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DECIPHERING CURRENCY DYNAMICS: QUANTITATIVE EVIDENCE ON KEY DRIVERS OF INDIA'S FOREIGN EXCHANGE RATE MOVEMENTS

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ABSTRACT
This study explores the relationship of key macroeconomic indicators with India's REER from 1991 to 2022, utilizing the ARDL cointegration method. By analyzing the long-run and short-run relationships between REER and variables such as the CPI, call money rate, imports, exports, and money supply, the research uncovers significant dynamics influencing the REER. The study found that higher domestic inflation as indicated by the CPI, leads to currency depreciation fostering competitiveness in Indian exports while elevating import costs. Conversely, elevated interest rates represented by the call money rate, tend to appreciate the rupee by attracting foreign investment. Surprisingly, while exports positively correlate with REER, imports exhibit negligible influence potentially due to India's inflexible import demands. Also, it was seen that the error correction term ensuring long-run stability of the equilibrium. Diagnostic tests confirm the ARDL model's reliability, enhancing confidence in the estimates. These findings contribute insights into the complex relationship between economic factors and exchange rate dynamics in India. Policy implications underscore the importance of inflation management, export promotion, interest rate adjustments, and prudent monetary policy execution in shaping exchange rate movements, offering policymakers a roadmap to achieve desired outcomes while balancing broader economic goals.

Keywords: *REER, Macroeconomic Variables, Autoregressive Distributed Lag (ARDL), CPI, Money Supply.*

JEL Classifications: *F31, F41, E31, C22, C32*

1. INTRODUCTION
In today's interconnected global economy, exchange rates play a crucial role, significantly influencing a country's trade competitiveness, capital movements, and overall macroeconomic stability (Jashandeep, Drishty, & Anjali, 2018). These rates, symbolizing the relative value of a country's currency vis-à-vis others, undergo influence from an array of factors, spanning both domestic and international realms. In the context of India's rapid economic growth and deepening integration into the global market, the maintenance of a stable and competitive exchange rate assumes extremely importance, serving as a pillar while the nation broadens its trade networks and entices foreign investments.

Exchange rates serve as a critical point in international economic engagements, as no nation can operate in isolation given their varied resource endowments. The fluctuation of these rates significantly impacts various economic indicators, including interest and inflation rates, as well as the quantities of imports, exports, and overall production. Such fluctuations underscore the crucial role exchange rates play in the economic fortunes of nations participating in the global trade of goods and services. The significance of exchange rates lies in their capacity to harmonize the price systems across disparate nations, thus enabling direct comparisons of traded goods across borders (Usman, 2009). Through their impact on the magnitude of imports and exports, exchange rates wield considerable influence over a country's balance of payments position.

In emerging economies such as India, the importance of the exchange rate has grown significantly since the adoption of a flexible exchange rate regime. Before the introduction of the Structural Adjustment Program (SAP) in 1991, India's exchange rate policy tended to favour the overvaluation of the rupee, fluctuating between Rs 18.11 and Rs 25.79 around 1991. This bias toward overvaluation stimulated export activities but hindered non-oil exports and increased reliance on imported inputs.

Following the implementation of SAP, India experienced heightened exchange rate volatility due to increased vulnerability to external shocks. The impact of the global economic downturn on India's exchange rate was particularly pronounced. From 1991 to 2022, the rupee saw a significant appreciation against the dollar, rising from around Rs 18.11/$ to over Rs 81.35/$, representing a surge of approximately 349.1%. This surge was largely driven by a sharp decline in India's foreign earnings, triggered by the persistent rise in crude oil prices, which reached an unprecedented US$ 85.41 per barrel in March 2024.

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The combination of soaring oil prices & exchange rate fluctuations poses a significant challenge to macroeconomic stability and economic growth for countries like India that are not primarily reliant on oil production. As Usman (2009) suggests, nations such as Nigeria often witness substantial increases in government spending during periods of high oil revenue, while periods of reduced oil revenues often coincide with budget deficits.

In light of this context, the purpose of this study is to identify the relationship of key macroeconomic variables, namely inflation, call rate (interest rate), imports, exports, and money supply, with India's exchange rate. The motive of the study to explore the key determinants impacting the valuation of the Indian rupee in comparison to other currencies.

Inflation, representing the general increase in prices of goods and services, stands as a crucial determinant of exchange rates. As per the Purchasing Power Parity (PPP) theory, sustained disparities in inflation rates among nations can trigger adjustments in exchange rates to restore equilibrium in purchasing power (Jashandeep et al., 2018; Osiegbu & Onuorah, 2011). Elevated domestic inflation rates may potentially ruin the currency's worth, while lower inflation rates could facilitate currency appreciation.

The call rate, indicative of the interest rate set by the central bank for lending funds to commercial banks, assumes a crucial role in exchange rate dynamics. Fluctuations in interest rates can influence capital movements and investment decisions, consequently affecting the demand for and supply of currencies in the foreign exchange market (Usman, 2009). Elevated interest rates typically entice foreign capital inflows, potentially resulting in the increase of the domestic currency.

A nation's trade equilibrium, evident in its import & export levels, holds considerable influence over variation in exchange rates. A persistent trade deficit, where imports surpass exports, can exert downward pressure on the native currency, whereas a surplus might trigger currency appreciation (Osiegbu & Onuorah, 2011). Grasping the nexus between trade patterns and exchange rates is pivotal for policymakers striving to uphold a competitive export sector and navigate the implications on country's current account.

