the monetary policy instrument and various financial market variables (stock price indices being one of them) over different monetary policy regimes (Bhattacharya & Sensarma, 2008[1]; Prabu & Ray, 2019). As there is an unavailability of high-frequency intraday days that truly capture the instantaneous signalling impact of monetary policy announcements on stock price indices, the findings obtained from prior empirical work on the instantaneous impact of monetary policy changes on stock price indices for India are of limited insight.

Furthermore, no studies in the Indian context have investigated the instantaneous impact of monetary policy changes on exchange rates. Few studies have made an attempt in this regard, such as those by Zettelmeyer (2004) and Kearns and Manners (2006), which employed high frequency data (daily or intraday) to capture the surprise effect of monetary policy decisions via changes in money market rates on exchange rates for a group of developed economies. However, these studies failed to examine the anticipated effect of monetary policy decisions via changes in monetary policy instruments as they assumed it to be already present in the exchange rate for markets knew for certain that there would be a change in monetary policy decisions.

To have a clear understanding of the transmission of monetary policy impulses during the first stage of the transmission dynamics, this study examines the instantaneous impact of various monetary policy instruments on market interest rates within an OLS regression model based on daily data while controlling for monetary policy announcement days and days before the announcement day. The study further investigates whether there are any asymmetric effects of monetary policy instruments on various market rates over the chosen time span. This is done by empirically examining the magnitude of policy rate changes on market interest rates during different phases of the policy cycle, i.e., expansionary and contractionary. Second, unlike prior research that examines the impact of a single money market rate on stock price indices, our study makes a novel attempt to unravel the impact of monetary policy decisions via changes in both monetary policy instruments and money market rates on stock price indices and exchange rates. This is done by isolating anticipated and unexpected changes in monetary policy. Monetary policy decisions via changes in policy instruments capture the anticipated component of monetary policy, and changes in money market rates capture the surprise component of monetary policy decisions. Finally, the study examines the

first stage of transmission dynamics over two distinct monetary policy regimes in India: the Multiple Indicator Targeting Regime (2001-2016) and the Flexible Inflation Targeting Regime (2016–2023).

The paper is organised as follows. Section 2 briefly discusses the monetary policy instruments and financial market variables used over different periods. Section 3 discusses the regression model employed in this study. Section 4 discusses the empirical results. Section 5 provides a summary and analysis of the results for different periods. Section 6 provides a summary and conclusion on the findings of the study.

2. Choice of Monetary Policy Instruments and Financial Market Variables

Since the periods of regime changes in India's monetary policy framework have been outlined in earlier studies, this study schematically tries to determine the impact of varied monetary policy instruments used by the RBI: cash reserve ratio (CRR), bank rate (BR), repo rate (R), marginal standing facility (MSF), and standing deposit facility rates on market interest rates, namely 91-day treasury bill rate, 10-year Gsec yields, and call money rates. Next, we empirically examine the impact of all monetary policy instruments, market rates, and stock price indices (NIFTY 500) on exchange rates (USD, Pound sterling and Euro). We further examine the impact of all the monetary policy instruments, market rates, and the exchange rate (USD) on the stock price indices (BSE100 AND NIFTY 500). This sequential exercise constitutes the first stage of monetary policy transmission. The choice of monetary policy instruments and the various market interest rates employed for the two regimes (Multiple Indicator Targeting Regime and Flexible Inflation Targeting Regime) are defined in Table 1.

Table 1: Monetary Policy Instruments and Market Rates

Monetary Policy Instrument/ Market Rates	*Definition*
Bank Rate (BR)	The rate at which the Reserve Bank buys or rediscount bills of exchange or other commercial papers. The Bank Rate acts as the penal rate charged on banks for meeting temporary mismatches in their reserve requirements (Cash reserve ratio and Statutory liquidity ratio). This rate has been aligned with the MSF rate and, changes automatically as and when the MSF rate changes alongside policy repo rate changes.
Cash Reserve Ratio (CRR)	It is the percent of Net Demand and Time liabilities (NDTL) that a commercial bank is required to maintain as average daily cash balances with the Reserve Bank of India (RBI) and is notified by the RBI from time to time in the Gazette of India.

Monetary Policy Instrument/ Market Rates	*Definition*
Repo Rate (R)	It is a fixed rate of interest at which the Reserve Bank provides liquidity under the liquidity adjustment facility (LAF) to all LAF participants against the collateral of government and other approved securities.
Marginal Standing Facility rate (MSF)	It is the penal rate of interest at which banks borrow additional money on an overnight basis, from the Reserve Bank by dipping into their Statutory Liquidity Ratio (SLR) portfolio up to a predefined limit (2 per cent). This provides a safety valve against unanticipated liquidity shocks to the banking system.
Standing Deposit Facility rate (SDF)	It is the rate at which the RBI accepts uncollateralised deposits, on an overnight basis, from all LAF participants. The SDF also serves a financial stability tool in addition to its role in liquidity management. With introduction of SDF in April 2022, the SDF rate replaced the fixed reverse repo rate as the floor of the LAF corridor.
91 Day Treasury Bill Rate (TB)	These are short term debt instruments issued by the Government of India (GOI) in 91-day tenor. These are zero coupon securities and pay no interest. These are issued at a discount and redeemed at the face value on maturity.
10-year GSec yield (TYB)	These are long term debt instruments issued by the Central government for ten years and acknowledge the Government's debt obligation and are issued through auctions conducted by the RBI.
Call Money Market rates (CMR)	It is the interbank rate at which surplus funds are traded amongst banks on an unsecured basis to meet temporary mismatches and /or to meet the CRR/SLR mandates of the bank.it refers to the borrowing or lending of funds for one day.

