

# An Evaluation of Monetary Policy in India: A SVAR Approach

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## Abstract

This paper sets an examination for the strength of the monetary policy transmission variables in India for the period 2000 to 2019 on the monthly basis. The variables incorporated in the model are Gross Domestic Product, Bank Rate, Wholesale Price Index and Exchange rate. The techniques of Structural Vector Autoregressive Model (SVAR) have been applied to perceive the clear picture of the contemporaneous relationship among the variables, thus providing with the relative importance and strength of each variable within the model. In the first place, all the variables were instituted to be statistically significant. At the same time, WPI and GDP are found to be more prominent, while exchange rate demanding a pivotal change in the working of the banking sector.

**Keywords:** monetary policy, Gross Domestic Product, Structural Vector Autoregressive Model, variable.

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## 1. INTRODUCTION

Regime turnarounds represent important milestones in the history of monetary policy, framing it and, in turn, being framed by it. The analytical substructure of monetary policy framework sustained a silent shift in the late 1990s (Reddy, 1999). In India, monetary policy endured a change, most strikingly in the middle of the 1980s when the authorities swapped their inclination to the explicit monetary policy targeting with the feedback purely based on the directions given in the report of the Committee to Review the Working of the Monetary System (henceforth known as the Chakravarty Committee). A brief phase of extensive guidelines of monetary policy, or "monetary targeting with feedback," was paved over the scope of administered stepping in the interest rates and flow of bank credit of the 1970s and 1980s. The expanding market positioning of monetary policy has possibly tilted the usage of instruments conclusively. Ensuring the optimal use of given resources, significant adjustments were brought in the internal debt policy in 1992-1993, acknowledging that pre-emption of the resources of the banking system must be brought to the minimal. The process of Interest rate deregulation was commenced across the different segments. All the sector-specific and use-specific interest rate prescriptions were allowed to be eliminated in September 1990, except for the loans under Rs. 200,000, subject to a minimum rate prescription. Given the monetary policy statement (April 1998), the Reserve Bank of India (RBI), also reported the switching towards

a multiple indicator approach so as to enlarge the scope of variables which could be studied, ignoring the particular reliance upon a single instrument variable namely a growth in broad money (M3). The 1990s' inception, structural and economic changes and later advancement towards more advanced policy regimes have given evaluation of monetary transmission mechanisms in developing economies a significant note. However, no empirical agreement on the precise operation and the relative significance of the various channels has been found. It has been a difficult process—the well-known "black box"—as numerous channels have been operating simultaneously to achieve the desired results. From the standpoint of the effectiveness of various policy tools and the timing of policy measures, channels of monetary policy transmission are crucial to identify and are therefore crucial to design and layout the monetary policy. Since none of the monetary policy channels act isolated, relevant feedbacks and interactions, need to be carefully pondered for a true interpretation of the transmission mechanism (Governor *et al.*, 2002). Thus, it can be perceived that the roles of variable transmission variables of monetary policy are found to be mixed. Also there has not been ample amount of focus on the other variables of monetary policy transmission in India.

The paper advances as follows. In Section 2, we examine the earlier workings of the taken monetary policy variables. In Section 3, we propose various

techniques of SVAR model to interpret the strength of contemporaneous relationship among the GDP, Bank Rate, WPI and Exchange Rate. Section 4, covers the data and econometric modelling. In Section 5, we have derived out the results. Lastly Section 6, gives the conclusion.

## 2. REVIEW OF LITERATURE

Review of literature is a prerequisite for the researcher to arrive at a finer mastery of the existing topic and enables the critical evaluation of the research to synthesize the findings in a coherent whole. The concepts applied, the application of the models and the proposals mentioned in the previous studies will probably lessen the encountered challenges.