The total money supply in an economy, which reflects the overall amount of currency in circulation, affects exchange rates by influencing expectations about inflation, interest rates, and the broader economic outlook (Usman, 2009). Expansionary monetary measures, which augment the money supply, may potentially dissolve the currency's worth, while contractionary policies might lead to currency strengthening.

The literature discussed above aids in identifying the key variables influencing the REER, highlighting the significance of analyzing the long-run and short-run relationship between these fundamental economic indicators and the REER. This research seeks to enrich the existing knowledge base and furnish invaluable insights for policymakers, enterprises, and investors active within the Indian economic landscape.

Expanding on the previous discussion, this research outlines its objective as follows. The basic goal is to explore into the impact of macro-economic variables on India’s Exchange Rate, focusing on the following ***objectives:***

- Analyzing the connection between India's exchange rate and key macroeconomic variables, including inflation, call rates, imports, exports, and money supply.
- Based on the outcome of the estimation providing major practical and policy implications.

1.1 OVERVIEW:

Chart 1 below illustrates the temporal trends of the selected macroeconomic variables spanning from 1991 to 2022, as employed in this investigation.

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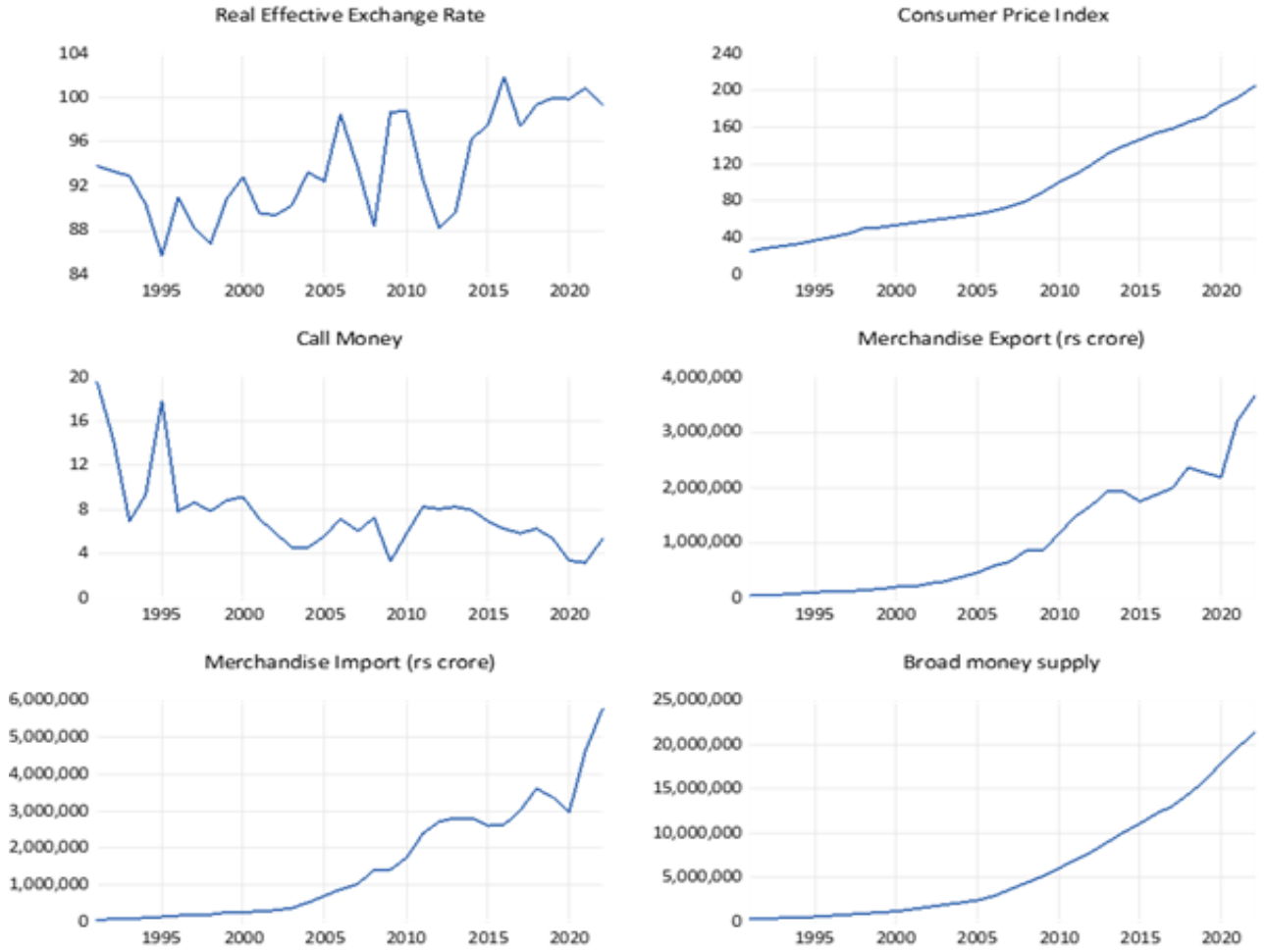
CHART 1. TREND OF SELECTED VARIABLES (1991-2022)



Source: *Author's own construction*

The REER shows fluctuations, indicating periods of currency appreciation and depreciation. These movements will impact the competitiveness of Indian exports and the cost of imports, affecting trade balances and inflation. The CPI exhibits a steady upward trend, reflecting a consistent rise in the general price level or inflation in India over the years. Rising inflation erodes purchasing power and impact consumption and investment decisions. The call money rate, which represents the interbank lending rate, displays a volatile pattern, reflecting changes in monetary policy and liquidity conditions.

