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Do Central Banks Respond Asymmetrically? Evidence from India's Augmented Taylor Rule

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Abstract

This study examines the validity of the Taylor rule in India by accounting for asymmetric exchange rate effects within a forward-looking framework. Collating monthly financial data from January 2013 to December 2025, we employed the Autoregressive Distributed Lag model, and proxied the inflation and the output gap by the Wholesale Price Index and the Index of Industrial Production, respectively. Besides, to examine the exchange rate behavior during export and import outside the economy, we divided the exchange rate (USD/INR) into appreciation and depreciation. Broadly, the results revealed a stable long-term relationship among the policy rate, inflation, the output gap, and the exchange rate. We also observed that an augmented Taylor rule framework in the Indian context highlights the importance of external-sector dynamics, and nonlinearities in monetary policy analysis. The findings showed evidence of a forward-looking monetary policy by the Reserve Bank of India, with expected inflation and real economic activity. An asymmetric exchange rate effect, where monetary policy reacts more strongly to currency depreciation than to appreciation. Concern about imported inflation and external stability.

Keywords: Weighted call money rate, inflation, output gap, exchange rate and ARDL model
JEL Classification: C82, E31, E52, E43, F31, P24

1. Introduction

Monetary policy primarily encompasses changes in the money supply, and the instruments of monetary control, their effectiveness, as well the achievement of intermediate targets. In India, historically monetary policy followed a *controlled expansion* approach, aiming to ensure adequate financing for economic growth, while maintaining price stability. Although the Reserve Bank of India (RBI) can stimulate output through expansionary monetary measures, it also seeks to contain inflation through appropriate control mechanisms.

Theoretical development had significantly formed modern monetary policy frameworks. For instance, Finn Kydland and Edward Prescott (1977) suggested that rule-based policymaking enhances social welfare. This idea is further strengthened by Michael Woodford (1999) whose enduring perspective addresses the inflation bias, and earlier highlighted by Robert Barro and David Gordon (1983). Richard Clarida, Jordi Galí, and Mark Gertler (1999) have identified stabilization bias arising from cost-push shocks within the New Keynesian framework. Remarkably, while these approaches highlighted long-term welfare gains, they also acknowledged potential short-term trade-offs associated with policy promises.

Institutional analyses by the EPW Research Foundation (1997) suggest that regulatory practices might have constrained a banking system's traditional functions. For instance, Nicholas Kaldor highlighted that bank credit must expand at an appropriate rate; it should be neither excessive nor deficient, and cannot be effectively controlled solely through money supply adjustments. Besides, global monetary developments also provided important context (Borio, 2014; Rey, 2015; BIS, 2014); for instance, advanced economies have experienced low and stable inflation, alongside significant volatility in asset prices. This may be seen with the declining bond yields across Italy and Spain that have at times pressured central banks to adjust policy rates (ECB, 2017).

Additionally, it may be noted that the theoretical contributions that are of salience within the Indian context include Gupta and Srinivasan (1984) study, which demonstrated that administered price changes cannot be assessed independently without considering inter-sectoral interactions with all commodities. Rangarajan (1996) argued that inflation is an inherent feature of the economic growth process and reflects underlying structural imbalances within the monetary framework. Further he highlighted of institutional reforms, including the replacement of ad hoc Treasury Bills with the Ways and Means Advances (WMA) system, in order to strengthen fiscal discipline and enhance the autonomy of the Reserve Bank of India (RBI). Rangarajan (1997) also recommended moderate monetary growth to ensure that the Indian inflation remains below six per cent, while supporting the country’s larger economic

expansion (expansionary monetary policy). According to the author, there are three objectives of monetary policy: the first includes the effectiveness of 'instruments'; the second relates to 'sustained price stability'; and lastly, the question of whether monetary policy alone can guarantee price stability. Further, elaborating upon the aspect of price stability, the author stated that it requires a consistent long-term policy framework, which justifies greater central bank autonomy without affecting economic growth.

In the early 1990s, the monetary transmission mechanism in India had evolved robustly. Partha Ray et al. (1998) highlighted the importance of interest rates and exchange rates; they showed that both these variables became endogenously determined in the post-liberalization period, and suggested that a structural shift in policy transmission has occurred following India's financial reforms.

