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Exploring the Influence Dynamism of Economic Factors on Fluctuation of Exchange Rate - An Empirical Investigation for India Using ARDL Model

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Abstract: *The Indian Foreign Exchange Market has experienced significant changes over the past decade, due to high degree of instability of the Indian Rupee leading to its devaluation against major global currencies. Exchange rate is considered as one of crucial indicators to determine the economic growth. Volatility of exchange rate of each day is influenced by various factors such as demand and supply, Gross Domestic Product, Interest rate, employment rate, public debt, balance of payments, inflation etc. Though there are multiple causes to determine the movement of exchange rate, but still the accurate level of causation is unpredictable. Keeping this in mind, this paper tries to attempt the relationship that exists between the exchange rate and select macroeconomic factors. To analyse the extent of influence of the selected variables on the exchange rate, the research paper uses 10 years of data spanning from Jan 2013 to Nov 2022. Further, the study uses monthly data of above-mentioned variables to bring out the analysis to meet the objectives. Descriptive statistics is used to find the characteristics of the data, correlation analysis and Ordinary Least Square method is used to find the relationship and impact level select macroeconomic factors on exchange rate. Autoregressive Distributed Lag (ARDL) model is used to find if any short run and long run association exists between the variables and the exchange rate.*

Keywords: exchange rate; GDP; public debt; balance of payments; inflation.

JEL Classification: E31; B23; C12; C58; H63.

Introduction

Exchange rate is defined as the value of one currency expressed in terms of another currency, and it is an influential factor in a nation's economy (Madura, 2006). The significance of the exchange rate lies in its role as both a macroeconomic policy variable and a variable for business operations. The exchange rate is determined by factors such as interest rates, inflation, GDP, current account deficits, exports, and imports, and is considered

a barometer of a nation's money supply. When the rupee weakens against the dollar, it indicates that the Indian currency has lost value compared to the US dollar. This can occur either because there is an abundance of rupees in the market or a shortage of dollars. The value of the rupee is dependent on the availability of US dollars in the Indian market. India gains funds from three sources: exports, foreign investments, and NRI remittances. If there are fewer dollars available, the dollar becomes more valuable, and the rupee loses value. India primarily imports crude oil, and the countries it imports from only accept US dollars or other major currencies, making it necessary for India to maintain a sufficient supply of these currencies.

The foreign exchange market, also referred to as the forex or FX market, is where currency trading takes place through the exchange of various currency rates. This market is dominated by central banks, commercial banks, investment banks, hedge funds, money managers, and individual retail traders. The market's performance is also influenced by various economic, political, and social factors. In India, the rupee has experienced both stability and volatility throughout its history. During the post-independence period, the Indian government maintained a fixed exchange rate regime with the rupee linked to the US dollar, but as the economy liberalized in the 1990s, the government gradually relaxed currency rate regulations. The Reserve Bank of India now manages the exchange rate using a basket of currencies, and the rupee has experienced significant volatility over the years, including a recent episode of depreciation in 2022. Indian Rupee broke through the 83 per Dollar mark in October 2022, reaching an all-time low of 83.002. These fluctuations in the exchange rate have necessitated research on the impact of various factors. It will help investors forecast and take necessary preventive steps towards these fluctuations.

Graph 1. Fluctuation in Indian Currency
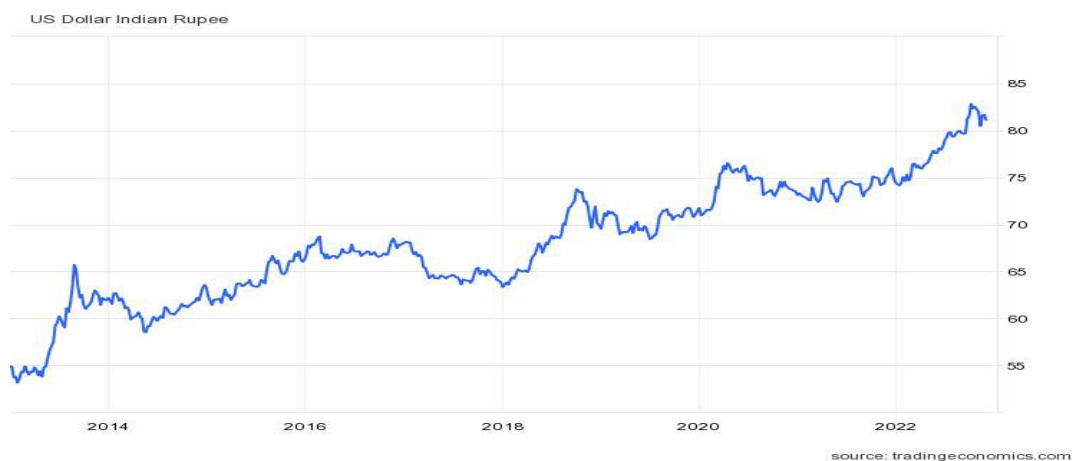
The graph shows the movement of Dollar- rupee exchange rate for a period of 10 years starting from 2013. As can be seen from the graph, the exchange rate is highly volatile. The rupee was as low as 52 in 2013 as compared to Rs 83 against dollar in 2022.