Higher call rates reduce borrowing and economic activity but help control inflation. Indian exports show a consistent upward trend, especially after the mid-2000s, indicating increasing global demand for Indian goods and services. However, changes in REER and global economic conditions will influence export performance. Imports also exhibit a sharp upward trend, reflecting India's growing demand for foreign goods and raw materials, driven by economic growth and rising incomes. Import levels can be affected by REER movements and domestic demand conditions. The broad money supply trend displays a consistent rise, indicating an increase in the money circulating in the Indian economy over time. This expansion fuels economic growth but may also contribute to inflationary pressures if not managed properly.

The interconnectedness of these trends is evident. For instance, a depreciation in the REER can make Indian exports more competitive in global markets, potentially boosting export growth. However, it can also make imports costlier, contributing to higher inflation (reflected in the CPI). To counteract inflationary pressures, the central bank may raise call money rates, which can dampen domestic demand & import growth but also potentially slow down economic activity.

Changes in export and import levels can impact trade balances, affecting currency demand and supply, which in turn can influence the REER. Additionally, strong economic growth, reflected in rising money supply and imports, will put upward pressure on inflation, prompting monetary policy adjustments through call money rates.

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The paper is structured into five main segments: Introduction, Literature Review, Data & Methodology, Results & Interpretation, and Conclusion.

2. LITERATURE REVIEW

The literature offers two primary perspectives on the influence of exchange rate fluctuations on economic activities: the traditional perspective and the empirical perspective. According to Edwards (1989), exchange rate misalignment, like currency devaluation, can adversely affect tradable activities, leading to decreased net exports and aggregate demand. Edwards further argues that real depreciation may cause adverse effects, ultimately resulting in overall economic contraction due to nominal depreciation elevating the general price level and dampening aggregate demand, as well as potentially redistributing income from individuals with a higher marginal propensity to consume to those with a lower propensity.

Iyoha and Oriakhi (2004) attributed movements in the RER during a specific period to nominal stock from fiscal deficits. They have utilized co-integration and error correction models to scrutinize the impact of the REER on economic activities in Nepal, aiming to spot whether the aggregate demand or aggregate supply channel was primarily affected by fluctuations in the RER.

Odusola (2006) utilized co-integration & ECM methodologies to scrutinize the behaviour of India's overall import demand between 1971 and 1995, suggesting that import volume is co-integrated with relative import price and real GDP, and that import demand in India is primarily influenced by real GDP and exhibits less sensitivity to changes in import prices.

Obadan (2006) applied a VECM to examine the Marshall-Lerner condition in the exchange rate-balance relationship in the Baltic States, finding the condition fulfilled for Lithuania but not for Estonia, with ambiguous results for Latvia, despite traditional factors being adequate in explaining trade dynamics in Baltic countries.

Aliyu (2009) observed that oil windfalls led to excessive fiscal spending on development projects, followed by financing through money creation post-windfalls, contributing to inflationary pressures and exacerbating significant real exchange rate movements, as highlighted by Lu and Zhang (2003).

Omojimite and Akpokodje (2010) posit that exchange rate variations in India are influenced by shifts in international trade patterns, changes in institutional frameworks, and structural transformations in production processes. Englama et al. (2010) argue that in Nigeria, the real exchange rate is mainly influenced by external shocks from global agricultural commodities and oil prices, major exports, and foreign exchange sources.

Lama and Medina (2010) note that the minimal impact on the RER resulted in marginal fluctuation between 1970 and 1977 in Nigeria. However, increased oil dependency led to trade shocks from oil price fluctuations, causing a 10%naira exchange rate variation during 1978–1985.

Haker and Hatemi (2004), employing the GDP function approach pioneered by Mordi (2006), scrutinized import demand and export supply elasticity across 117 countries, offering insights into economic decision-making processes in India and other countries with similar economic structures. Sampath (2011) investigated the relationship between macroeconomic variables & stock prices in India from 1993 to 2010, revealing that economic growth positively influences stock prices.

Antonia and Bara (2008) delved into the connection between the real effective exchange rate and aggregate real trade balance in major OECD countries during the post-Bretton Woods era, finding limited evidence suggesting that exchange rates significantly influence trade balances using various parametric and non-parametric techniques.

Bahmani-Oskoee and Kovyryalova (2008) harnessed the VECM is used to assess the long-term effects of exchange rate devaluation on South Africa's trade balance, presenting evidence that suggests exchange rate devaluation worsens South Africa's trade balance over time.

Modi, Chandrashekar, and Chittedi (2016) explored the correlation between macroeconomic variables and capital inflows in India from 2004 to 2014, employing ADF, Variance Decompositions Technique, & Impulse Response Function methods, reporting that the majority of macroeconomic variables exhibit a positive relationship with capital inflows.