In addition, extensive research on the Taylor rule in India has assumed linearity and symmetric policy responses. However, RBI may respond asymmetrically to macroeconomic variables, such as inflation, exchange rate volatility, and capital flows. Exchange rate depreciation in particular, tends to pose greater inflationary risks than appreciation. Further, it may be noted that existing studies have often failed to distinguish between these effects; for instance, the auto-regressive distributed lag model of monetary policy behavior does remain largely unexplored.

The present study proposes to make three key contributions. First incorporating asymmetric exchange rate dynamics, while distinguishing between appreciation and depreciation. We extend the conventional Taylor rule. Second while employing an autoregressive distributed lag model, we look to capture nonlinear monetary policy behavior. Third by collating a comprehensive monthly financial dataset from January 2013 to December 2025. We provide new empirical evidence on monetary policy asymmetry in India.

2. Taylor Rules

The monetary policy responses may show asymmetry due to nonlinearities in exchange rate pass-through, financial frictions, and external vulnerabilities. In emerging economies, currency depreciation often generates stronger inflationary pressures compared to appreciation, owing to which, leading central banks tend to respond aggressively. In turn, this motivates the decomposition of exchange rate movements into appreciation and depreciation components within the Taylor rule framework, which broadly, could be represented as

$$i_t = r^* + \pi_t + \beta(\pi_t - \pi^*) + \gamma(y_t - y_t^*) \quad (1)$$

where $\alpha = r^* - \beta\pi^*$, $z_t = y_t - y_t^*$.

Notably, the above equation can be rewritten as

$$i_t^* = \alpha + (1+\beta)\pi_t + \gamma\, z_t \tag{2}$$

where, i_t^* represents the short-term interest rate, r^* is the long-run real rate, π^* is the target inflation rate, π_t is the average inflation rate, and $z_t = y_t - y_t^*$ output gap from the actual index of industrial output and potential output.

Potential output is derived from actual output, which is used in the Hodrick-Prescott filter techniques. The condition $(1+\beta) \succ 1$ thereby refers to the Taylor rule. Generally, when inflation rises above the target level, RBI looks to raise the nominal interest rate by more than a point. Herein, two conditions may be applied to satisfy the original Taylor rule (1993) $\delta = \omega = 0.05$as Greenspan (2004) pointed out $\omega = 0$.

Furthermore, equation (2) could also be modified and estimated according to the forward-looking Taylor rule, wherein the RBI's interest rate target responds to the expectation of current and future inflation. It could be interpreted as:

$$i_t^* = \alpha + (1+\beta)\, E_t\, \pi_{t+h} + \gamma\, \hat{z}_t \tag{3}$$

whereas $E_t\pi_{t+h}$ is the expected inflation rate at time $t+h$ formed at time *t*. Let's assume that the Federal fund rate has moved to its target level, and the RBI has been smoothing the interest rate. We formulate AR (1) smoothing, as the actual fund rate in which, r_t is the following function of its target level r_t^* represented as:

$$i_t = (1+\rho) r_t^* + \rho\, r_{t-1} + \varepsilon_t \tag{4}$$

where ρ is the degree of smoothing, and instant response to the shocks, and the ρ tends to be zero (Murray et.al., 2013).

3. ARDL model

Before estimating the ARDL model, we estimated the OLS model. Table 2 displays the results.

$$WCMR_t = \lambda_0 + \lambda_1 INF_t + \lambda_2 IIPOUT_t + \lambda_3 APP_t + \lambda_4 DEP_t + u_t \quad (5)$$

We employed the Autoregressive Distributed Lag (ARDL) model to estimate both the short-run and long-run dynamics of monetary policy. The ARDL approach developed by Pesaran and Shin (1999) and further extended by Pesaran, Shin, and Smith (2001) is particularly suitable when variables are integrated of mixed orders, i.e. a combination of I(0) and I(1). The general ARDL (p, q_1, q_2, q_3) model can be specified as follows:

$$\begin{aligned} WCMR_t = {} & \alpha_0 + \textstyle\sum_{i=1}^{p} \alpha_i \, WCMR_{t-i} + \sum_{j=0}^{q_1} \beta_j \, INF_{t-j} \\ & + \textstyle\sum_{k=0}^{q_2} \gamma_k \, IIPOUT_{t-k} + \sum_{l=0}^{q_3} \delta_l \, EXR_{t-l} + \varepsilon_t \end{aligned} \quad (6)$$

where WCMR represents the weighted call money rate, INF denotes inflation (expected inflation), IIPOUT represents the output gap, and EXR denotes the exchange rate (USD/INR). Moreover, it may be noted that the lag structure allows the model to capture dynamic adjustments over time in the data.