(Sengupta 2014) found the bank lending channel as the principal source of monetary transmission policy of India. The interest rate and asset price channels have turned out to be stronger and the exchange rate channel, despite weak, displayed a mild refinement in the post LAF period. (Mishra, Montiel, and Sengupta n.d.) applying a monthly VAR data from April 2001 to December 2014 witnessed a statistically significant effects because of the positive shocks given to the policy rate . (Disyatat and Vongsinsirikul 2003) on examining the transmission of money in Thailand. The empirical findings hint to a transmission mechanism where investment is especially susceptible to monetary shocks and banks play a key role in connecting monetary policy to actual activity. (Aleem 2010) by deriving out the empirical results of the augmented VAR models suggested the important role of the bank lending channel in India. (Bjørnland 2009) estimated a model for Australia, Canada, New Zealand and Sweden. It has been witnessed that monetary policy methodically counters the movements in exchange rate of all countries, remarkably in Canada. (Rate 2017) the quantitative analysis of empirical data based on macroeconomic advancements in Serbia, and in the emerging economies, found the exchange rate to be more crucial transmission mechanism compared to the interest rate studied how monetary policy affected real variables through the transmission channels using the vector auto-regression (var) methodology and the conventional Cholesky decomposition. ( Peersman & Smets, 2002) used identified Vector Autoregressions (VARs) to capture macroeconomic effects of unforeseen policy changes in the United States and in the euro area countries. Unanticipated spurt in the short-term interest rate tended to a real exchange rate appreciation and a short-term decline in output. Prices were observed to be more lagged, and they specifically began to decline significantly below the zero for certain quarters shortly after GDP. (Baig and Goldfajn 2002) found no such evidence of high interest rates leading to weaker exchange rates. The impact of a shock made in interest rates on the exchange rate was found to be insignificant in all the five cases (Philippines being the only exceptional). (Calvo and Reinhart 2000) state that a

system with the flexible exchange rate in the emerging economies features a de facto peg. As being pictured by under-development of financial markets, their central banks have to intervene for the exchange rate stabilisation. It is generally explained in the form of “fear of floating” hypothesis. There is a negligible impact of interest rate shocks on inflation; this result is congruous with that (Christiano and Evans n.d.)“a robust feature of our results is that monetary policy shocks account for a very small part of the variation in prices”.

That being so, our goal is to assess the relative strength of each variable using the SVAR model and determine whether the findings are consistent with earlier research.

## 3. SVAR Framework

A model is only considered "structural" if it can be used to forecast the impact of deliberate shocks, being positive or negative both. To achieve such forecast, the model must explain how changes in some model components (parameters, equations, observable or unobservable random variables) correspond to changes in the intervention, and it must be true that the modified model accurately captures the behaviour that is being modelled in post-shock.

In accordance with theory, the SVAR model grants the implementation of short-run in conjunction long-run constraints; whereas, the VAR model does not, and the vector error correction model (VECM) only permits the imposition of long-run limit.

The SVAR model just needs the barest minimum of limitations. Additionally, similar to a regular VAR model, the SVAR model proposes two relevant tools in the guise of impulse-response functions and variance decompositions, thus providing further description about the impact and transmission of macroeconomic shocks and policy innovation.

In the interest of recovering structural innovations from the computed VAR, the structural VAR model sets identifying limits on VAR estimates. Practically, the identification can be accomplished by setting short- or long-run identification limits. Utilising long-run limitations has the advantage because economic theory often offers more information about long-term interactions than it does regarding short-term dynamics.

Reduced form of VAR model in the following form can be written as -

$$Y_t = AY_{t-1} + APY_{t-p} + \epsilon Y_{t-p} + \epsilon D + \mu_t \dots \dots \dots (1)$$

Where Y represents a nx1 vector of endogenous variables, p characterizes the ordering of the VAR model, and  $\mu_t$  stands for a nx1 vector of reduced form residuals, respectively. We can take no notice of the deterministic component as it remains unchanged by shocks to the system.

Accordingly, the SVAR model can be presented as follows

$$AY_t = A_1^* Y_{t-1} + \dots + A_p^* Y_{t-p} + B \varepsilon_t \dots \dots \dots (2)$$

While the matrix B holds the model's structural form parameters, the instantaneous relationships are modelled using matrix A. ( $\varepsilon_t$ ) is a nx1 structural disturbance vector, and VAR ( $\varepsilon_t$ ) =  $\Lambda$ , where  $\Lambda$  is a diagonal matrix, with the diagonal members being the structural disturbance variance.

The widely held belief in the literature is that shocks cannot be directly detected. Therefore, it is necessary to put some limitations. In order to do this, it is customary to multiply Eq. (2) by  $A^{-1}$  which results in the following relationship between the structural disturbances and the reduced form disturbances:

$$\mu_t = A^{-1} B \varepsilon_t \dots \dots \dots (3)$$

This allows us to rescript eq. (3) as follows:

$$A \mu_t = B \varepsilon_t$$

**4. Data collection and Econometric Modelling**

The data sample is gathered using the Reserve Bank of India's database, which includes monthly data for the research period from 2000 to 2019. Variables with the same order of integration are incorporated into the standard time-series analysis of a SVAR model.