Vadivel, Veeramani, and Raghutla (2020) delved into the interconnection between exchange rates & the WPI for India using the Flexible Least Squares method, discovering that exchange rate fluctuations influence wholesale prices and that both imports and exports also impact exchange and wholesale prices in the local market.

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Babu Rao (2019) analyzed exchange rate regimes and their effects on BRICS countries' growth, concluding that adopting a pegged exchange rate regime could foster economic growth in BRICS nations.

While a significant body of literature delves into the determinants of exchange rate fluctuations, a conspicuous ***research gap*** surfaces regarding India's exchange rate dynamics.

Previous studies have predominantly concentrated on developed economies or conducted aggregate analyses across multiple countries, leaving a void in comprehensive research tailored to the Indian context. Moreover, existing literature often overlooks the complex interaction among specific economic indicators and their collective influence on India's exchange rate.

The study estimates key economic determinants of exchange rate using time-series methodology as identified on the basis of extensive literature review. Time series data, which is collected over successive time intervals, is particularly well-suited for studying the relationship between variables over time. It allows for dynamic analysis, capturing how changes in one variable affect another variable over different time periods. This is crucial when studying responsiveness, as they measure how the exchange rate responds to changes in its determinants.

The subsequent section explains the chosen variables, data sources, and the methodological approach adopted to fulfil the established objectives.

3. DATA AND METHODOLOGY

In the introductory section, this research adopts a multidimensional approach, incorporating five pivotal variables to explore their influence on India's exchange rate. Drawing insights from extensive literature review, the chosen variables are tailored to the characteristics of the dataset, ensuring a robust time series analysis methodology. Data aggregation spans from 1991 to 2022, encompassing a spectrum of sources including the Bank for International Settlements & RBI.

The variables under study comprise the Real Effective Exchange Rate (EXCH), representing a composite of various currencies, along with Inflation Rate (INF), Call Rate (INT), Imports (IMP), Exports (EXP) & Broad Money Supply (MS), whereas import, export, broad money supply denominated in local currency units and study includes the export & import of merchandise goods only. These selections are rooted in established theoretical frameworks linking macroeconomic indicators to exchange rate fluctuations.

The functional form of equation is stated as follows:

$$\text{EXCH} = f\,(\text{INT, INF, IMP, EXP, MS}) \quad (1)$$

The baseline econometric model is expressed as below:

$$\text{EXCH} = \beta_0 + \beta_1\text{INT} + \beta_2\text{INF} + \beta_3\text{IMP} + \beta_4\text{EXP} + \beta_5\text{MS} + u \quad (2)$$

In this paradigm, EXCH denotes the REER, whereas INT express the call rate. Representing inflation, INF stands for the CPI. EXP embodies exports, while IMP mirrors import. MS characterizes the broad money supply, with μ denoting the stochastic disturbance or error term. Furthermore, f defines the functional relationship, with β0 serving as the model's intercept or constant. Complementing these, β1 through β5 elucidate the coefficients associated with each independent variable.

As depicted in Chart 1 within the Introduction section, the course of the variables exhibits non-linear patterns and exhibit fluctuations at different time intervals. Investigation into such datasets might yield misleading outcomes, potentially undermining the study's findings. To mitigate this, Natural Logarithmic Transformation has been applied to the raw data, aiming to linearize the trends to a certain degree. Subsequent analysis has been conducted on the logarithmically transformed values of the dataset.

After applying the log, equation becomes

$$Ln(\text{EXCH}) = \beta_0 + \beta_1 Ln(\text{INT}) + \beta_2 Ln(\text{INF}) + \beta_3 Ln(\text{IMP}) + \beta_4 Ln(\text{EXP}) + \beta_5 Ln(\text{MS}) + u \quad (3)$$

Before inquiring into detailed analysis, it's essential to thoroughly examine the stationary properties and integration orders of each macroeconomic variable. In this paper, we investigated the stationarity properties of time series data for various macroeconomic variables using the ADF test (Dickey, et al., 1981).

Stationarity is a critical concept in time series analysis, as non-stationary data can lead to misleading regression outcomes and unreliable statistical inferences. The ADF test, an augmented version of the Dickey-Fuller test, was employed to detect unit roots, indicating non-stationarity in the time series data. This test was performed on both the levels and first differences of the time series, with and without intercept and trend components.

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The testing procedure involved setting the null-hypothesis (H0) as a unit root against the alternative hypothesis (H1) of stationarity, followed by computing the ADF test statistic and comparing it with critical values. If the test statistic exceeded the critical value, the null hypothesis was upheld, indicating non-stationarity, whereas a test statistic below the critical value led to the rejection of the null hypothesis, suggesting stationarity.

This test was chosen over the Phillips-Perron (PP) test due to its robustness to higher-order serial correlation and its capacity to handle complex time series patterns. Unlike the PP test, which employs a non-parametric correction, the ADF test explicitly accounts for serial correlation through lagged terms, making it more suitable for the variables under investigation, as corroborated by existing literature. The outcomes of the ADF test informed subsequent analysis and modelling decisions, with non-stationary variables undergoing appropriate differencing or transformation to achieve stationarity before further analysis.

After describing their respective behaviours, we apply the f bounds test developed by Pesaran, Shin, and Smith (2001) to determine possible co-integration among the variables.