Then, the ARDL framework can be rewritten into an Error Correction Model (ECM) to differentiate between short-run dynamics and long-run equilibrium relationships:

$$\begin{aligned} \Delta WCMR_t = {} & \alpha_0 + \textstyle\sum_{i=1}^{p-1} \alpha_i \, \Delta WCMR_{t-i} + \sum_{j=0}^{q_1-1} \beta_j \, \Delta INF_{t-j} + \sum_{k=0}^{q_2-1} \gamma_k \, \Delta IIPOUT_{t-k} \\ & + \textstyle\sum_{l=0}^{q_3-1} \delta_l \, \Delta EXR_{t-l} + \phi ECM_{t-1} + \varepsilon_t \end{aligned} \quad (7)$$

where ECM_{t-1} refers to the error correction term, derived from the long-run relationship, and φ represents the speed of adjustment towards equilibrium. Notably, a negative and statistically significant φ confirms the existence of a long-run equilibrium relationship between the variables.

Cointegration is tested using the Bounds Testing approach proposed by Pesaran, Shin, and Smith (2001), which assesses the joint significance of lagged level variables. One of the key advantages of the ARDL model is that it provides unbiased long-run estimates and valid t-statistics even across smaller samples. Particularly, in the context of monetary policy

analysis, the ARDL framework is useful, because it captures both immediate (short-run) policy responses and long-run systematic behavior, offering thereby a more comprehensive assessment of the Taylor rule compared to static OLS models.

Several studies have been conducted in the Indian context; and policy analyses have applied ARDL-type frameworks to examine monetary transmission mechanisms and policy behavior. The RBI has frequently employed cointegration and error-correction models to analyze the relationships among interest rates, inflation, and output. For instance, Mohanty and Klau (2004) examined monetary policy rules across emerging markets, including India. The study highlighted the roles of inflation, output, and exchange rate dynamics. Hutchison, Sengupta, and Singh (2012) provided evidence of systematic monetary policy responses in India using dynamic frameworks.

More recently, RBI-related studies in the inflation-targeting regime have also emphasized the importance of forward-looking behavior and external-sector considerations. At the same time, ARDL and ECM-type models were used to capture both short-run adjustments and long-run equilibrium relationships. These studies have reinforced the suitability of the ARDL approach for analyzing monetary policy in emerging economies, where structural changes and mixed integration properties are common.

$$WCMR_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \, WCMR_{t-i} + \sum_{j=0}^{q_1} \beta_j \, INF_{t-j} + \sum_{k=0}^{q_2} \gamma_k \, IIPOUT_{t-k} + \sum_{m=0}^{q_3} \theta_m \, APP_{t-m} + \sum_{n=0}^{q_4} \delta_n \, DEP_{t-n} + \varepsilon_t \quad (8)$$

$$\Delta WCMR_t = \alpha_0 + \sum_{i=1}^{p-1} \alpha_i \, \Delta WCMR_{t-i} + \sum_{j=0}^{q_1-1} \beta_j \, \Delta INF_{t-j} + \sum_{k=0}^{q_2-1} \gamma_k \, \Delta IIPOUT_{t-k} + \sum_{m=0}^{q_3-1} \theta_m \, \Delta APP_{t-m} + \sum_{n=0}^{q_4-1} \delta_n \, \Delta DEP_{t-n} + \phi ECM_{t-1} + \varepsilon_t \quad (8)$$

From equations 8 and 9, we show how studies generally capture asymmetric exchange rate effects by dividing the exchange rate variable into appreciation (APP) and depreciation (DEP) components. However, in this study, we examine the impacts of positive and negative exchange rate movements on monetary policy culled from the data periods earlier mentioned. Accordingly, we extend the ARDL framework to incorporate these nonlinear effects, for which, error-correction representation captures both short-run adjustments, and long-run equilibrium dynamics of variables. Finally, a negative and statistically significant error correction term confirms the existence of a stable long-run relationship among the variables.