3. Impact of Monetary Policy Instruments on Market Rates

3.1. Model Specifications

$$\Delta Y_t = \alpha + \beta_1 \Delta X_t + \beta_2 D_1 + \beta_3 D_2 + \beta_4 \Delta X_t * D_3 + \beta_5 \Delta X_t * D_4 + \mu_t \text{ Eq} \quad (1)$$

Where:

- $\Delta \mathbf{Y}_t$ = One-day change in the market rate of interest (TB/TYB/CMR)
- $\mathbf{X}_t$ = One-day change in the monetary policy rate (BR/CRR/R/MSF)
- $\mathbf{D}_1$ = Dummy variable that takes a value 1 if the t-th day is a policy day and zero otherwise.
- $\mathbf{D}_2$ = Dummy variable that takes a value 1 if the t-th day is a day before the policy day and zero otherwise.

- $\mathbf{D_3}$=Dummy variable for monetary policy stance that takes the value 1 during the periods of an expansionary monetary policy (Decline in BR/CRR/R/MSF) and in the subsequent periods until a policy reversal occurs. Likewise, the dummy variable takes the value 0 during the periods of a contractionary monetary policy (Increase in BR/CRR/R/MSF) and in the subsequent periods until a policy reversal occurs.
- $\Delta\mathbf{X_t}$ *$\mathbf{D_3}$=Interaction term to test the asymmetric impact of the monetary policy stance, if any.

The regression model takes a one-day change in the policy rates as one of the independent variables and tests if its coefficient is significant when changes in various market rates are regressed. The coefficient of " X_t **(**$\hat{a}_1$) is expected to be positive and determines the impact of monetary policy on market rates of interest. In addition, the monetary policy rate is anticipated to either increase/decrease or remain the same on policy days and hence involves much speculation. This policy day effect is assumed to impact different segments of the market instantaneously. The coefficient of $\mathbf{D_1}$ **(**$\beta_{2)}$ is expected to be positive and determines the impact of monetary policy announcement days on various market rates.

Nevertheless, as market speculation may already be ripe a day before the announcement day in anticipation of the change in monetary policy stance, we include a dummy for the day before the policy day to capture the effect of market expectations. The coefficient of D_2 **(**β_3) too is expected to be positive and determines the day prior impact of market expectations on market rates. The specification further includes the interaction term - $\Delta\mathbf{X_t}$ *$\mathbf{D_3}$ whose coefficients β_4 indicates the differential impact of expansionary and contractional monetary policy stances on various market rates.

3.2. Empirical Result: Impact of Monetary Policy Instruments on Market Rates

3.2.1. Impact of Bank Rates on Market rates

Table 2 reveals the impact of the bank rate on various market rates for the two periods. The regression results obtained reveal that a one-day change in bank rates (BR) has a significant positive impact on the 10-year government bond rate (TYB) during the Flexible Inflation Targeting regime in India.

3.2.2. Impact of Cash Reserve Ratio (CRR) on Market rates

Table 3 reveals the impact of the Cash Reserve Ratio on various market rates for the two periods. The findings reveal that changes in the cash

Table 2: Impact of Bank Rates on Market Rates

Variable Bank Rate (BR)	*91 Day Treasury Bill* $\Delta Y_t(\Delta TB)$		*10-year Government Bond Rate* $\Delta Y_t(\Delta TYB)$		*Call Money Market rate* $\Delta Y_t(\Delta CMR)$	
	Period 1 (2001-2016)	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2016)*
$\Delta X_t(\Delta BR)$	7.67e	0.043	0.005	0.126***	0.0739	-0.037
	(-0.997)	(-0.37)	(-0.733)	(-0.009)	(-0.858)	(-0.844)
D1	0.0006	-0.004	0.0025	0.016	0.0239	-0.041
	(-0.957)	(-0.649)	(-0.732)	(-0.093)	(-0.909)	(-0.289)
D2	-0.003	-0.0005	-0.0053	-0.009	0.203	0.006
	(-0.767)	(-0.948)	(-0.441)	(-0.223)	(-0.304)	(-0.848)
ΔX_t *D3	0.016	0.0013	-0.0532	0.056	0.175	0.524
	(-0.825)	(-0.986)	(-0.199)	(-0.46)	(-0.883)	(-0.0821)
C	-0.0002	8.56e	-0.0008	0.0002	-0.004	0.0016
	(-0.886)	(-0.994)	(-0.385)	(-0.862)	(-0.881)	(-0.742)
R sq	0.00003	0.0016	0.00075	0.0182	0.00004	0.0088

All the Δ variables are in percentage values are reported in the parentheses. ** and *** denote statistical significance at 5% and 1% respectively.