The following ARDL models are estimated to check for the existence of cointegration as follows:

$$\Delta \ln Exch_t = \alpha_1 + \sum_{i=1}^{m} \theta_{1i} \Delta lnExch_{t-i} + \sum_{i=0}^{n} \theta_{2i} \Delta lnINT_{t-i} + \sum_{i=0}^{p} \theta_{3i} \Delta lnINF_{t-i} + \sum_{i=0}^{q} \theta_{4i} \Delta lnIMP_{t-i} + \sum_{i=0}^{r} \theta_{5i} \Delta lnEXP_{t-i} + \sum_{i=0}^{s} \theta_{6i} \Delta lnMS_{t-i} + \beta_7 lnExch_{t-1} + \beta_8 lnINT_{t-1} + \beta_9 lnINF_{t-1} + \beta_{10} lnIMP_{t-1} + \beta_{11} lnEXP_{t-1} + \beta_{12} lnMS_{t-1} + u_{1t} \quad (4)$$

The ARDL model comprehensively explores the complex interaction of the REER with various independent variables such as interest rate, inflation, imports, exports, and money supply, capturing both their long-term and short-term dynamics.

Equation (4) introduces α_1 as the constant term, with Δ representing the first difference, and m, n, p, q, r, s denoting the optimal lag lengths. The AIC serves as the lag selection criteria in this study for determining the optimal lag length in the ARDL model. AIC strikes a balance between model fit and complexity, penalizing over-parameterization and favouring simplicity. Widely embraced in econometric modelling, AIC boasts desirable asymptotic properties, consistently identifying the true lag order with increasing sample sizes (Lütkepohl, 1991). Its efficacy in determining suitable lag structures has been extensively validated, especially in analyses of exchange rates and macroeconomic time series (Chinn & Meese, 1995). Employing AIC aligns this study with established methodologies, ensuring the robustness and reliability of the model's estimates and inferences. Additionally, the lagged terms of the dependent variable (ΔlnExcht-i) capture the autoregressive aspect of the model.

$$\Delta \ln Exch_t = \alpha_1 + \beta_7 lnExch_{t-1} + \beta_8 lnINT_{t-1} + \beta_9 lnINF_{t-1} + \beta_{10} lnIMP_{t-1} + \beta_{11} lnEXP_{t-1} + \beta_{12} lnMS_{t-1} + u_{1t} \quad (5)$$

In equation 5, the coefficients β_7, β_8, β_9, β_{10}, β_{11}, and β_{12} represent the long-term relationships among the variables under study, while u_{1t} denotes the error term in the model. The ARDL technique aims to examine the existence of long-term cointegration relationships among these variables, with the null hypothesis (H0) positing no such association ($\beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} = 0$) and the alternative hypothesis (H1) suggesting otherwise ($\beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} \neq 0$). Critical values provided by Pesaran, Shin, and Smith (2001) are used to assess the computed F statistic. If it surpasses the upper threshold, indicating I (1) behavior for all variables, the null hypothesis of zero cointegration is rejected. Conversely, falling below the lower threshold suggests I (0) behavior for all variables, making the null hypothesis unassailable. When the statistic falls within the bounds, the test outcome remains inconclusive. In cases where cointegration is rejected, ARDL models with error correction mechanisms are applied to explore short-term dynamics.

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$$\Delta \ln Exch_t = \alpha_1 + \sum_{i=1}^{m} \theta_{1i} \Delta lnExch_{t-i} + \sum_{i=0}^{n} \theta_{2i} \Delta lnINT_{t-i} + \sum_{i=0}^{p} \theta_{3i} \Delta lnINF_{t-i} + \sum_{i=0}^{q} \theta_{4i} \Delta lnIMP_{t-i} + \sum_{i=0}^{r} \theta_{5i} \Delta lnEXP_{t-i} + \sum_{i=0}^{s} \theta_{6i} \Delta lnMS_{t-i} + \beta_7 lnExch_{t-1} + \beta_8 lnINT_{t-1} + \beta_9 lnINF_{t-1} + \beta_{10} lnIMP_{t-1} + \beta_{11} lnEXP_{t-1} + \beta_{12} lnMS_{t-1} + \delta ECT_{t-1} + u_{1t} \quad (6)$$

In equation 6, the parameters θ_{1i}, θ_{2i}, θ_{3i}, θ_{4i}, θ_{5i}, θ_{6i} symbolize the immediate fluctuations, while the ECT_{t-1} term embodies the corrective element, signifying the deviation from the long-term balance in the preceding period. The parameter δ denotes the pace of rectification, delineating how swiftly the REER readjusts towards the enduring equilibrium post-deviation.

To verify the strength of the model, several diagnostic tests are performed on the regression. These include the LM test (Breusch-Godfrey) for assessing serial correlation, the Breusch-Pagan-Godfrey test to investigate heteroskedasticity, the Jarque-Bera test to evaluate residual normality, and the CUSUMSQ test to detect parameter instability. Movement beyond the 5% critical threshold in the CUSUMSQ test indicates instability in the model's parameters.

Selecting these tests over other alternatives stems from their statistical characteristics, straightforward applicability, and extensive utilization across empirical investigations, notably within exchange rate modelling and macroeconomic time series analysis. By opting for these established and resilient assessments, this study adheres to established methodologies, affirming the dependability and authenticity of the outcomes.

In the next section, the results of the applied tests and analysis have been interpreted and discussed in detail in the context of the study.