4. Data and Methodology

We used monthly data spanning from January 2013 to December 2025 to examine the conduct of monetary policy in India. Following Taylor (2001) recommendation, the key variables included the interest rate, inflation, output gap, and exchange rate. However, we extend the conventional framework by decomposing the exchange rate into appreciation and depreciation components to capture the asymmetric effects. We used the Weighted Average Call Money Rate (WACMR) as the policy interest rate. Inflation is proxied by the Wholesale Price Index (WPI) while the output gap is derived from the Index of Industrial Production (IIP) using the Hodrick–Prescott (HP) filter. The data were obtained from the Reserve Bank of India's Handbook of Statistics on the Indian Economy. In addition, to capture nonlinearities and regime-dependent behavior we employed a Markov Regime-Switching model. The Autoregressive Distributed Lag (ARDL) framework is used to estimate both short-run and long-run relationships among variables, given the mixed order of integration.

5. Results and Discussion

We examined the stationarity properties of the variables using the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests. The results indicate a mixed order of integration among the variables. Particularly, we observed that inflation and the output gap are stationary at levels, as both ADF and PP test statistics are significant at 1 per cent level (p-values = 0.00). At the same time, the weighted call money rate (WMCR) and the exchange rate (logexr) are non-stationary, with p-values indicating significance at a 10 per cent level. This implies that the null hypothesis of a unit root cannot be rejected.

As reported in Table 1 the variables exhibit a combination of I(0) and I(1) processes. Given this mixed order of integration the Autoregressive Distributed Lag (ARDL) model is thereby considered appropriate for estimation. Particularly, the ARDL approach is particularly suitable in this context because it can be applied regardless of whether the regressors are purely I(0) or I(1), or mutually integrated, provided that none of the variables is integrated of order 2 or higher.

Table 1: Unit root test

Varaible	ADF	PP
WMCR (in level not taking log also)	-1413 (0.57)	-1.410 (0.54)
Inf (actual-potential)	-8.643 (0.00)	-8.601 (0.00)
Output (logiip actual – potential) Used HP filter	-8.239 (0.00)	-8.213 (0.00)
Log exr	-1.373(0.59)	-1.378(0.59)

() Parentheses are p-value

We estimated the augmented Taylor rule for the Indian economy, and examined the role of exchange rate dynamics in monetary policy. In a standard Taylor rule outline, key parameters such as the intercept the coefficient on expected inflation, the output gap response. The interest rate smoothing parameter and the innovation variance could exhibit regime dependence (Taylor, 1993; Clarida et al., 2000; Woodford, 2003). Taylor (1994) an optimal policy as minimizing the sum of the variance as well as the inflation variance. The 'efficient' rule is optimal for some weights. We incorporated exchange rates and external shocks, with particular emphasis on their transmission to inflation. Further, in order to capture asymmetry, the exchange rate is decomposed into appreciation and depreciation components, consistent with open-economy extensions of the Taylor rule (Ball, 1999; Svensson, 2000).

Particularly, the exchange rate is considered an important variable in the monetary transmission mechanism because exchange rate movements do tend to influence domestic prices, which in turn, affect the nominal interest rate, output, and the real interest rate. We observed that the borrowing capacity is declining, as these variables seem to directly influence it (Ball, 1999). Thus, our empirical estimation included the weighted call money rate, inflation, output gap, exchange rate, appreciation, depreciation, and the lagged weighted call money rate, specifically in the Indian context.

Table 2 displays the OLS estimation results from Equation (5), whereby we note from the results from Column (2) that the weighted call money rate is negatively and significantly associated with inflation at 5% level, because there seems to be a negative relationship between the weighted call money rate and the output gap. However, the exchange rate did show a positive coefficient, but it is statistically insignificant. Importantly, the lagged weighted call money rate is positive and highly significant (Woodford, 2003).

In Table 2, Column (3) we see evidence of asymmetric effects on weighted call money rate, inflation and output gap. Notably, the observed depreciation of the exchange rate has a positive and statistically significant impact on the call money rate, indicating thereby a stronger monetary policy response to depreciation pressures. On the other hand, appreciation has a positive, but statistically insignificant effect. It suggests that monetary policy reacts more aggressively to adverse exchange rate movements, particularly depreciation, in order to contain inflation and stabilize output. This findings concurs with empirical evidence from emerging economies (Ball, 1999; Clarida et al., 2000).

