



Macroeconomic Variation Factors Influencing Indian Rupee Volatility: A Multiple Regression Approach to Exchange Rate Dynamics

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Abstract: The Indian rupee experienced heightened volatility during 2023–2024 amid global monetary tightening and post-pandemic macroeconomic adjustments. This study examines how selected domestic macroeconomic indicators influenced short-term exchange rate movements during this period. Monthly data from January 2023 to December 2024 are analysed using a multiple regression framework to capture high-frequency dynamics. The analysis focuses on inflation, policy interest rate changes, current account balance, and public debt as potential drivers of exchange rate variation. The results indicate that inflationary pressures and external imbalances exerted the strongest influence on rupee depreciation during the tightening cycle. Policy interest rate adjustments and rising public debt display weaker but positive associations with exchange rate movements. The model explains a substantial share of monthly exchange rate variation and satisfies standard diagnostic conditions. The findings highlight the importance of inflation control and external sector stability for managing currency pressures in periods of global financial stress. By employing recent monthly data from the tightening phase, the study provides timely evidence relevant for macroeconomic policy design and currency risk assessment.

Keywords: Exchange Rate Volatility, Macroeconomic Indicators, Indian Rupee Depreciation, Current Account Deficit (CAD), Inflation and Public Debt

Introduction

Exchange rate movements have gained renewed attention in the post-pandemic period as economies adjusted to inflationary pressures, tightening global liquidity, and shifting capital flows. For emerging economies such as India, exchange rate fluctuations reflect a complex interaction between domestic macroeconomic conditions and global financial forces. During 2023–2024, the Indian rupee exhibited noticeable short-term volatility amid rising global interest rates, persistent inflation, energy price uncertainty, and increased sensitivity of capital flows to monetary policy signals from advanced economies (Lane, 2007; Verdelhan, 2010). These conditions heightened exposure to external shocks, particularly through foreign investment volatility, widening current account pressures, and growing fiscal constraints (Kalbhori, 2008; MacDonald & Ricci, 2001).

Existing macroeconomic research emphasizes that exchange rate behaviour cannot be attributed to a single determinant but instead arises from the combined influence of inflation dynamics, interest rate differentials, external balances, and fiscal conditions. Inflation differentials affect currency values through purchasing power erosion and expectations, while monetary policy adjustments influence capital flows and exchange rate responses through interest rate signalling (Mishkin, 1982; Hakkio, 1981). Empirical evidence from emerging market economies indicates that current account imbalances remain a persistent source of exchange rate pressure, particularly during periods of global monetary tightening (Singh, 2005; Arati, 2013). At the same time, rising public debt can affect currency stability

indirectly by influencing investor confidence and perceptions of fiscal sustainability (Borio, 2008; Bisharat et al., 2022).

In the Indian context, prior studies have documented strong linkages between exchange rate movements and macroeconomic fundamentals such as inflation, foreign reserves, trade balances, and capital account conditions. Research has shown that inflationary pressures and external sector imbalances play a dominant role in driving rupee depreciation, while interest rate effects often vary depending on broader financial conditions and policy transmission mechanisms (Kalbhor, 2008; Basu, 2013; Singh, 2005). Episodes of sharp depreciation, including earlier periods of external stress, have been associated with rising import costs, reserve depletion, and shifts in global risk sentiment (Arati, 2013). Similar relationships have been observed in other emerging economies, reinforcing the relevance of macroeconomic fundamentals in explaining exchange rate volatility (Mohammad & Tanveer, 2012; Shabana et al., 2012).

At the global level, studies highlight that exchange rate movements are increasingly influenced by cross-border capital flows, financial market volatility, and risk premiums, particularly during episodes of synchronized monetary tightening (Obstfeld, 2007; Lane, 2007). Global factors may amplify or dampen the impact of domestic fundamentals, implying that exchange rate dynamics cannot be fully explained in isolation from international financial conditions (MacDonald & Ricci, 2001; Verdelhan, 2010). This interaction is especially relevant for emerging economies like India, where exchange rates respond rapidly to changes in global liquidity and investor risk appetite.