4. RESULTS AND INTERPRETATION

Table 1 unveils the detection of a unit root within the time series data upon undergoing the Augmented Dickey-Fuller (ADF) test at various levels and difference orders, as delineated by Dickey et al. (1981). This test, employed to evaluate stationarity as outlined in the methodology, scrutinized the variables: Real Effective Exchange Rate (EXCH), Call Rate (INT), Inflation (INF), Imports (IMP), Exports (EXP), and broad money supply (MS). Preceding the ADF test, logarithmic transformations were applied to all variable values.

TABLE 1. Summary result of Unit Root Test using Augmented Dickey Fuller test (ADF Test)

AUGMENTED DICKEY FULLER TEST									
	LEVEL				1ST DIFFERENCE				
	INTERCEPT		TREND & INTERCEPT		INTERCEPT		TREND & INTERCEPT		
Variables	***T-Stats.***	***Prob***	***T-Stats.***	***Prob***	***T- Stats.***	***Prob***	***T-Stats.***	***Prob***	***Remark***
LnREER	-2.339	0.166	-4.399	0.009*	-	-	-	-	I (0)
LnINT	-3.485	0.015*	-	-	-	-	-	-	I (0)
LnCPI	1.033	0.995	-5.580	0.0003*	-	-	-	-	I (0)
LnIMP	-1.771	0.387	-1.647	0.744	-4.344	0.001*	-	-	I (1)
LnEXP	-1.760	0.392	-1.394	0.842	-5.034	0.000*	-	-	I (1)
LnMS	-1.841	0.354	-0.439	0.981	-1.185	0.020*	-	-	I (1)

Source: *Author's own calculation;* ***Note:*** ** indicates 5% at significance level;* ***ln*** *denotes* ***natural log*** *of the variable.*

The determination of the optimal lag length for conducting the ADF test for each variable relies on the Akaike Information Criterion. Upon assessing the statistical significance of the test statistics, it emerges that, in their original form, the null hypothesis positing the existence of a unit root can be rejected for REER, INT, and CPI.

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This suggests that REER, INT, and CPI exhibit stationarity in their original form, denoted as I (0). Conversely, all other variables demonstrate stationarity solely through first differences, signifying they are integrated of order 1 or I (1). Given this mix of I (0) and I (1) characteristics among the macroeconomic variables, the bounds test approach to the ARDL Model is employed to explore potential cointegration relationships among them.

TABLE 2. ARDL Approach (Bounds Test) to Co-integration

Model	F- Statistics	Decision
F_{REER} = *LnREER, LnINT, LnCPI, LnIMP, LnEXP, LnMS*	4.2167905	Co-integration
Critical Values		
Significance level	**Lower Bound I (0)**	**Upper Bound I (1)**
1%	3.06	4.15
2.5%	2.7	3.73
5%	2.39	3.38
10%	2.08	3

Variable	Coefficient	Std. Error	t- Statistics	Prob.
LnCPI	-0.347490	0.117458	-2.958427	0.0104*
LnEXP	0.307045	0.104142	-2.948335	0.0106*
LnIMP	-0.023255	0.093096	-0.249797	0.8064
LnINT	0.070263	0.030634	2.293602	0.0378*
LnMS	-0.523585	0.107916	4.851779	0.0003*
C	1.061954	0.189561	5.602181	0.0001*

EC = LREER - (-0.3475*LCPI + 0.3070*LEXP - 0.0233*LIMP + 0.0703*LINT - 0.5236*LMS + 1.0620)

Source: *Author's own calculation;* ***Note:*** *Lag Length is chosen on the basis of AIC; * denotes 5% level of statistical significance*

Selected through the Akaike Information Criterion (AIC), the ARDL model (2, 2, 1, 2, 1, 2) is formulated in logarithmic form according to equation 3. This model configuration allocates lags as follows: two for the REER, two for the CPI, one for Exports (EXP), two for Imports (IMP), one for the Call Rate (INT), and two for the Broad Money Supply (MS).

The ARDL (2, 2, 1, 2, 1, 2) model furnishes long-run coefficients, as outlined in Table 4. Upon conducting the bounds test, the computed F-statistic of 4.2167905 surpasses the critical upper bound value of 3.38 at a 5% significance level, as posited by Pesaran et al. (2001). This outcome prompts the denial of the null hypothesis of no cointegration, suggesting the presence of a long-term equilibrium connection involving the Real Effective Exchange Rate (REER).and the independent variables: CPI, Call Rate (INT), Imports (IMP), Exports (EXP), and Broad Money Supply (MS) throughout the study period.

The inverse long run relation noted between fluctuations in the CPI with the REER corresponds to established principles of exchange rate theory. According to this framework, heightened inflation rates typically lead to the devaluation of a nation's currency, a phenomenon substantiated by prior empirical investigations (e.g., Dornbusch, 1976; Bilson, 1978). The adverse coefficient attributed to CPI mirrors the outcomes documented by Haile and Soligo (2015), who observed a comparable adverse effect of inflation on the RER in their examination of Ethiopia.

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Whereas, the positive coefficient of export indicates that an increment in merchandise exports is related with an appreciation of the REER in India. This positive relationship can be attributed to the potential inflow of foreign exchange earnings from exports, which can strengthen the domestic currency's value.