Significance of the Study

Exchange rate changes are significantly influenced by economic variables, including GDP (Gross Domestic Product), interest rates, and CPI (Consumer Price Index). GDP is a measure of a nation's overall economic health, and a strong GDP is frequently correlated with a more robust domestic currency. Higher interest rates may entice foreign investors looking for greater returns, boosting the native currency's demand and hence supporting its exchange rate. Lower interest rates, on the other hand, may deter foreign investment and cause currency depreciation. Conversely, the CPI measures inflation levels, and higher inflation can weaken a currency's purchasing power and cause devaluation. These economic factors interact intricately, which highlights their relevance in determining exchange rates and makes them essential indicators for firms, investors, and regulators through this present study.

Problem Statement

The foreign currency market in India has undergone significant changes in recent years, primarily due to the high volatility of the Indian rupee, causing it to lose value compared to major currencies in the global market. Exchange rates play a crucial role in international trade and are not only important in determining the type of

hedging to reduce exchange rate risks but also in predicting exchange rates. Accurately predicting exchange rates is crucial for businesses, as changes in foreign currency rates can greatly affect import and export profits and losses. The volatility of the exchange rate is unpredictable till now. Hence, the present study helps to find how the selected economic factors affect movement of exchange rate during the selected period.

Supporting Theory

The objective of econometrics is the application of testing the theories. In this line, this research mainly supports two theories namely, Monetary Model and Uncovered Interest Parity. Hence, the study has tested the following theories. The monetary model theory developed by Cassel (1918) argues that exchange rate volatility is primarily driven by changes in monetary policy and differences in inflation rates between two countries. When a country raises interest rates or tightens monetary policy, the demand for its currency increases, leading to an appreciation of its exchange rate. On the other hand, the uncovered interest parity theory developed by Keynes (1923) suggests that exchange rate movement are driven by differences in interest rates between two countries. If the interest in one country is higher than in another, its currency is expected to appreciate, making it less volatile.

1. Literature Review

In addition to the above supporting theories, the study also provided insight into the existing studies on the same which are done by many economists over the years. Here, a few important literatures are mentioned below.

1.1 Volatility of Exchange Rate

The value of a currency is influenced by multiple factors, some of which have a greater impact than others. These factors may vary over time and between countries. A study conducted by Consensus Economics on 90 currencies relative to the USD between 2010 and 2011 found that five key factors shape exchange rates: relative economic growth, inflation differential, trade or current account balance, equity flows, and short and long-term interest rates (Karl, 2004). Fluctuations in exchange rates can have a negative impact on international trade by creating uncertainty and increasing risks associated with changes in currency value (Sauer 2001). Research on the factors that influence exchange rates in developing countries has mostly focused on Latin America and has emphasized the role of trade in exchange rate movements (Diaz-Alejandro 1982; Edwards 1989).