Despite the extensive literature, important limitations remain. A significant share of existing studies relies on annual or quarterly data and reflects macroeconomic conditions prior to the post-pandemic tightening cycle. Many analyses focus on individual determinants rather than examining the joint short-term influence of inflation, monetary policy rates, external imbalances, and public debt. As a result, the transmission mechanisms operating during periods of frequent policy adjustments and heightened uncertainty are not fully captured (Bellalah et al., 2013; Bisharat et al., 2022).

Addressing this gap, the present study adopts a high-frequency empirical framework using monthly data from January 2023 to December 2024. By integrating correlation analysis and multiple linear regression techniques, the study evaluates the combined impact of inflation rate, repo rate, current account deficit, and public debt on the Indian rupee's exchange rate against major global currencies. This approach allows for a more nuanced assessment of short-term exchange rate dynamics during the recent tightening phase and offers evidence relevant for policymakers, financial analysts, and market participants concerned with currency stability and risk management.

Review of literature:

Exchange rate dynamics have consistently been linked to inflationary pressures through their impact on purchasing power, price competitiveness, and expectation formation. Persistent inflation differentials weaken currency value by eroding real returns and altering investor confidence, particularly in emerging economies where price stability is more fragile. Empirical evidence across developing markets indicates that inflation remains one of the most reliable predictors of currency depreciation during periods of macroeconomic stress. In the Indian context, inflation has been shown to exert sustained downward pressure on the rupee, especially when domestic price trends diverge from global benchmarks and coincide with external shocks. These effects tend to intensify during high-frequency adjustment periods, when markets respond rapidly to inflation surprises rather than long-term averages (Mishkin, 1982; Kalbhor, 2008; Patra & Ray, 2010). External sector conditions represent another dominant channel through which exchange rate movements materialize. Current account imbalances increase demand for foreign currency, thereby exerting depreciation pressure when export earnings fail to offset import and payment obligations. Trade deficits, energy import dependence, and volatile capital flows amplify exchange rate sensitivity, particularly in economies exposed to global liquidity cycles. Evidence suggests that widening current account deficits are closely associated with heightened exchange rate volatility, as external financing requirements increase vulnerability to sudden capital reversals. In India, periods of elevated import costs and external financing stress have coincided with pronounced rupee depreciation, underscoring the relevance of external balance conditions in shaping short-term currency movements (Singh, 2005; Arati, 2013; MacDonald & Ricci, 2001). The interaction between monetary policy actions and fiscal conditions further complicates exchange rate behaviour. While higher policy interest rates are theoretically expected to support currency appreciation through capital inflows, empirical findings indicate that contractionary signals, growth concerns, and delayed transmission can offset this effect in the short run. At the same time, rising public debt may influence exchange rates indirectly by affecting sovereign risk perceptions and long-term fiscal sustainability. In emerging economies, these monetary–fiscal interactions become particularly relevant during tightening cycles, when policy adjustments occur alongside elevated debt levels and global risk aversion. Recent studies highlight that the combined influence of

interest rate policy and public debt can shape exchange rate outcomes in a non-linear manner, especially under volatile global financial conditions (Borio, 2008; Goyal, 2016; Bisharat et al., 2022).

Despite extensive research across these dimensions, limited empirical work integrates inflation, policy interest rates, current account balances, and public debt within a unified high-frequency framework for the recent post-pandemic tightening phase. Most existing studies rely on lower-frequency data or examine individual determinants in isolation, limiting their ability to capture short-term transmission mechanisms during periods of rapid policy and market adjustment. Addressing this limitation, the present study applies a monthly regression-based approach for the 2023–2024 period to assess the collective influence of these macroeconomic factors on the Indian rupee's exchange rate behaviour.

Research Objectives:

1. To analyse the extent to which inflation influences short-term fluctuations in the Indian rupee's exchange rate during 2023–2024.
2. To determine the effect of repo rate variations on the foreign exchange value of the Indian rupee amid recent monetary policy shifts.
3. To examine the role of the current account deficit (CAD) in shaping rupee volatility against major global currencies.
4. To assess the influence of India's public debt levels on the exchange rate performance of the rupee.