Table 1. reports the outcomes of the common Augmented Dickey-Fuller and Phillips-Perron tests for all the variables. The assumption that the test variables have a unit root is the null hypothesis. Converting the variables into their log form, the unit root test was applied, to contemplate the stationarity of the variables. This hypothesis is disproved for GDP, Bank rate, WPI and Exchange rate. All of the model's variables were found to be stationary at their first difference.

**Table 1: Results of Unit Root Tests**

| Variables | ADF Test  |                  | PP Test   |                  |
|-----------|-----------|------------------|-----------|------------------|
|           | Level     | First difference | Level     | First difference |
| LGDP      | -0.784249 | -2.573533***     | -0.115840 | -3.457747***     |
| LBR       | -2.052829 | -3.457865*       | -1.893754 | -3.457747*       |
| LWPI      | -1.515848 | -3.457747*       | -1.529686 | -3.457747*       |
| LEX       | -2.437    | -3.457747*       | -1.529686 | -3.457747*       |

Note – 1) \*\*\*, \*\* and \* show the significance level at 1%, 5% and 10% ii) All the variables are stationary at first difference iii) LGDP, LBR, LWPI AND LEX show the natural log of GDP, Bank rate, WPI and Exchange rate.

However, it also becomes imperative to highlight that the Shwarz criteria (SC) and Akaike Information criteria (AIC) are used for the optimal lag length selection, which was found to be two for the selected variables.

**4.1 SVAR Model**

We can recognise and estimate the SVAR's parameters by identifying limits on structural matrices that are frequently suggested by prior knowledge and theory (Sims, 1980).

**A-B Restrictions (Short -run)**

With several pre built restrictions, based on the subjective assumptions in order to capture the strength of each channel in the short- run, the ordering of the variables become an important task. As it's associated with the Cholesky Decomposition, a recursive model will always imply an ordering of the variables, which are supposed to be guided by the theoretical or institutional ideas.

The number of limitations equals the number needed  $n(n - 1) / 2$  for the exact identification of the model; hence the model has been precisely recognised. The variables have been arranged according to their responsiveness. The variable that responds the least is ordered first.

**Matrix 1**

|     |   |          |          |          |   |                       |
|-----|---|----------|----------|----------|---|-----------------------|
| BR  | = | 1        | 0        | 0        | 0 | $\varepsilon_t^{br}$  |
| EX  |   | $a_{21}$ | 1        | 0        | 0 | $\varepsilon_t^{ex}$  |
| WPI |   | $a_{31}$ | $a_{32}$ | 1        | 0 | $\varepsilon_t^{wpi}$ |
| GDP |   | $a_{41}$ | $a_{42}$ | $a_{43}$ | 1 | $\varepsilon_t^{gdp}$ |

The Bank Rate is independent of all other factors, as can be seen from the structural model's first equation. It would be reasonable to suppose that the central bank, within a month, is unable to inspect the variables that are introduced in its monetary policy reaction function contemporaneously. As a result, the contemporaneous shocks designated to the other endogenous variables within the model will have no effect the current policy rate, thus allowing the non-policy rate elements to be set to zero in one row of the  $A^0$  matrix. Another common behavioural constraint is that some variables move slowly in response to changes in financial and policy variables Thus, for instance, changes in domestic monetary policy variables and exchange rates are not immediately reflected in output and price changes. In other words, prices and output do not respond contemporaneously to the changes instituted in the monetary policy variables and exchange rate. Therefore, the second equation represents a contemporaneous impact of shocks in bank rate to exchange rate. The third equation displays a contemporaneous impact of shocks in bank rate and exchange rate to WPI. Finally, the fourth equation

constitutes a contemporaneous impact on all the variables as a result of shock to GDP. The calculations of the defined matrix are in the Table 2.

**Table 2: Results of Matrix 1**

|                           |           |           |          |
|---------------------------|-----------|-----------|----------|
| Log likelihood - 464.2347 |           |           |          |
| <b>Estimated A matrix</b> |           |           |          |
| 1.000000                  | 0.000000  | 0.000000  | 0.000000 |
| 0.184258                  | 1.000000  | 0.000000  | 0.000000 |
| -1.603388                 | 1.269846  | 1.000000  | 0.000000 |
| 0.001061                  | 0.001353  | -0.000651 | 1.000000 |
| <b>Estimated B matrix</b> |           |           |          |
| 3.093596                  | 0.000000  | 0.000000  | 0.000000 |
| 0.000000                  | 55.044530 | 0.000000  | 0.000000 |
| 0.000000                  | 0.000000  | 1.293683  | 0.000000 |
| 0.000000                  | 0.000000  | 0.000000  | 0.732869 |