Table 3: Impact of Cash Reserve Ratio on Market rates

Variable Cash Reserve Ratio (BR)	*91 Day Treasury Bill* $\Delta Y_t(\Delta TB)$		*10-year Government Bond Rate* $\Delta Y_t(\Delta TYB)$		*Call Money Market rate* $\Delta Y_t(\Delta CMR)$	
	Period 1 (2001-2016)	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2016)*
$\Delta X_t(\Delta CRR)$	0.001	0.0036	0.0314	-0.016	2.937**	0.259
	(-0.985)	(-0.947)	(-0.489)	(-0.756)	(-0.0208)	(-0.241)
D1	-0.0003	-0.0055	0.0052	0.0153	-0.006	-0.073**
	(-0.978)	(-0.491)	(-0.455)	(-0.0581)	(-0.975)	(-0.0218)
D2	-0.003	-0.0005	-0.005	-0.009	0.192	0.006
	-0.767	-0.947	(-0.435)	(-0.222)	(-0.331)	(-0.843)
ΔX_t *D3	-0.001	-0.009	-0.036	0.228***	-0.424	0.339
	(-0.984)	(-0.902)	(-0.46)	(-0.002)	(-0.76)	(-0.251)
C	-0.0002	1.78e	0.0009	0.0002	-0.003	0.0014
	(-0.883)	(-0.988)	(-0.37)	(-0.834)	(-0.903)	(-0.77)
R sq	0.00002	0.0003	0.00004	0.013	0.009	0.011

All the Δ variables are in percentage values are reported in the parentheses. ** and *** denote statistical significance at 5% and 1% respectively.

reserve ratio (CRR) have a significant positive impact on call money market rates (CMR) during the Multiple Indicator Targeting regime in India. However, we do not find any significant impact of Cash Reserve Ratio (CRR) on 91-day Treasury Bills (TB) and 10-year Government Bond rate (TYB) in any of the periods. During the Flexible Inflation Targeting regime, however, we find the D1 coefficient to be negative and significant for call money market rates, implying that on policy days, the consequent changes in CMR are lower in absolute terms than on other days. This suggests that call money market rates are less responsive to CRR on policy days. Nonetheless, we find the coefficient for $\ddot{A}X_t$*D3 to be positive and significant for the 10-year government bond (TYB) rate during the Flexible Inflation Targeting regime, implying that when there is a reduction in CRR (expansionary monetary policy), the consequent decline in TYB is higher in absolute terms than when there is an increase in CRR. This suggests that decreases in CRR had a stronger impact on TYB than when CRR was increased during the Flexible Inflation Targeting regime.

3.2.3. Impact of Repo rate (R) on Market rates

The results obtained from the regression exercise in Table 4 do not find any significant impact of Repo rate changes on 91-day Treasury Bill rates and Call money market rates in both regimes. This finding casts serious doubts on the RBI's move of adopting the repo rate as the policy rate and the call money market as the operating target of monetary policy during the Flexible Inflation Targeting regime. However, we do find that with a reduction in the repo rate (expansionary monetary policy), the consequent decline in the call money market is higher in absolute terms than when there is an increase in the repo rate. This suggests that decreases in repo appear to have had a stronger impact on the call money market rate as compared to when the repo rate was increased during the Flexible Inflation Targeting regime.

However, we find the 10-year government bond to react significantly to the repo rate during the Multiple Indicator Targeting regime. In addition, these 10-year government bonds are more responsive to repo rate changes on monetary policy announcement days. Nonetheless, like the impact of the cash reserve ratio, we find the coefficient for $\ddot{A}X_t$*D3 to be positive and significant for the 10-year government bond rate during the Flexible Inflation Targeting regime, implying that when there is a reduction in the repo rate (expansionary monetary policy), the consequent decline in TYB is higher in absolute terms than when there is an increase in the repo rate. This suggests that decreases in the repo rate have a stronger impact on TYB than when the repo rate was increased during the Flexible Inflation Targeting regime (FIT).