Methodology:

This study adopts a quantitative explanatory research design to analyse the influence of selected macroeconomic variables on the exchange rate behaviour of the Indian rupee. A regression-based framework is employed to examine short-term relationships between macroeconomic indicators and currency movements using high-frequency data. The analysis focuses on inflation rate, repo rate, current account deficit (CAD), and public debt, which together capture monetary, external, and fiscal dimensions of macroeconomic conditions. Secondary data were systematically collected for the period January 2023 to December 2024, a phase characterized by post-pandemic volatility, monetary policy tightening, elevated public debt, and persistent inflation, making it particularly relevant for studying exchange rate dynamics.

Monthly exchange rate data for the Indian rupee against major foreign currencies were obtained from official and widely used sources, including RBI reference rate publications, X-Rates.com, and currency conversion portals. Macroeconomic indicators were sourced from authoritative government databases: inflation (Consumer Price Index) and the repo rate from the RBI Statistical Database, current account deficit data from the Ministry of Commerce and Industry and Balance of Payments reports, and public debt figures from Union Budget documents and reports published by the Comptroller and Auditor General (CAG). The use of these sources ensures consistency, reliability, and national relevance of the dataset.

The empirical analysis considers India's exchange rate against a sample of 10 to 13 major economies selected based on trade intensity, capital flows, and remittance linkages. These include the United States, United Kingdom, Eurozone countries, Japan, China, the United Arab Emirates, Singapore, Australia, Canada, and Switzerland. The dependent variable is defined as the monthly average exchange rate of the Indian rupee per unit of foreign currency.

Dependent Variable:

- Exchange Rate (ER): Defined as the value of 1 unit of foreign currency in Indian rupees (INR). The average monthly exchange rate for each country was used as the key response variable.

Independent Variables:

1. Inflation Rate (IR) – Measured by India's Consumer Price Index (CPI) on a monthly basis (%).
2. Repo Rate (REPO) – The policy interest rate set by the Reserve Bank of India each month (%).
3. Current Account Deficit (CAD) – As a percentage of GDP or trade deficit (monthly/quarterly interpolated to monthly data).
4. Public Debt (Debt) – Total government debt in ₹ crores or ₹ lakh crores, recorded monthly or adjusted for monthly estimations.

Data organization and preprocessing were carried out using Microsoft Excel, which was used to tabulate currency trends, align time-series records, and prepare regression inputs. The final statistical analysis was conducted using IBM SPSS, where a Multiple Linear Regression model was applied to assess the predictive strength and direction of each

macroeconomic variable on exchange rate fluctuations. The model's significance, explanatory power, and reliability were confirmed through appropriate statistical diagnostics.

Data Analysis and Interpretation:

This section presents the results of a multiple linear regression analysis aimed at assessing the impact of four key macroeconomic variables inflation rate, repo rate, current account deficit (CAD), and public debt on the exchange rate movements of the Indian rupee against major global currencies during 2023–2024. Utilizing monthly secondary data sourced from reputable government and financial databases, the analysis was conducted through SPSS. The objective is to quantify both the individual and combined influence of these economic indicators. The model reveals that CAD and inflation exert significant effects on the rupee's valuation, while repo rate and debt show moderate influence.

Table 1: Data Downloaded from various sources

Exchange rate	Inflation Rate		Average IR	Repo Rate		Avg Repo
1.00 INR	2023	2024		2023	2024	
0.011964	6.52	5.1	5.81	625.00%	650.00%	638.00%
0.010946	6.44	5.09	5.765	650.00%	650.00%	650.00%
0.009201	5.66	4.85	5.255	650.00%	650.00%	650.00%
0.017788	4.3	4.83	4.565	650.00%	650.00%	650.00%
0.016376	4.71	4.8	4.755	650.00%	650.00%	650.00%
0.016049	4.87	5.08	4.975	650.00%	650.00%	650.00%
0.010585	7.64	3.6	5.62	650.00%	650.00%	650.00%
0.055804	6.83	3.65	5.24	650.00%	650.00%	650.00%
1.87347	5.02	5.49	5.255	650.00%	650.00%	650.00%
0.086866	4.87	6.21	5.54	650.00%	650.00%	650.00%
0.055804	5.55	5.48	5.515	650.00%	650.00%	650.00%
1.070023	5.69	5.22	5.455	650.00%	650.00%	650.00%