Source: Author’s calculations

**Table 3: Coefficients and Estimates**

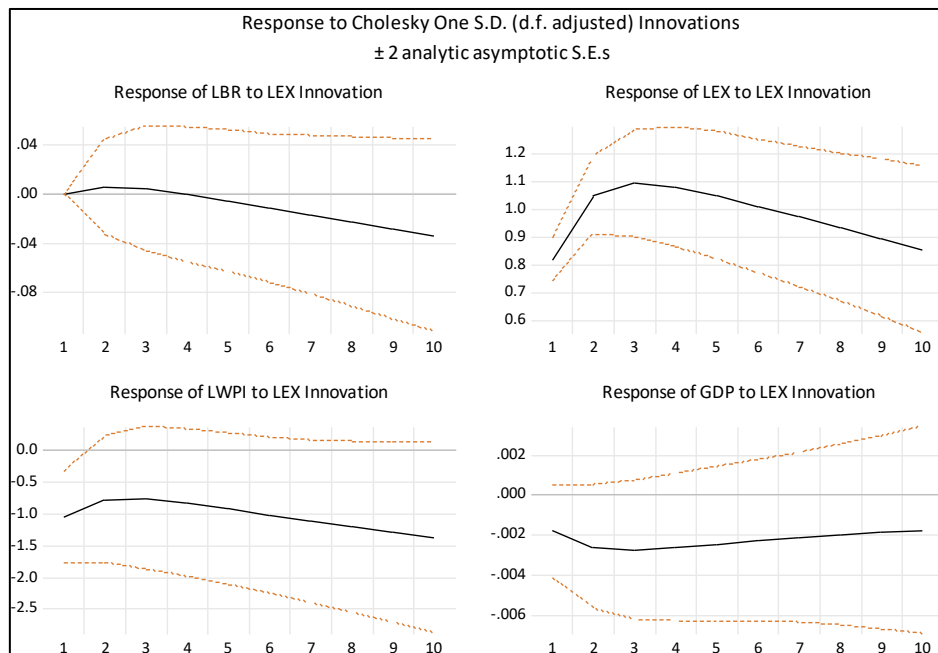
| Equation | Coefficient     | Estimate         |
|----------|-----------------|------------------|
| Ex       | a <sub>21</sub> | 0.184258         |
| WPI      | a <sub>31</sub> | <b>-1.603388</b> |
|          | a <sub>32</sub> | 1.269843         |
| GDP      | a <sub>41</sub> | 0.00061          |
|          | a <sub>42</sub> | 0.001353         |
|          | a <sub>43</sub> | <b>-0.000651</b> |

Source: Author’s Calculations

However, in order to have a better inspection of the contemporaneous relationship among the variables, the impulse response function has been taken out as a perfect interpretation of the results.

**5. Impulse Response Function**

Figure displays the reactions of the variables to a positive one standard error shock in the Exchange Rate. Dotted lines around each response indicate the two standard error confidence intervals. If the graph of the taken variables surpasses the red line, the graphs become statistically insignificant.



**Figure 1: Response of variables to Exchange rate**

The kind of the exchange rate regime and extent of economic openness dictate the role of the exchange rate channel. Both the Bank rate and WPI are found to have a significant negative relationship with exchange rate. There has been a sharp fall in Bank Rate. Declining WPI can also be detectible source of a significant negative relation with exchange rate. The key issue to be called attention to is the negative value of WPI through the entire period.

The negative inflationary impact of the impulse response may also be seen as evidence of a robust countercyclical monetary policy in response to pressures on the foreign currency market. The foreign exchange market eventually becomes sound, despite at a higher

(depreciated) exchange rate level, and as a result, interest rates start to decline as output along with inflation return towards their commencing position.

In terms of the impulse reactions to exchange rate shocks, it can be wondered that a constructive shock given to the nominal exchange rate (i.e., a depreciation) results in a temporary decline in production, which might be a reflection of the trade balance effect's 'J-Curve' effect on output. However, GDP first falls and rises sluggishly further. The fact that the trade-turnover to GDP ratio has increased further supports this. Due to India's limited exchange rate flexibility, this channel is still of little importance.