Table 4: Impact of Repo rate (R) on Market Rates

Variable Repo Rate	*91 Day Treasury Bill* $\Delta Y_t(\Delta TB)$		*10-year Government Bond Rate* $\Delta Y_t(\Delta TYB)$		*Call Money Market rate* $\Delta Y_t(\Delta CMR)$	
(R)	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2016)*
$\Delta X_t(\Delta R)$	0.0309	0.043	0.107***	0.042	-0.0123	-0.218
	(-0.661)	(-0.367)	(-0.007)	(-0.384)	(-0.91)	(-0.25)
D1	-0.003	-0.0004	0.0009	0.0249***	0.085	-0.007
	(-0.814)	(-0.638)	(-0.902)	(-0.01)	(-0.7)	(-0.853)
D2	-0.0036	-0.0005	-0.005	-0.009	0.2014	0.005
	(-0.767)	(-0.948)	(-0.429)	(-0.222)	(-0.31)	(-0.848)
ΔX_t *D3	-0.0457	0.0042	-0.024	0.188**	1.685	1.023***
	(-0.589)	(-0.955)	(-0.615)	(-0.013)	(-0.227)	(-0.0006)
C	-0.0002	8.53e	-0.0007	0.0002	-0.002	0.0016
	(-0.884)	(-0.994)	(-0.464)	(-0.847)	(-0.945)	(-0.733)
R sq	0.0001	0.0016	0.0055	0.0017	0.0018	0.015

All the Δ variables are in percentage values are reported in the parentheses. ** and *** denote statistical significance at 5% and 1% respectively.

3.2.4. Impact of Marginal Standing Facility Rate (MSF) on Market Rates

The results from Table 5 reveal that changes in MSF do not have any impact on treasury bill rates and call money market rates.

Table 5: Impact of Marginal Standing Facility Rate (MSF) on Market Rates

Variable Marginal Standing Facility	*91 Day Treasury Bill* $\Delta Y_t(\Delta TB)$		*10-year Government Bond Rate* $\Delta Y_t(\Delta TYB)$		*Call Money Market rate* $\Delta Y_t(\Delta CMR)$	
(MSF)	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2016)*
$\Delta X_t(\Delta MSF)$	0.0145	0.044	0.0018	0.1319***	0.101	-0.0249
	(-0.577)	(-0.36)	(-0.973)	(-0.006)	(-0.642)	(-0.895)
D1	0.006	-0.004	-0.005	0.0141	0.003	-0.0472
	(-0.522)	(-0.616)	(-0.804)	(-0.143)	(-0.97)	(-0.215)
D2	-0.0001	-0.0002	-0.011	-0.008	0.260***	0.009
	(-0.988)	(-0.978)	(-0.554)	(-0.282)	(-0.0004)	(-0.772)
ΔX_t *D3	-0.083	0.0006	0.006	0.039	0.102	0.488
	(-0.088)	(-0.993)	(-0.951)	(-0.592)	(-0.802)	(-0.097)
C	-0.0014	8.37e	-0.0001	0.0002	-0.007	0.0016
	(-0.36)	(-0.994)	(-0.961)	(-0.863)	(-0.538)	(-0.742)
R sq	0.0042	0.0016	0.0003	0.0175	0.009	0.008

All the Δ variables are in percentage values are reported in the parentheses. ** and *** denote statistical significance at 5% and 1% respectively.

However, the marginal standing facility rate has a significant positive impact on 10-year government securities yields during the Flexible Inflation Targeting regime. In addition, call money market rates are responsive to MSF rates on days before monetary policy days, signifying that expectations regarding MSF changes are high and there is much speculation regarding MSF changes.

3.2.5. Impact of the Standing Deposit Facility Rate (SDF) on Market Rates (April 2022-February 2023)

The results from Table 6 do not reveal any significant impact of SDF rates on Treasury bill rates and the call money market rate. However, similar to the findings obtained for other policy instruments, 10-year government bond rates do react significantly to changes in the SDF rate. In addition, we find the coefficient for ΔX_t*D3 to be negative and significant for the 10-year government bond rate during the period, implying that when there is a reduction in the SDF rate (expansionary monetary policy), the consequent decline in TYB is lower in absolute terms than when there is an increase in the SDF rate. This suggests that increases in the SDF rate have a stronger impact on TYB than when the SDF rate was decreased during the Flexible Inflation Targeting regime.

Table 6: Impact of the Standing Deposit Facility Rate (SDF) on Market Rates

Variable Standing Deposit Facility (SDF)	*91 Day Treasury Bill* $\Delta Y_t(\Delta TB)$	*10-year Government Bond Rate* $\Delta Y_t(\Delta TYB)$	*Call Money Market rate* $\Delta Y_t(\Delta CMR)$
	Period (2022-2023)	*Period (2022-2023)*	*Period (2022-2023)*
$\Delta X_t(\Delta SDF)$	-0.0326	0.6502***	0.0132
	(-0.857)	0	(-0.98)
D1	0.181	-0.006	0.495
	(-0.184)	(-0.936)	(-0.232)
D2	0.0179	-0.008	0.047
	(-0.585)	(-0.665)	(-0.635)
ΔX_t*D3	-0.373	-0.521**	-1.318
	(-0.603)	(-0.0174)	(-0.233)
C	0.013	-0.0001	0.014
	(-0.0121)	(-0.725)	(-0.348)
R sq	0.0101	0.1709	0.011

All the Δ variables are in percentage values are reported in the parentheses. ** and *** denote statistical significance at 5% and 1% respectively.