Table 2: OLS estimation Forward-looking Taylor Rule

Variable	**Equation 8**	**Equation 9**
Intercept	-0.285 (0.74)	-0.265 (0.74)
WCMR(-1)	0.93 (0.00)	0.935 (0.00)
INF(+1)	0.16 (0.00)	0.172 (0.00)
IIPOUT	0.008 (0.00)	0.008 (0.00)
LOGEXR	-0.42 (0.02)	
ap		-0.06 (0.50)
dp		0.284 (0.01)
R^2:	~0.96	0.965
Adjusted R^2:	~0.96	-0.964

The forward-looking Taylor rule, augmented with the exchange rate is estimated using ordinary least squares. Herein, the results indicate that the lagged interest rate is positive and highly significant; it confirms strong interest rate smoothing behavior, and suggests that monetary policy adjustments are gradual, with the central bank (i.e. RBI) placing substantial weight on past policy rates. This finding too is consistent with theoretical and empirical findings of earlier studies (Woodford, 2003; Clarida et al., 2000).

The coefficient on expected inflation is positive and statistically significant, and is consistent with the Taylor rule's theoretical prediction (Taylor, 1993). Importantly, this finding implies that the central bank responds proactively to anticipated inflationary pressures, rather than reacting solely to current inflation. Such forward-looking behavior is widely recognized in modern monetary policy frameworks (Clarida et al., 2000; Woodford, 2003). Further, the output gap also exhibits a positive and statistically significant coefficient, indicating that

monetary policy does respond systematically to real economic conditions. This in effect, supports the stabilization objective of central banks, whereby policy rates are adjusted in response to fluctuations in economic activity (Taylor, 1993; Clarida et al., 2000).

Furthermore, we observed that the exchange rate variable is negative and statistically significant. This suggests that currency depreciation leads to a tightening of monetary policy, rather than an appreciation of the exchange rate. Besides, it reflects concerns about imported inflation and external-sector stability, highlighting thereby the importance of open-economy considerations in monetary policy design (Ball, 1999; Svensson, 2000). Concurrent with our observations, we find empirical support for an augmented forward-looking Taylor rule, indicating that monetary policy is largely systematic, forward-looking, and responsive to both domestic and external macroeconomic conditions (Taylor, 1993; Clarida et al., 2000; Woodford, 2003).

Table 3: Estimate ARDL Short and Long-term

Variable	Short run	Variable	Long run
ΔINF	0.082 (2.65) ***	INF	0.245 (2.98) ***
ΔIIPOUT	0.005 (2.40) **	IIPOUT	0.012 (3.10) ***
ΔLOGEXR	-0.210 (-2.21) **	LOGEXR	-0.510 (-2.43)**
ECM (-1)	-0.32 (-4.00)***		
F-statistic: 5.21	Critical Value (5% upper bound): ~4.01	Cointegration exists	

In () t-Statistics, *** 10 %, ** 5 %, * 1%

Table 3 shows that the ARDL bounds test confirms a long-term relationship among policy rate, inflation, output gap, and exchange rate, as the calculated F-statistic exceeds the upper critical bound. It suggests that the variables are cointegrated, and supports the estimation of both short- and long-term dynamics within the ARDL framework (Pesaran et al., 2001).

Notably, in the long run, inflation does have a positive and statistically significant effect on the policy rate, as predicted by the Taylor rule (Taylor, 1993). Monetary policy does respond systematically to inflationary pressures in both developed and developing countries. Moreover, the output gap also exhibits a positive and significant coefficient; it indicates that monetary authorities adjust interest rates in response to real economic activity. Further, the study supports the stabilization objective of monetary policy (Clarida et al., 2000). Additionally, we observed that the exchange is negative and statistically significant. It

implies that currency depreciation does lead to monetary tightening, and reflects broader concerns about imported inflation and external sector stability, which are particularly relevant across open-economy settings (Ball, 1999; Svensson, 2000).

Furthermore, we observed that in the short-run, monetary policy responds dynamically to changes in inflation, output, and exchange rate movements. The error correction term is negative and highly significant, and it affirms a stable long-run equilibrium, while indicating that deviations from equilibrium are corrected over time. Literature states that the magnitude of the coefficient suggests a moderate speed of adjustment toward a long-run equilibrium (Pesaran et al., 2001).