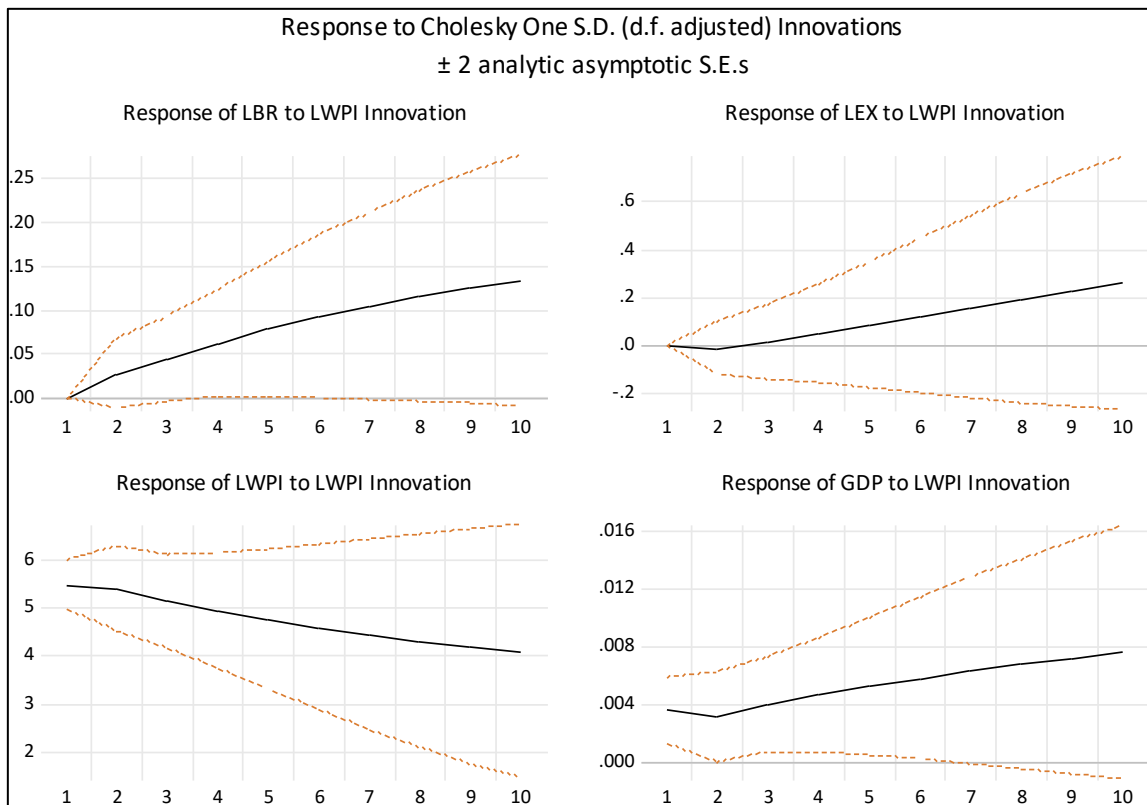


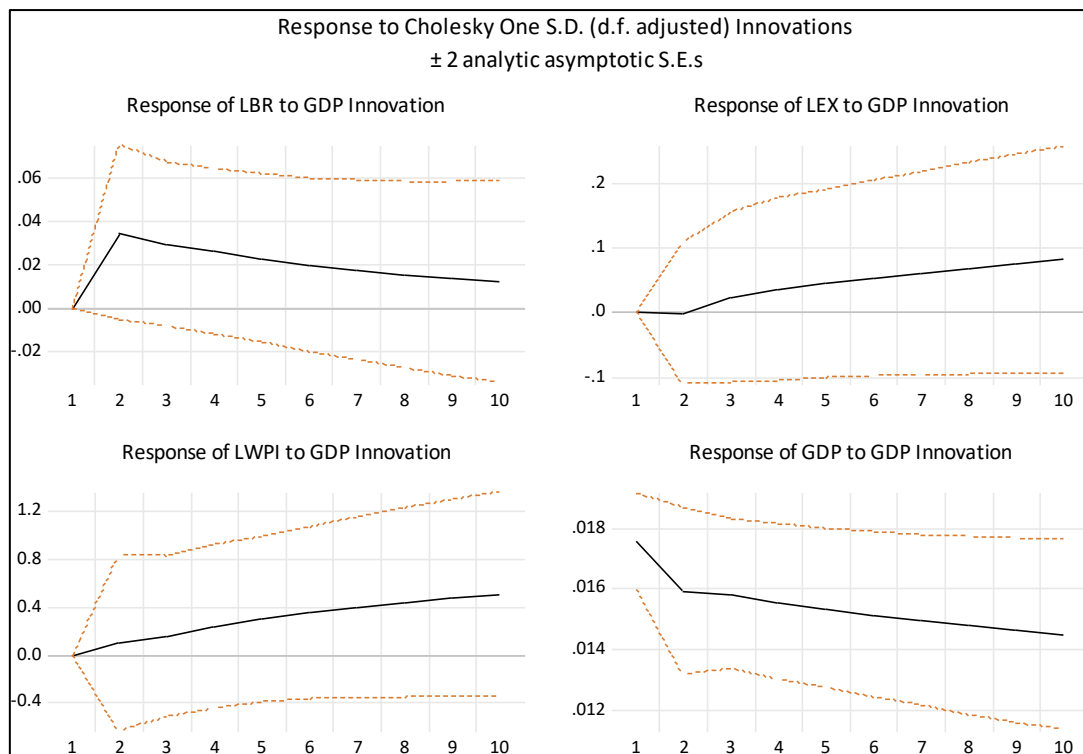
Figure 2: Response of variables to WPI

The lending rate graph goes on increasing, as a shock to WPI accompanied by the concept that the increase in WPI requires the need to adopt a strict policy stance, which is reflected in the rising graph of lending rates. Relationship between WPI and Exchange rate is justified on the grounds that the increases in WPI and external debt would raise exchange rates because these are the constituents that frequently lead to the home currency's depreciation. Thus, the rising exchange rate GDP graph can be witnessed.

As per the conventional "neutrality of money" theory, upsurge in inflation is ineffective on real gross

domestic product (GDP) since they raise prices and salaries in a manner that is identical to each other and only modifies the units of measurement. Another perspective is that economic growth challenges such as supply-side interruptions or fiscal imbalances are what actually drive slow growth, not rising inflation, which is only a symptom of these underlying issues. Alternatively, specific macroeconomic theories, such as New Keynesian theories, hold that, at least in certain set of conditions, rising inflation can raise real GDP in the short term. Such theories struggle to account for "stagflation," or the concomitant high inflation and sluggish economic development.





**Figure 3: Response of variables to GDP**

The impact of GDP on financing efficacy cannot be neglected. The macroeconomic environment, including the GDP and other factors, significantly influences how banks develop. An increase in GDP causes an increase in economic activity and a rise in credit defaults, both of which result in a decline in bank liquidity (a rise in the lending rates). It is conceivable that a positive shock given to GDP raises the lending rate and then it declines moderately, after which it remains almost the same for a longer period. Given a shock to GDP, there is an uninterrupted rise in the exchange. Higher production figures, giving a clue of higher demand for that nation's goods, are reflected in high GDPs. Higher demand for a nation's products and services frequently results in higher demand for that nation's currency, leading to currency appreciation. It is noticeable that a shock to GDP results in a sluggish increase to WPI, which might suggest a positive relation between the two.