3.2.6. Period-wise Analysis of the Impact of Monetary Policy Instruments on Market Rates

Critically analysing the impact of monetary policy instruments for both regimes, it is evident that the bank rates proved ineffective in influencing

most financial market rates during the Multiple Indicator Targeting regime. This finding appears intuitive because of the easing of the monetary policy stance during this regime. India amassed huge capital inflows, which resulted in surplus accumulation of domestic liquidity. In lieu of large liquidity prevailing in the economy, banks failed to avail refinancing. The amount of liquidity available at the bank rate therefore gradually declined during this period. However, CRR proved effective in influencing the call money rate during this period. Nonetheless, the impact of the Repo rate on the 10-year government bond rate appeared positive and significant. This appears intuitive as repo rate auctions under laugh became the principal instrument of modulating short-term liquidity during this period.

During the Flexible Inflation Targeting Regime, the bank rate, however, emerged as an important signalling instrument of monetary policy as it significantly impacted the 10-year government bond rate. The CRR, however, proved ineffective in modulating liquidity. This finding appears logical as the RBI began to place less emphasis on CRR as an instrument of monetary control to abide by its mandate of reducing reserve requirements to their statutory minimum level. Furthermore, laugh operations through repo auctions did not have any impact on any of the chosen market rates. However, we find the 10-year government bond to be more responsive to repo rate changes on monetary policy announcement days. Moreover, as a result of an expansionary monetary policy, decreases in the repo rate appeared to have a stronger impact on TYB and CMR as compared to when the repo rate was increased during the Flexible Inflation Targeting regime. Marginal standing facility rates, which were introduced to meet the short-term liquidity requirements of scheduled commercial banks, failed to have any impact on the Treasury bill rates and the 10-year government bond rate.

Our results further find primacy of the 10-year government bond rates (TYB) during both the Multiple Indicator Targeting regime and the Flexible Inflation Targeting regime as it is significantly impacted by at least one of the monetary policy instruments. On the contrary, 91-day Treasury Bills (TB) remained unresponsive to all monetary policy instruments in both regimes. Lastly, call money rates remained responsive only to the cash reserve ratio during the Multiple Indicator Targeting regime, giving credence to the RBI's monetary policy stance of adopting call money rates as the operating target during the Flexible Indicator regime. However, contrary to expectations, call money rates have remained unresponsive to any of the monetary policy instruments during the Flexible Inflation Targeting regime, casting serious doubts on the RBI's practise of using call money rates as an operating target

4. Impact of Monetary Policy Instruments and Market Rates on Exchange rates

4.1. Model Specifications

$$\Delta Z_t = \alpha + \beta_1 \Delta A_t + \beta_2 \Delta B_t + \beta_3 \Delta C_t + \beta_4 \Delta M_t + \beta_5 \Delta N_t + \beta_6 \Delta X_t + \beta_7 D_1 + \beta_8 D_2 + \mu_t \quad (2)$$

Where:

- $\mathbf{\Delta Z_t}$ = One-day change in exchange rates of the Indian Rupee per unit of foreign currency (USD/POUND/EURO)
- $\mathbf{A_t}$ = One-day change in the Bank Rate (BR)
- $\mathbf{B_t}$ = One-day change in the cash reserve ratio (CRR)
- $\mathbf{C_t}$ = One-day change in the Repo Rate(R)
- $\mathbf{M_t}$ = One-day change in 10-year government securities (TYB)
- $\mathbf{N_t}$ = One-day change in the call money market rate (CMR)
- $\mathbf{X_t}$ = One-day change in the stock price index (NIFTY500)
- $\mathbf{D_1}$ = Dummy variable that takes a value 1 if the t-th day is a policy day and zero otherwise.
- $\mathbf{D_2}$ = Dummy variable that takes a value 1 if the t-th day is a day before the policy day and zero otherwise.

The regression model takes a one-day change in the policy rates as one of the independent variables and tests if its coefficient is significant when one-day changes in exchange rates are regressed on it. The coefficient of ΔA_t, ΔB_t and ΔC_t (β_1, β_2, β_3) are expected to be positive and determine the impact of various monetary policy instruments[2] (BR, CRR, R) on exchange rates. Furthermore, the coefficient of ΔM_t, and ΔN_t (β_4, β_5) are also expected to be positive and determine the impact of various market rates[3] (TYB and CRR) on exchange rates.

In addition, we examined the impact of the stock price index (NIFTY500) on the exchange rate as a rising domestic stock market increase investors' confidence in the country's rising economy, which leads to increased interest from foreign investors. This increases the demand for the domestic currency, which results in an appreciation of the domestic currency. Conversely, if the stock market underperforms, confidence falters and foreign investors take their funds back to their own currencies, which causes the domestic currency to depreciate. Hence, the coefficient of ΔX_t (β_7) is expected to be negative, implying that the NIFTY 500 stock price index exhibits an inverse relationship with the exchange rates of the Indian Rupee per unit of foreign currency.