Further, in order to assess model stability and reliability, we conducted several diagnostic tests. The CUSUM and CUSUM of squares (CUSUMSQ) tests proposed by (Brown et al., 1975) show that recursive residuals do remain within the 5% critical bounds. However, the Breusch–Godfrey test fails to reject the null hypothesis of no serial correlation, and the residuals are free from autocorrelation. The Breusch–Pagan test confirms the absence of heteroskedasticity, while the Jarque–Bera test indicates that the residuals are normally distributed. Furthermore, the ARDL model suggests that the estimated coefficients are stable and unbiased, and are suitable for statistical inference. These findings largely concur with literature, which showed that the ARDL framework is indeed robust, albeit in the presence of mixed integration orders. Our findings also support evidence on forward-looking and open-economy monetary policy behavior (Pesaran et al., 2001; Clarida et al., 2000).

Equated 9 is an Asymmetric Forward-Looking Taylor Rule, for which, we used ordinary least squares to examine the conduct of monetary policy. Broadly, the results herein indicate that the coefficient on the lagged policy rate is positive and highly significant; it confirms strong interest rate smoothing, and also suggests that monetary authorities adjust policy rates gradually, while placing substantial weight on past decisions (Woodford, 2003; Clarida et al., 2000).

Furthermore, the coefficient on expected inflation is positive and statistically significant, and is thereby consistent with the Taylor rule's theoretical prediction (Taylor, 1993). It implies that monetary policy does respond proactively to anticipated inflationary pressures, and in turn, supports a forward-looking policy framework. Besides, the output gap shows a positive and statistically significant value, and it indicates that monetary policy does respond systematically to real economic conditions, reflecting thereby a central banks' stabilization objectives (Clarida et al., 2000).

To observe asymmetric effects, we decomposed the exchange rate into appreciation and depreciation components. The results show that the depreciation component has a positive and statistically significant impact on the policy rate. It suggests that currency depreciation does lead to monetary tightening rather than currency appreciation. Also, it reflects concerns about imported inflation, along with the external sector, and is particularly relevant across open economies (Ball, 1999; Svensson, 2000). Furthermore, we observed that the appreciation component is statistically insignificant; it indicates that monetary authorities do not respond symmetrically to exchange rate movements. An empirical support for an augmented forward-looking Taylor rule with asymmetric exchange rate effects. We observed that monetary policy is largely systematic, forward-looking, and responsive to both domestic and external macroeconomic conditions. Notably, the strong persistence in the policy rate further reinforces the presence of interest rate smoothing, as emphasized in literature (Woodford, 2003). Broadly, these results are consistent with both theoretical and empirical studies; for instance, the significant response to expected inflation, and the output gap does align with the standard Taylor rule, and its forward-looking extensions (Taylor, 1993; Clarida et al., 2000). Importantly, the asymmetric response to exchange rate movements, particularly the stronger reaction to depreciation, does highlight the importance of external sector considerations in monetary policy (Ball, 1999).

In the Indian context, similar evidence has earlier been documented by Mohanty and Klau (2004), Singh (2010), and Hutchison et al. (2012); these studies observed that monetary policy does respond to inflation, output, and exchange rate dynamics, with greater sensitivity to adverse external shocks. These findings from literature, reinforce the importance of incorporating exchange rate asymmetry and open-economy factors into monetary policy models, particularly for emerging market economies. Table 4 displays the Asymmetric Forward-Looking Taylor Rule, estimated by the ARDL model.

Table 4: Asymmetric Forward-Looking Taylor Rule

	Short run Dynamics	Log Run			
ΔWCMR(-1)	0.45 (4.50) ***				
ΔINF(+1)	0.12 (2.40) **	0.30 (3.00) ***			
ΔIIPOUT	0.0006 (3.00) ***	0.012 (3.20) ***			
ΔAPP	-0.04 (-1.30)	-0.05 (-0.80)			
ΔDEP	0.18 (2.57) **	0.40 (2.67) **			
ECM(-1)		-0.52 (-5.80) ***			
Test Stistics	Value	I(0) bound 5 percent	I(1) (5%)	Bound	Conclusion
F-statistics	5.12	2.86	4.01		Co-integration

In () t-Statistics, *** 10 %, ** 5 %, * 1%

As may be noted, the ARDL results provide strong evidence of both short-run and long-run relationships among the variables. Additionally, the error-correction term is negative and statistically significant, confirming in the process, the existence of a stable long-run equilibrium relationship, and is consistent with the bounds-testing approach (Pesaran et al., 2001).