The lack of notable impact stemming from alterations in imports on the REER may stem from various factors, such as importer's practices in hedging against exchange rate fluctuations or the relative magnitude of import volumes compared to other macroeconomic factors (Bussière, 2012)., even though it can be observed from the result that import is showing an inverse relation with the REER, which aligns with the general economic theory that if imports increase, it typically leads to an increase in the demand for foreign currency to pay for the higher volume of imports. This increased demand for foreign currency can cause the domestic currency to depreciate in the foreign exchange market, resulting in a decrease in the REER.

The long run relationship observed between the call rate and the REER aligns with the interest rate parity theory, which suggests that elevated interest rates draw in foreign investment, resulting in the appreciation of the local currency (Frankel, 1979; Engel, 1996). These finds support the findings of Inoue and Hamori (2009), who documented a similar positive link between interest rates and the REER in their examination of East Asian nations.

The negative coefficient for the money supply variable suggests that an increment in money supply tends to weaken the REER. An increased money supply leads to higher inflationary pressures in the economy, this increase in inflation leading to a depreciation of the currency in the foreign exchange market. Consequently, there may be a decrease in the REER as the currency becomes less valuable relative to other currencies, affecting the current account balance by potentially worsening it due to decreased competitiveness in international trade and increased import costs. This observation aligns with the conclusions drawn by Uddin et al. (2013). The calculated error correction term (ECT) mirrors the adjustment mechanism responsible for maintaining long-term equilibrium.

TABLE 3. Estimation Results of ECM Regression

Variable	Coefficient	Std. Error	t- Statistics	Prob.
D (LREER (-1))	0.950577	0.211465	4.495201	0.0005
D(LCPI)	0.212908	0.280364	0.759397	0.4602
D (LCPI (-1))	0.850222	0.272255	3.122888	0.0075
D(LEXP)	-0.250180	0.096660	-2.588247	0.0215
D(LIMP)	0.128533	0.076756	1.674564	0.1162
D (LIMP (-1))	0.162580	0.047336	3.434578	0.0040
D(LINT)	0.042437	0.021443	1.979080	0.0678
D(LMS)	1.410667	0.364838	3.866552	0.0017
D (LMS (-1))	-1.713660	0.416374	-4.115677	0.0010
CointEq (-1) *	-1.884025	0.290132	-6.493682	0.0000
R-squared	0.746283		Mean dependent var	0.000900
Adjusted R-squared	0.632110		S.D. dependent var	0.018441
S.E. of regression	0.011185		Akaike info criterion	-5.887292
Sum squared resid	0.002502		Schwarz criterion	-5.420226
Log likelihood	98.30938		Hannan-Quinn	-5.737874
Durbin-Watson stat	2.485517		criterion	

Source: *Author's own calculation*

The Error Correction Representation within the ARDL model unveils intricate short-term dynamics. Notably, the negative coefficient attached to the interaction term (CointEq) signals robust corrective forces, indicating a gradual realignment towards long-term equilibrium. Impressively, the error correction term's substantial magnitude implies nearly complete rectification of around 188% of short-term imbalances within the current

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period, showcasing the Real Effective Exchange Rate's responsiveness to shifts in factors like inflation, interest rates, trade volumes, and money circulation.

A commendable R-squared value of 0.746283 underscores the model's commendable alignment with empirical data, echoing findings from Bhattacharya (2012). The precision and goodness-of-fit reflected by the standard error of regression and sum squared residual echo conclusions drawn by Kemme and Teng (2000) and Goh et al. (2017).

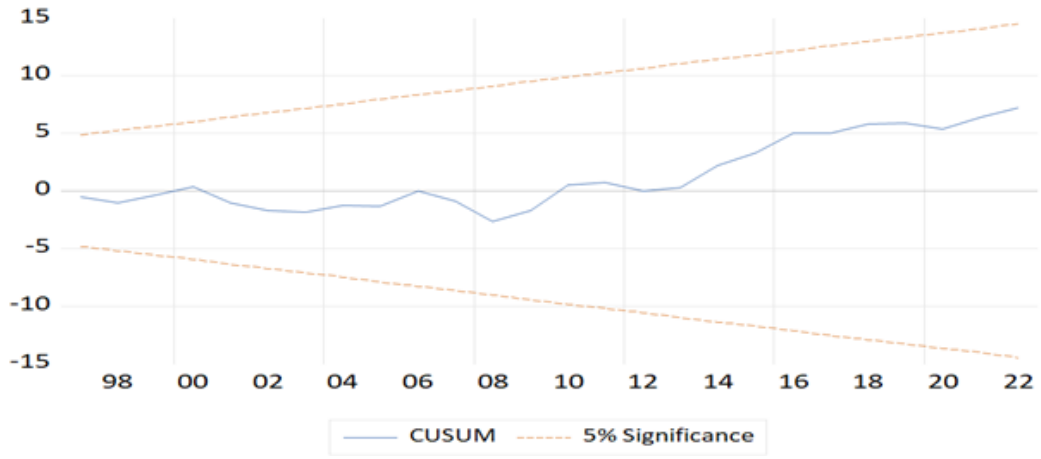
The log likelihood value attests to a favourable concordance between model predictions and actual observations, akin to results outlined by Takhtamanova (2010). Additionally, the Durbin-Watson statistic points towards negligible autocorrelation. Lastly, the reported AIC, SC, and HQ metrics highlight an optimal balance between model fit and complexity.