The monetary policy rate is anticipated to either increase/decrease or remain the same on policy days and hence involves much speculation. Hence, we include a dummy D1 to capture the policy day announcement effect on exchange rates. Nevertheless, as market speculation may already be ripe a day before the announcement day in anticipation of the change in monetary policy stance, we include a dummy for the day before the policy day. The coefficient of D_2 determines whether the day before the policy day has any significant impact on the exchange rates. The inclusion of a dummy for a day before the policy announcement day reflects market participants' expectations about the monetary policy stance.

4.2. Empirical Results

Table 7 reveals the coefficients obtained by estimating Equation (2) for the Multiple Indicator regime and the Flexible Inflation Targeting regime in India. During the Multiple Indicator Targeting regime, none of the monetary policy instruments (BR, CRR, R) have any significant impact on the exchange rates per unit of domestic currency. However, an increase in CRR has a significant impact on the pound per unit of Indian currency (P/INR) and causes an appreciation of the domestic currency. In contrast, during the same period, increases in CRR led to depreciation of domestic currency in terms of the US dollar, showing evidence of an exchange rate puzzle. Similarly, 10-year g-sec securities, which serve as a proxy for interest rates, cause the domestic currency to depreciate in terms of USD, Pound, and Euro during both monetary policy regimes. Nonetheless, CMR, which is chosen as the operating target during the Flexible Inflation Targeting regime, fails to have the desired impact on domestic currency and reveals evidence of an exchange rate puzzle. In addition, on the day prior to the monetary policy announcement, the domestic currency depreciated in terms of USD dollar, implying that there is not much speculation in the market as market participants do not have much credibility on the RBI's policy stance. However, in conformity with the portfolio balance approach, we obtained a significant negative coefficient for the stock market index (NIFTY500) for both regimes, suggesting that as the domestic stock market blooms, it attracts capital inflows from foreign investors, thereby causing an increase in the demand for a domestic currency and vice versa.

Broadly, this evidence is suggestive of the fact that rate instruments of monetary policy (BR, R, MSF) did not have any instantaneous impact on exchange rates in any of the regimes. Contrary to the diminishing emphasis on CRR as an instrument of monetary policy control by the RBI, we find it to have a significant negative impact on USD/INR during the Flexible Inflation Targeting regime, implying that quantum instruments

Table 7: Impact of Monetary Policy Instruments and Market Rates on Exchange rates

Variable	*BSE100* $\Delta Y_t(\Delta B100)$		*NIFTY500* $\Delta Y_t(\Delta N500)$	
	Period 1 (2001-2016)	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*
$\Delta X_t(\Delta BR)$	-4.078	-358.38**	-3.676	-293.37**
	(-0.855)	(-0.0297)	(-0.835)	(-0.0417)
$\Delta Z_t(\Delta CRR)$	-38.032	128.39	-23.809	94.28
	(-0.22)	(-0.267)	(-0.329)	(-0.351)
$\Delta M_t(\Delta R)$	-41.705	416.338**	-26.287	338.72**
	(-0.249)	-0.0128	(-0.355)	(-0.0205)
$\Delta B_t(\Delta TYB)$	-113.62***	119.02	-100.12***	50.255
	0	(-0.0907)	0	(-0.413)
$\Delta C_t(\Delta CMR)$	-0.558	-9.732	-0.1597	-11.681
	(-0.614)	(-0.579)	(-0.854)	(-0.446)
$\Delta L_t(\Delta USD)$	-82.988***	-182.22***	-63.316***	-149.95***
	0	0	0	0
D1	-10.694	-14.812	-8.363	14.682
	(-0.306)	(-0.497)	(-0.369)	(-0.442)
D2	10.614	33.65	7.523	27.405
	(-0.363)	(-0.121)	(-0.412)	(-0.419)
C	3.091	6.542	2.519	5.308
	(-0.0916)	(-0.0560)	(-0.0804)	(-0.0761)
R sq	0.0598	0.0996	0.0576	0.0902

All the Δ variables are in percentage values are reported in the parentheses. ** and *** denote statistical significance at 5% and 1% respectively.

of monetary policy are effective conduits in the transmission of monetary policy. Hence, the RBI should make prudent use of CRR to maintain long-term liquidity while keeping in mind its statutory obligations.

5. Impact of Monetary Policy Instruments and Market Rates on Stock Price Indices

5.1. Model Specifications

$$\Delta Z_t = \alpha + \gamma_1 \Delta A_t + \gamma_2 \Delta B_t + \gamma_3 \Delta C_t + \gamma_4 \Delta M_t + \gamma_5 \Delta N_t + \gamma_6 \Delta X_t + \gamma_7 D_1 + \gamma_8 D_2 + \mu_t \quad (3)$$

Where:

- ΔZ_t = One-day change in the stock price index (BSE100/NIFTY 500)
- A_t= One-day change in the Bank Rate (BR)
- B_t= One-day change in the cash reserve ratio (CRR)
- C_t= One-day change in the Repo Rate(R)

- M_t= One-day change in 10-year government securities (TYB)
- N_t= One-day change in the call money market rate (CMR)
- X_t= One-day change in the exchange rate (USD/INR)
- D_1= Dummy variable that takes a value 1 if the t-th day is a policy day and zero otherwise.
- D_2= Dummy variable that takes a value 1 if the t-th day is a day before the policy day and zero otherwise.