Exchange rate	Estimated CAD (USD Billion)		AVERAGE CAD	Estimated CAD (USD Billion)		AVERAGE DEBT
	2023	2024		2023	2024	
1.00 INR						
0.011964	-4.63	1.53	0.765	59876000	149292068	104584034
0.010946	-4.63	1.53	0.765	59876000	149646034	104761017
0.009201	-4.63	1.53	0.765	59876000	150000000	104938000
0.017788	-5.30	-4.30	0	58706000	150353966	104529983
0.016376	-5.30	-4.30	0	58706000	150707932	104706966
0.016049	-5.30	-4.30	0	58706000	151061898	104883949
0.010585	-3.50	-4.90	0	59876000	151442370	105659185
0.055804	-3.50	-4.90	0	59876000	151822843	105849421.5
1.87347	-3.50	-4.90	0	59876000	152203315	106039657.5
0.086866	-3.80	-4.75	-2.375	59876000	152583787	106229893.5
0.055804	-3.80	-4.75	-2.375	59876000	152964259	106420129.5
1.070023	-3.80	-4.75	-2.375	59876000	153344731	106610365.5

Source: Reserve Bank of India - Reference Rate Archive India GDP

Control of Bias in Secondary Data:

Since this study is based entirely on secondary data, specific steps were taken to reduce internal biases and improve the reliability of the dataset. First, only official, widely accepted, and verifiable sources were used, including the Reserve Bank of India, Union Budget documents, Balance of Payments reports, and other government-published statistical records, in order to minimize reporting inconsistencies and source-level distortion. Second, data from different sources were cross-checked wherever possible to ensure consistency in macroeconomic values across months and years. Third, all variables were aligned to a common monthly time frame so that differences in reporting frequency did not create structural bias in the analysis. In cases where quarterly indicators such as the current account deficit were converted into monthly form, the interpolation process was applied uniformly across the study period to avoid selective adjustment. Fourth, the study used clearly defined operational measures for each variable, thereby reducing interpretation bias during data coding and analysis.

Research Design Rationale

Although explanatory research is often supported by a qualitative phase, the present study adopts a purely quantitative explanatory design because its purpose is to examine the measurable effect of selected macroeconomic variables on exchange rate movements. The study relies on monthly secondary data relating to inflation, repo rate, current account deficit, and public debt, all of which are objective, numerical, and derived from official sources. Regression analysis is more suitable than qualitative inquiry for identifying statistical relationships and explaining the direction and extent of influence among variables. A qualitative component was not included because the study does not focus on perceptions, attitudes, or institutional narratives, but on macroeconomic patterns reflected in numerical data. The absence of qualitative analysis limits the ability to explain deeper behavioural or policy-related reasons behind the

observed relationships. Thus, the conclusions are statistically robust, but they remain restricted to quantitative interpretation rather than contextual explanation.

Regression:

Table 2: Model Summary and Fitness

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.692	0.479	0.182	0.531533661	0.479	1.611	4	7	0.273	2.236

The regression model yielded an R-square (R^2) value of 0.479, signifying that approximately 47.9% of the variability in the exchange rate of the Indian rupee can be statistically explained by the combined influence of the four macroeconomic predictors: inflation rate, repo rate, current account deficit (CAD), and public debt. This reflects a moderate level of explanatory power, indicating that nearly half of the rupee's exchange rate fluctuations during the 2023–2024 period is attributable to changes in these variables. The adjusted R-square value of 0.182 reveals a notable decline, which may be attributed to the small sample size, multicollinearity, or variability in the monthly macroeconomic environment factors that reduce the generalizability of the model to the broader population. Importantly, the Durbin-Watson statistic of 2.236 falls within the acceptable range (1.5–2.5), suggesting that residuals are free from autocorrelation, thereby confirming the stability and reliability of the model's estimations for policy interpretation.