(Çelĭk, 2022) It has been established that the short-term foreign debt and the exchange rate have a passing relationship. It was discovered that rising foreign debt will negatively impact exchange rates. Also Found an inverse relationship between Net capital and exchange rate (Hasan and Islam 2022). The findings indicate that the most significant macroeconomic variables influencing exchange rates are the current account balance, GDP growth rate, interest rate and foreign direct investment (Malekhosseini *et al.* 2019). The findings demonstrated that the real exchange rate misalignment from its equilibrium level has significantly responded to the type of exchange rate regime adopted by the countries, with the floating exchange rate regime increasing the real exchange rate misalignment wherever it is used in the selected developing countries. (Charles *et al.* 2022) Results showed that in Tanzania, there is a strong positive correlation between economic fundamentals and currency rate volatility (Rafiq *et al.* 2023). The study revealed that the rate of inflation, exports, and imports all remained substantial and played a considerable role in affecting currency rates in Pakistan. Exports and the inflation rate have a positive correlation with the exchange rate, whereas imports and the FOREX reserve have a negative correlation.

1.2 Establishing the Connection between Various Factors and Exchange Rate

1.2.1. Inflation

Inflation has a significant impact on a currency's value. Obstfeld and Rogoff noted in their book that changes in inflation and exchange rates are interrelated and can affect each other (Obstfield and Rogoff 1996). They suggested that central banks using inflation targeting could help stabilize exchange rates. If a country has a lower rate of inflation compared to others, it will likely see an increase in exports, and vice versa. Taylor suggested that policies like inflation targeting could play a critical role in reducing the volatility of exchange rates and stabilizing the economy (Taylor 1993). Engel and West also found a positive correlation between inflation and exchange rates, but noted that other factors like interest rates, trade balances, and political events can also influence this relationship.

1.2.2 Gross Domestic Products

The relationship between exchange rates and Gross Domestic Product (GDP) has been extensively studied in economics. Various studies have attempted to understand the interplay between these two important macroeconomic variables. Azid *et al.* (2005) studied the impact of economic growth on exchange rates and found a positive relationship between the two variables. McPherson and Rakovski (2000) analyzed the connection between exchange rates and GDP in Kenya, using time series data from 1970 to 1996. They examined both the direct and indirect relationships between real and nominal exchange rates and GDP growth and found no significant direct correlation. Madura (2006) investigated the relationship between exchange rates and market interaction and concluded that the exchange rate is dependent on market interaction and that GDP can negatively affect the exchange rate in a fixed exchange rate system. These studies demonstrate the complexity of the relationship between exchange rates and GDP, and that no single, clear-cut relationship exists. Further research is necessary to fully understand this dynamic relationship.

1.2.3 Interest Rates

The connection between interest rates and currency exchange rates is the subject of ongoing investigation among economists. Macdonald and Nagayasu (2000) used quarterly data from 14 industrialized countries between 1976 and 1997 to examine this relationship and find a long-term correlation. Edison and Paula (1991), on the other hand, used quarterly data and concluded that interest rates have no long-term effect on exchange rates, challenging earlier research that emphasized macroeconomic factors in determining exchange rates.

Apart from this, there are other studies that examine the varying views on how currency exchange rates are impacted by interest rate, producer price index, external debt, and GDP. Chen (2006) conducted research on six developing countries and analyzed the correlation between interest rates and exchange rates using a Markov regime switching method, with a focus on exchange rate volatility. The results indicated that an increase in nominal interest rates leads to a higher chance of a regime change, resulting in a more unstable exchange rate. On the other hand, Kraay (1999) conducted a study on a large dataset during speculative attacks and found no clear link between interest rates and exchange rates. The exchange rate of the Romanian leu was analyzed based on various economic factors such as GDP, inflation rate, money supply, interest rate, and balance of payments from 2000 to 2010, revealing an inverse relationship between the EUR/RON exchange rate, GDP, and money supply, but no correlation with balance of payments.

Macdonald and Nagayasu (2000) found a long-lasting relationship between interest rates and exchange rates in their analysis of data from fourteen industrialized countries from 1976 to 1997. Ramasamy and Abar (2015) utilized bootstrapping to investigate the impact of macroeconomic factors on the exchange rate and found that all factors, except employment and budget deficit, influenced the exchange rate. Edison and Pauls (1993) analyzed quarterly data and found no long-term impact of interest rates on exchange rates. McPherson *et al.* (2000) also found no relationship between the exchange rate and GDP or interest rates. Despite a substantial amount of research on the impact of exchange rates on microeconomic factors, there is a scarcity of studies on the effect of various economic variables on exchange rates, particularly in developing countries. This research will be beneficial for investors to comprehend the factors that influence the foreign exchange market and make informed decisions.