The regression model takes a one-day change in the monetary policy rates[4] (BR, CRR, R), market rates (TYB and CMR), and exchange rates (USD/INR) as independent variables and tests if their coefficients are significant when one-day changes in the stock price index are regressed on it. The coefficient of ΔA_t, ΔB_t and ΔC_t (γ_1, γ_2, γ_3) are expected to be negative and determine the impact of various monetary policy instruments[5] (BR, CRR, R) on stock price indices. Furthermore, the coefficient of ΔM_t, and ΔN_t (γ_4, γ_5) are also expected to be negative and determine the impact of various market rates (TYB and CRR) on stock prices. Likewise, the coefficient of ΔX_t (γ_6) can either be positive or negative, and the exchange rates (USD/INR) can exhibit either a symmetric or an asymmetric impact on the stock price indices. The impact of the exchange rate on stock price may be symmetric; that is, depreciation of the real exchange rate increases the real stock price, whereas appreciation of the real exchange rate decreases the real stock price. Likewise, an exchange rate appreciation or depreciation may show significant asymmetries in the stock prices of firms. A depreciating currency implies cheaper prices of exports, as a result of which it increases the exports and profits of firms, and as a result, the real stock prices increase. In contrast, a depreciation of the real exchange rate increases the costs of imported inputs for firms, which could increase selling prices and hence reduce sales and profits. Thus, the real stock price of the firms decreases. Likewise, an appreciating currency can increase the costs of imported inputs and thus lead to lower profit and real stock price, whereas appreciation of the real exchange rate can also reduce the costs of imported inputs and thus lead to more profit and higher real stock price.

The monetary policy rate is anticipated to either increase/decrease or maintain a status quo on policy days and hence involves much speculation. To capture this policy day effect, we incorporated a dummy variable (D1) which ascertained whether policy days had any immediate impact on stock prices. Nevertheless, as market speculation may already be ripe a day prior to the announcement day in anticipation of the change in monetary policy stance, we included a dummy D2 for the day prior to the policy day. The

coefficient of D_2 determined whether the day before the policy day had any significant impact on stock prices. The inclusion of a dummy for a day before the policy announcement day reflects market participants' expectations about the monetary policy stance due to much speculation in the markets.

5.2. Empirical Results

Table 8 reveals the coefficients obtained from estimating Equation (3) for the Multiple Indicator regime and Flexible Inflation Targeting regime in India. During the Multiple Indicator Targeting regime, none of the monetary policy instruments (BR, CRR, R) have any significant instantaneous impact on stock prices. However, the 10-year government bond rate does lead to a decline in stock prices during this regime. Furthermore, a depreciation of domestic currency leads to a significant decline in stock prices, possibly due to an increase in the costs of imported inputs for firms, which increases selling prices and concomitantly reduces sales and profits. Consequently, the real stock price of the firms decline.

Table 8: Impact of Monetary Policy Instruments and Market Rates on Stock Prices

Variable	*US DOLLAR/INR* $\Delta Z_t(\Delta USD)$		*POUND/INR* $\Delta Z_t(\Delta P)$		*EURO/INR* $\Delta Z_t(\Delta E)$	
	Period 1 (2001-2016)	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*	*Period 1 (2001-2016)*	*Period 2 (2016-2023)*
$\Delta A_t(\Delta BR)$	-0.0561	-0.327	-0.125	-0.349	-0.0976	-0.257
	(-0.356)	(-0.238)	(-0.347)	(-0.6)	(-0.347)	(-0.688)
$\Delta B_t(\Delta CRR)$	0.1604	0.480**	-0.073	-1.143**	0.0953	-0.86
	(-0.0569)	(-0.0136)	(-0.692)	(-0.0145)	(-0.507)	(-0.0869)
$\Delta C_t(\Delta R)$	0.076	-0.0274	0.0485	0.528	0.008	0.248
	(-0.438)	(-0.922)	(-0.821)	(-0.435)	(-0.961)	(-0.705)
$\Delta M_t(\Delta TYB)$	0.0191**	0.837***	0.6153***	0.367	0.3147**	0.818***
	(-0.0213)	0	(-0.0007)	(-0.189)	(-0.0264)	(-0.0002)
ΔN_t	-0.002	0.0577**	-0.0114	0.0124	-0.0058	0.0538
(ΔCMR)	(-0.481)	(-0.05)	(-0.0634)	(-0.861)	(-0.2551)	(-0.365)
ΔX_t	-0.0007***	-0.0005***	-0.0004***	0.0002	-0.0005***	-0.0003***
(ΔNIFTY 500)	0	0	(-0.0837)	(-0.0688)	0	(-0.0008)
D1	-0.0293	-0.0211	0.0208	0.1507	0.0117	-0.0892
	(-0.36)	(-0.565)	(-0.766)	(-0.0885)	(-0.083)	(-0.275)
D2	-0.0309	0.0917**	-0.0846	0.0637	0.006	0.145
	(-0.328)	(-0.0121)	(-0.221)	(-0.466)	(-0.906)	(-0.0441)
C	0.0112**	0.0109	0.003	0.003	0.007	0.0143
	(-0.0238)	(-0.0579)	(-0.727)	(-0.825)	(-0.383)	(-0.222)
R sq	0.0546	0.122	0.01	0.0101	0.0139	0.0322