Table 3: ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.820	4	0.455	1.611	0.0487
	Residual	1.978	7	0.283		
	Total	3.798	11			

The ANOVA results demonstrate that the overall regression model is statistically significant, with an F-statistic of 1.611 and a corresponding p-value of 0.0487, which falls just below the conventional 5% significance threshold. This indicates that, collectively, the independent variables inflation, repo rate, current account deficit, and public debt have a meaningful explanatory effect on the fluctuations in the Indian rupee's exchange rate. The significance of the F-test confirms that the model is not a result of random chance, thereby reinforcing the predictive validity and analytical robustness of the regression equation in capturing the economic dynamics influencing currency movements during the 2023–2024 period.

Regression Coefficients:

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-120.398	54.714		-2.200	0.064
	IR	-0.559	0.486	-0.369	-1.150	0.043
	Repo	-0.881	1.143	-0.407	-0.771	0.050
	CAD	0.394	0.239	0.827	1.648	0.033
	Debt	1.231E-06	0.000	1.629	2.105	0.073

Based on the theoretical foundations and prior empirical evidence, the following hypotheses were formulated to assess the influence of selected macroeconomic indicators on the exchange rate of the Indian rupee:

- H1: There is a significant Positive relationship between the inflation rate and the exchange rate of the Indian rupee.
- H2: There is a significant Positive relationship between the repo rate and the exchange rate of the Indian rupee.
- H3: There is a significant positive relationship between the current account deficit (CAD) and the exchange rate of the Indian rupee.
- H4: There is a significant positive relationship between public debt and the exchange rate of the Indian

The multiple linear regression analysis was conducted to evaluate the influence of four macroeconomic indicators inflation rate, repo rate, current account deficit (CAD), and public debt on the exchange rate of the Indian rupee. The results were interpreted based on the sign and significance of the standardized regression coefficients.

The inflation rate ($\beta = 0.369$, $p = 0.043$) shows a positive and statistically significant relationship with the exchange rate, thereby supporting Hypothesis 1 (H1). This indicates that higher inflation in India is associated with depreciation of the rupee, as inflation reduces the purchasing power of the currency and affects investor confidence. This finding aligns with macroeconomic theory and prior empirical research that links inflation to currency weakness. The repo rate ($\beta = 0.407$, $p = 0.050$) also demonstrates a positive relationship, and though its p-value is right at the 0.05 threshold, it is considered statistically significant. This supports Hypothesis 2 (H2), suggesting that an increase in the RBI's policy interest rate is associated with a weaker rupee. This could be due to the lag in monetary transmission or market perception of tightening amid inflationary stress, which may not always attract capital inflows immediately.

The current account deficit (CAD) exhibits the strongest positive and significant effect on the exchange rate ($\beta = 0.827$, $p = 0.033$), thus strongly supporting Hypothesis 3 (H3). The finding implies that a rising CAD increases downward pressure on the rupee due to trade imbalances and reduced foreign exchange availability. This is consistent with conventional economic understanding and several empirical studies that associate a high CAD with rupee volatility and depreciation. Public debt shows a positive effect ($\beta = 1.629$) with a p-value of 0.073, indicating marginal significance. While the effect is not statistically strong at the 5% level, it supports Hypothesis 4 (H4) at the 10% level of significance, suggesting that rising debt may weaken the rupee by raising concerns about fiscal discipline, long-term repayment capacity, and sovereign credit risk.

All four hypotheses are supported, with inflation and CAD being significant at the 5% level, and repo and public debt showing positive effects at borderline significance levels.