## 6. CONCLUSION

This paper lays out the far-reaching empirical analysis of the monetary policy variables in India. Using the SVAR model on the monthly data from 2000 till 2019, the paper explored the contemporaneous relationship among the variables, taken to be endogenous and exogenous simultaneously. All the variables were summed up to be statistically significant. Among the variables taken for our study, the strength of WPI and GDP has been found to be more prominent, stipulating their major role in monetary policy. However, the use of WPI has been a major interpretation of our study and has not been taken as a major source of consideration in past studies. WPI has been a pivotal estimate of inflation in

India. Monitoring the price inflation on the count of wholesale level is plainly a critical economic metric. Adjustments in monetary and fiscal policies have been highly altered in accordance with WPI. However, there has been a significant drop in WPI in the last one year. It becomes imperative for RBI to make some gritty choices between moderating wholesale inflation, shaky growth and the hawkishness of all the central banks globally.

The exchange rate channel has been perceived to have a negligible impact, being in consistent with previous studies so far. All facets of policymaking depend heavily on communication. A policy of propitious negligence of the exchange rate is unfeasible and unserviceable as the movement in the exchange rate influences the monetary transmission. It is a common knowledge that over the past 15 years, central banks have generally tended to increase the transparency of their monetary policy frameworks and current operations. However, it appears that central banks have been less open about how exchange rates affect monetary policy for a number of reasons. Of course, one of the challenges facing policymakers is that accurate exchange rate forecasting has proven to be challenging. Consequently, there is a lot of potential for inaccuracy when discussing exchange rates.

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