This study addresses the research gap by addressing the following questions:
- Is there a correlation between the chosen economic variables and the fluctuation of the foreign exchange rate?
- To what extent do the selected macroeconomic variables impact the fluctuation of the foreign exchange rate?

3. Research Objectives

1. To investigate the influence of various factors on the fluctuations in the foreign exchange rate.
2. To examine the correlation between the chosen economic variables and the foreign exchange rate.
3. To determine the effect of different economic variables on the fluctuation of the foreign exchange rate.

Graph 1. Research Framework
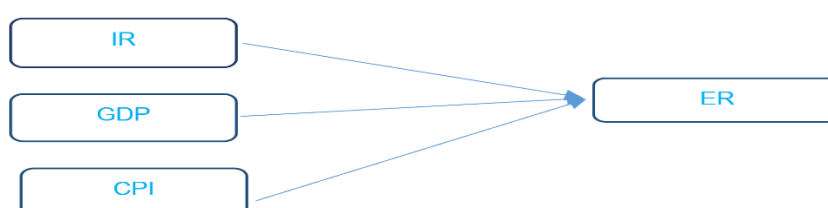
3.1 Hypothesis

H1- There is a significant relationship between GDP and Exchange Rate

H2- There is a significant relationship between Interest Rate and Exchange Rate

H3- There is a significant relationship between Consumer Price Index and Exchange Rate

3.2 Data and Model Specification

3.2.1. Data and Description of the Variables

The study is descriptive and analytical in nature and uses annual time series data on Exchange rate which is an endogenous variable. To see the influence of various variables on the exchange rate, the study has considered selecting macroeconomic variable as exogenous variables. All exogenous factors are chosen after a rigorous evaluation of current studies, as well as the cause for the link. The selected macroeconomic variables used in the study are Consumer Price Index (CPI) which is the proxy of inflation, Gross Domestic Product (GDP) and Interest Rate (IR). The study uses monthly observations for the above-mentioned variables spanning from Jan 2013 to Nov 2022 over a period of 10 years. Bloomberg terminal was used to gather all the variable data.

3.2.2. Econometric Model and Methodology

The Augmented Dickey Fuller Test was used to assess the stationarity of all variables. Furthermore, descriptive statistics is used to characterize the features of each variable. The study used correlation analysis to determine the link between the variables. Additionally, the fundamental econometric model is developed in accordance with the study's objectives, which are listed below.

$$\text{Exchange Rate} = \alpha + \beta_1 (GDP)_t + \beta_2 (IR) + \beta_3 (CPI)_t + \mu_t \tag{1}$$

The study used the robust Autoregressive Distributed Lag (ARDL) model developed by Pesaran and Shin (1999) and improved by Pesaan, Shin, and Smith (2001) to investigate the long run and short run influence of the variables. This model offers a number of benefits over other cointegration models, including the Engle and Granger cointegration test and the Johansen cointegration test. This model can also be used if the variables are integrated in a different level order, such as I(0) or I(1). The model is significantly more efficient in small and limited data, like in this research.

According to the procedure, the study employed ARDL bound F test to check the presence of long run relationship among the variables. Hypothesis is framed and presented below

H_0– There is no presence of long run relationship

H1 – There is a presence of long run relationship

The decision of accept or reject depends on the F statistics value. If the F statistics isgreater than the lower 1(0) and upper bound 1(1), then there is a presence of long run relationship among variables and vice versa. The study used conditional ARDL to determine the long run coefficients of each variable after calculating co-integration with the help of the Bound F test. It demonstrates how far each regressor influences the exchange rate of India. To estimate this, the study constructed the Unrestricted Error.