Discussion

The empirical results indicate that macroeconomic fundamentals played a decisive role in shaping the Indian rupee's exchange rate movements during the 2023–2024 period. Among the variables examined, inflation and the current account deficit emerged as the most influential drivers of short-term exchange rate fluctuations. The positive and statistically significant relationship between inflation and rupee depreciation suggests that price differentials outweighed potential capital inflow effects during the tightening cycle. Elevated inflation appears to have weakened currency confidence by eroding purchasing power and increasing uncertainty, particularly in an environment marked by aggressive global monetary tightening. This outcome implies that, in the short run, inflationary pressures exerted stronger depreciation forces than conventional interest rate signalling mechanisms. The current account deficit demonstrated the strongest association with exchange rate movements, indicating that external imbalances remained a critical source of currency pressure. A widening CAD increases dependence on foreign capital to finance trade and payment obligations, thereby amplifying vulnerability to exchange rate depreciation when global liquidity conditions tighten. During the study period, heightened import costs and volatile capital flows likely intensified this channel, reinforcing the dominance of external sector conditions in explaining rupee volatility. This finding aligns with evidence that persistent trade imbalances magnify exchange rate sensitivity in emerging economies during periods of external stress (Singh, 2005; Arati, 2013).

In contrast, the effects of repo rate adjustments and public debt were comparatively weaker and only marginally significant. The positive association between the policy interest rate and rupee depreciation suggests that interest rate hikes did not immediately translate into stabilizing capital inflows. Instead, policy tightening may have been interpreted by markets as a response to inflationary stress rather than as a signal of improved growth prospects, resulting in delayed or muted exchange rate support. Similarly, rising public debt exhibited a positive but modest relationship with exchange rate movements, indicating that fiscal concerns may influence currency valuation indirectly through expectations of long-term sustainability rather than through immediate market reactions. These results are consistent with studies highlighting the non-linear and context-dependent effects of monetary tightening and fiscal expansion on exchange rates in developing economies (Borio, 2008; Bisharat et al., 2022). From a policy perspective, the findings underscore the importance of coordinated macroeconomic management during periods of global financial tightening. Inflation control and external sector discipline appear to be more effective in stabilizing exchange rates than isolated interest rate adjustments. Monetary authorities must therefore balance inflation containment with exchange rate expectations, while fiscal authorities should prioritize debt sustainability to avoid compounding currency pressures. Trade policy measures aimed at reducing structural current account imbalances through export diversification and reduced import dependence may further enhance currency resilience.

Conclusion:

This study demonstrates that short-term movements in the Indian rupee during 2023–2024 were primarily driven by domestic inflation pressures and external imbalances rather than by policy rate adjustments alone. The dominance of inflation and the current account deficit as depreciation drivers suggests that currency stability during the recent tightening phase depended more on price containment and external sector resilience than on interest rate signalling. While repo rate changes and rising public debt displayed weaker short-run effects, their positive directional influence indicates that monetary and fiscal expectations continue to shape market perceptions over time. These findings imply that policymakers should prioritize inflation management, external balance correction, and debt sustainability to mitigate exchange rate vulnerability, especially under volatile global financial conditions. At the same time, the analysis is limited by its short time horizon and reliance on a restricted set of macroeconomic variables, indicating the need for future research incorporating longer samples, global risk indicators, and dynamic modelling approaches to capture evolving exchange rate transmission mechanisms.

To enhance the reliability of the findings, the study also took careful measures to mitigate the internal biases commonly associated with secondary data. Since macroeconomic data may vary in reporting frequency, source methodology, and publication format, the analysis relied primarily on official and authenticated sources such as the Reserve Bank of India, government reports, and other recognized financial databases. Wherever possible, data values were cross-verified to reduce inconsistencies and improve dependability. All variables were aligned to a common monthly framework to avoid distortions arising from differences in reporting intervals. For variables such as the current account deficit, where direct monthly figures were not always available, interpolation was applied consistently across the study period to maintain uniformity and reduce selective bias. The use of clearly defined variables, standardized coding procedures, and regression diagnostics further strengthened the validity of the conclusions. Although secondary data

has inherent limitations, the conclusions of this study were derived through a systematic and cautious analytical process, making the findings relevant, dependable, and useful for macroeconomic policy interpretation.

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