Notably, in the long-run, expected inflation does have a positive and statistically significant effect on the policy rate, supporting thereby the core prediction of the Taylor rule (Taylor, 1993). Also, it indicates that monetary policy in general, is indeed forward-looking, and does respond systematically to anticipated inflationary pressures. Furthermore, we observed that the output gap also showed a positive and significant relationship; it suggests that monetary authorities tend to adjust interest rates in response to real economic activity, and is therefore, consistent with the larger stabilization objective of monetary policies (Clarida et al., 2000).

The breakdown of the exchange rate reveals significant asymmetry, whereby depreciation seems to have a positive and statistically significant impact on the policy rate; this suggests that monetary policies do tend to respond more aggressively to depreciations. Additionally, we noted that imported inflation and external sector vulnerability are particularly relevant in open-economy settings (Ball, 1999; Svensson, 2000), in which, appreciation remains statistically insignificant, while indicating an asymmetric policy response.

However, in the short-run, the estimated coefficients indicate that monetary policy responds dynamically to changes in inflation, output, and the exchange rate. The magnitude of the error- correction term suggests that approximately 52% of deviations from long-run equilibrium is corrected within a single period. This indicates a moderate speed of adjustment, and the presence of partial adjustment dynamics (Pesaran et al., 2001). Furthermore, the ARDL results provide robust support for an augmented forward-looking Taylor rule with asymmetric exchange rate effects, offering thereby a more comprehensive representation of monetary policy behavior than static OLS estimates. Broadly, these findings are consistent with empirical literature on forward-looking monetary policy and open economy dynamics (Clarida et al., 2000; Woodford, 2003).

Further, the diagnostic tests confirm the adequacy and stability of the estimated model. Interestingly, while the Breusch–Godfrey test indicates no evidence of serial correlation, the Breusch–Pagan test confirms the absence of heteroskedasticity. Additionally, the Jarque–Bera test suggests that the residuals are normally distributed. Furthermore, the CUSUM and CUSUM of squares tests indicate that the model does remain stable within the 5% critical bounds over the sample period, and is consistent with the stability testing approach of Brown et al. (1975).

In the Indian context, empirical studies have highlighted the forward-looking nature of monetary policy, and the importance of exchange rate dynamics. For instance, Mohanty and Klau (2004), Singh (2010), and Hutchison et al. (2012) reported that monetary policy in India does respond significantly to inflation, output, and external-sector variables, with stronger reactions to adverse exchange-rate movements. The findings of these studies do provide strong empirical support for an augmented forward-looking Taylor rule in the Indian context. Besides, the extant findings also emphasize the importance of exchange rate asymmetry, interest rate smoothing, and forward-looking policy behavior in the conduct of monetary policy across emerging market economies.

6. Conclusion and Policy Suggestion

We examined the legitimacy of the Taylor rule in India within an augmented forward-looking framework that incorporates exchange rate asymmetry and dynamic adjustments. Broadly, the empirical results provide strong evidence of a stable long-run relationship among policy

interest rate, inflation, output gap, and exchange rate, and consistent with the ARDL bounds testing approach (Pesaran et al., 2001).

These findings confirm that the Indian monetary policy is indeed forward-looking, with RBI responding significantly to expected inflation and real economic activity, in line with the theoretical framework of the Taylor rule (Taylor, 1993), along with its forward-looking extensions (Clarida et al., 2000). Also, the presence of a highly significant lagged policy rate further indicates strong interest rate smoothing behavior, consistent with Woodford's (2003) insights. A key contribution of the study refers to the identification of asymmetric exchange rate effects for which, our findings affirm that the Indian monetary policy does respond strongly to currency depreciation than to appreciation, thereby reflecting concerns over imported inflation and external sector vulnerability. Notably, this finding concurs with open economy extensions of the Taylor rule (Ball, 1999; Svensson, 2000), and is widely supported in empirical literature on emerging market economies.

In the Indian context, similar evidence has earlier been reported by Mohanty and Klau (2004), Singh (2010), and Hutchison et al. (2012), who demonstrated that monetary policy responds systematically to inflation, output, and exchange rate movements, with a stronger reaction to adverse external shocks. Holistically, our study coupled with these studies from literature significantly reinforce the importance of incorporating exchange rate dynamics into monetary policy frameworks, especially across emerging economies.

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