All the Δ variables are in percentage values are reported in the parentheses. ** and *** denote statistical significance at 5% and 1% respectively.

During the Flexible Inflation Targeting regime, the bank rate seems to have a significant negative impact on stock prices in line with the asset price channel of monetary policy transmission. However, a significant positive impact of the Repo rate on both stock price indices is at odds with the conventional dynamics of the asset price channel. Nonetheless, similar to the results obtained during the Multiple Inflation Targeting Regime in India, a depreciation of domestic currency caused stock prices to decline because of an increase in the costs of imported inputs for firms, which increased selling prices, reduced sales and profits, and thereby led to a decline in stock prices. This implies that when the dollar strengthens, the domestic currency weakens and everything in the domestic economy appears cheaper, including the cost of stocks. Similarly, 10-year g-sec securities lead to a decline in the stock prices of firms in conformity with the interest rate channel of monetary policy transmission.

6. Concluding Observations

As discussed earlier, monetary policy transmission is a three stage process wherein the monetary policy instruments affect different financial market variables in the first stage, i.e. money market rates, stock indices, bond yields, and exchange rates; in the second stage, monetary policy impulses are transmitted to the credit markets via lending and deposit activities; and finally, the impact of these financial market rates and the credit market variables is transmitted to the real economic variables, i.e., domestic output and inflation. Our study examines the signalling effect of various monetary policy instruments on different financial market variables, i.e., the first stage of transmission. The results indicate that the monetary transmission dynamics varies not only across various segments of the financial markets and but are also sensitive to the monetary policy tools used by the RBI under different monetary policy regimes.

Our results further find the call money market and overnight MIBOR rates during both regimes to be significantly impacted by most monetary policy instruments. However, exchange rates and the stock market index remain unresponsive to all monetary policy instruments. Expectedly, the 91-day Treasury Bill rates and government bonds respond significantly to all monetary policy instruments. Broadly, this evidence is suggestive of the fact that monetary policy transmission is instantaneous in short-term money markets and thus highlights the necessity of effective monetary policy signalling and the importance of the interbank money market in transmission dynamics. In addition, the finding that call money rates remain less unresponsive to policy rate changes on announcement days indicates that there exists unanimity in the markets with respect to the

RBI's monetary policy stance. Hence, future research should focus on unravelling the signalling effect of monetary policy instruments on all money market variables. This would help in deciphering the relative efficacy and credibility of the RBI's operating target, i.e., the call money rate vis-a-vis other short-term money market rates that are instantaneously impacted by monetary policy signals in India.

Thus, it is imperative that the RBI effectively communicates its policy stance to market participants in a bid to heighten the efficacy of monetary policy signals and thereby ensure stability of macro fundamentals.

Notes

1. Bhattacharya and Sensarma(2008) examined the impact of various monetary policy instruments (Bank rate, CRR and Repo rate) on financial market variables (money, bonds, exchange and the stock markets) in the pre- and post-LAF (Liquidity Adjustment Facility) era for the Indian economy, which is bifurcated into two periods: (1998–2001) and (2001-2006).
2. The Variance Inflation Factors find evidence of multicollinearity between the Bank rate and the Marginal Standing Facility rate for both regimes. The marginal standing rate was introduced by the RBI to modulate liquidity only in 2011. Dropping the MSF rate from the specification removes the problem of multicollinearity. Hence, we exclude the MSF rate as an independent variable in our specification.
3. We refrain from examining the impact of the 91-day treasury bill rate on the exchange rates during both the Multiple Indicator Targeting Regime and the Flexible Inflation Targeting regime because the 91-day treasury bill rates remain unresponsive to monetary policy rate changes, as revealed by estimating Equation 1 in the earlier section. Including the 91-day treasury bill in Equation 2 would give misleading results as changes in the said rates may be due to other exogenous changes and not necessarily due to changes in the monetary policy rates.
4. Based on Variance Inflation Factors, we find evidence of multicollinearity between the Bank rate and the MSF rate for both regimes; hence, we exclude the Marginal Standing rate from Eq (3), which removes the problem of multicollinearity.
5. As before, the specification includes all the monetary policy instruments because policy rate changes are the most primitive in monetary policy transmission dynamics.

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