TABLE 4. Results of Residual Diagnostic Tests

Diagnostic Test	**Jarque-Bera Test**		**Lagrange Multiplier Test**		**Bruesch-Pagan-Godfrey Test**	
Nill Hypothesis (H_0)	Normality (Normally Distributed Residuals)		Zero-serial correlation		Homoskedasticity	
ARDL Models						
	F-Statistics	**P-value**	**F-Statistics**	**P-value**	**F-Statistics**	**P-value**
(2, 2, 1, 2, 1, 2)	5.346679	0.069021	2.199617	0.1535	0.495317	0.9053

Source: *Author's own calculation*

CHART 2: CUSUMSQ Test Results for ARDL (2,2,1,2,1,2) Model



Source: *Author's own construction*

The diagnostic assessments depicted in table 4 affirm the foundational assumptions and residual reliability of the ARDL model. Specifically, the Jarque-Bera test attests to the normal distribution of residuals, while the Lagrange Multiplier test dismisses the presence of serial correlation, and the Breusch-Pagan-Godfrey test underscores the homogeneity of residuals. These outcomes, coupled with the residual plot illustrated in chart 2, exhibiting fluctuations around the zero-mark devoid of discernible patterns, collectively support the argument that the ARDL model adheres to crucial criteria for trustworthy estimation and inference.

5. CONCLUSION & POLICY IMPLICATIONS

The study uncovers a long run significant relationship between the REER and crucial macroeconomic factors, including the CPI, Call Rate (INT), Imports (IMP), Exports (EXP), and Broad Money Supply (MS).

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Firstly, focusing on the two major components of current account balance which are highly exposed to exchange rate movements, it was found that there exists positive significant long run relation between India's exports and REER. While India's imports do not exhibit any significant relationship with REER. This is in conformity with the accepted economic theory that depreciation in the value of a nation's currency makes its exports more competitive and thereby has favourable impact on credit side of current account.

Further, the study found inverse relation found between CPI with REER adheres to traditional exchange rate principles, indicating that in the studied period, India's elevated inflation devalues the nation's currency. This is in line with the economic principles of causation as increasing inflation makes exports less competitive and imports more attractive. Thus, high inflation is not just detrimental to country's internal price balance but also detrimental to country's external balance.

Additionally, positive connection between the call rate and REER was observed and which aligns with interest rate parity theory where heightened interest rates entice foreign capital inflows, prompting currency appreciation. This appreciation can make exports costlier and imports cheaper, potentially worsening the trade balance.

Lastly, the negative coefficient for the money supply variable suggests that an increase in money supply tends to weaken the REER as enhanced money supply fuels inflationary pressures in Indian economy signal more demand of commodities causing an increase in the import which will adversely affect the trade balance of the country, eventually result in trade deficit. These theoretically justification demonstrate the crucial relationship between inflation, interest rates, money supply, and the REER, ultimately shaping a country's trade and current account balances.

The short-term dynamics, as indicated by the Error Correction Representation, underscore the REER's responsiveness to deviations from equilibrium, with roughly 188% of disequilibrium being rectified annually. The model's diagnostic tests and goodness-of-fit metrics, such as R-squared, standard error of regression, and log likelihood enhancing confidence in the estimations and deductions.

The detrimental effect of inflation on the Real Effective Exchange Rate (REER) emphasizes the imperative for robust inflation management strategies. Upholding price stability via monetary policy adjustments, including interest rate adjustment and money supply management, holds potential to stabilize exchange rates and support export competitiveness. With exports and REER exhibiting a positive relationship, policymakers ought to prioritize export expansion through trade facilitation, export incentives, and enhancing the business climate. Broadening the export portfolio and venturing into untapped markets can further fortify India's export capabilities. The positive association between interest rates and REER suggests that well-judged interest rate policies can attract foreign investments and support currency appreciation, although with careful considerations for domestic investment and economic expansion. The negative impact of money supply on REER underscores the importance of aligning monetary policies with exchange rate objectives. Expansionary monetary measures should be executed cautiously, considering their potential consequence on inflation, interest rates, and currency values. While the study did not uncover a substantial influence of imports on REER, it remains crucial to monitor import volumes and enact policies fostering import substitution to alleviate trade deficits and mitigate downward pressure on the domestic currency. To mitigate adverse effects of exchange rate fluctuations on businesses and importers, policymakers should advocate for hedging strategies adoption and furnish suitable risk management tools and infrastructure.

In future inquiries, the inclusion of additional variables like foreign direct investment (FDI), external debt, and terms of trade, could yield a more holistic view of exchange rate determinants. While our study presumed linear relationships, prior investigations have underscored the potential for non-linear dynamics in exchange rate modelling. Incorporating non-linear methodologies may offer a more precise depiction of the underlying connections. Exploring sector-specific analyses could furnish valuable insights into how exchange rate fluctuations affect different industries, thereby facilitating more targeted policy interventions. Additionally, expanding the scope of analysis to encompass regional and cross-country comparisons, could deepen our understanding of exchange rate dynamics and their drivers across diverse economic landscapes.

By incorporating these suggestions and leveraging the findings of this study, policymakers can develop more robust and adaptive strategies for managing exchange rates, fostering export competitiveness, and promoting overall macroeconomic stability in the Indian economy.

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