Correction Model (UECM) of ARDL approach and written as

$$\text{Exchange Rate}_t = \beta + \sum \delta_1 GDP_{t-i} + \sum \delta_2 IR_{t-l} + \sum \delta_3 CPI_{t-i} + \varepsilon_t \tag{2}$$

where, t = time series notation, β_0 = Intercept, δ= Beta Coefficient, ε_t = Residual or error term

Once the existence of long run equilibrium among the variables is being proved, the next process is to estimate the short run dynamic coefficients with the help of the error correction model associated with long run estimates obtained from ARDL-UECM approach. The ECM explains how long time it will take to get adjusted or speed of adjustments of dependent variable towards the long run equilibrium. The following equation is constructed for error correction mechanism of ARDL Approach.

$$\text{Exchange Rate}_t = \beta_0 + \sum \delta_1 GDP_{t-i} + \sum \delta_2 IR_{t-l} + \sum \delta_3 CPI_{t-i} + \Phi ECM_{t-1} + \varepsilon_t \tag{3}$$

where, ECM indicates error correction term, Φ is the speed of adjustment parameter to long run equlibrium and δ1, δ 2 and δ 3 are short run coefficients. Furthermore, for long-run equilibrium stability, the sign of ECT must be negative but significant.

As previously noted, the study applied residual diagnostics for ARDL model also to assess the presence of autocorrelation and heteroscedasticity. In addition to this, study employed the Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) graph (Brown, Durbin and Evans, 1975) to test the stability of the long run relationship associated with short run.

3.3 Empirical Research and Findings

3.3.1. Checking Unit Root Hypothesis

Testing of unit root problem with data on respective variables is always crucial prior applying any econometric model. Hence, using of non-stationary time series data leads to the spurious results (Gujarati and Porter 2009). As per the time series assumptions, the absence of unit root which means presence of mean and variance constant over a period of time in a time series to make the series stationary (Hendry 1995). For checking the unit root test of each variable, the study used Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (1979). The following hypothesis is formulated to check the presence of unit root test of each variable.

3.3.2. Unit Root Test

H0: Unit root problem in time series data (*i.e.*, $\delta = 0$)
H1: No unit root problem in time series data (*i.e.*, $\delta < 0$)

Table 1. Summary of Unit Root Test

Variables	At Level(With Trend and Intercept)		First Level of Difference (With Trend and Intercept)		Inference
	T- Statistics	Probability	T- Statistics	Probability	
Consumer Price Index	-0.617148	0.8615	-7.063227	0.0000*	Stationary
Exchange Rate	-1.829410	0.3648	-10.94582	0.0000*	Stationary
GDP	-2.179490	0.2149	-13.00490	0.0000*	Stationary
Interest Rate	-1.199247	0.6732	-6.591982	0.0000*	Stationary

* Indicates significance at 1 per cent level.

The table demonstrates the Augmented Dicker fuller test to study the stationary properties of time series. The results show that all the variables used in the test are stationary at the first level of difference *i.e.* the order of integration is I(1).

Table 2. Summary of Descriptive Statistics

Variables	CPI	GDP	ER	IR
Mean	4.9178	5.8462	4.2165	1.8567
Median	4.9163	5.8593	4.2119	1.8718
Maximum	5.1744	6.0690	4.4160	2.3272
Minimum	4.650	5.4612	3.9751	1.4469
Std. Deviation	0.1360	0.1496	0.0913	0.2673
Skewness	0.0546	-0.3293	-0.2438	-0.2515
Kurtosis	2.1326	1.9072	2.8456	1.9151
Jarque-Bera	3.7893	8.0726	1.2970	7.0900
Probability	0.1503	0.0176	0.5228	0.0288

Table 2 presents the descriptive statistics for the variables. GDP has the highest mean value (M= 5.846214, SD= 0.149603) followed by CPI (M= 4.917853, SD= 0.136093) followed by ER which has the lowest Standard Deviation value (M= 4.216528, SD= 0.091392).

Table 3. Correlation Analysis

Variables	ER	GDP	IR	CPI
ER	1			
GDP	0.8119**	1		
IR	-0.8106**	-0.8259**	1	
CPI	0.9453**	0.8871**	-0.8951**	1
Note: **Correlation is significant at 5% level				

IR has the lowest mean value (M= 1.856750, SD= 0.267385). Rows 3 and 4 indicates the minimum and maximum values which shows that CPI has a minimum of 4.650144 and maximum of 5.174453, GDP has a minimum of 5.461201 and maximum of 6.069097, ER (Min= 3.975186 Max= 4.416066) and lastly IR has a minimum of 1.446919 and maximum of 2.327278. CPI has a longer tale towards the right side which is seen by the positive value of skewness 0.0546 while GDP (-0.3293), ER(-0.2438) and IR(-0.2515) have longer tail towards right. All the variables are lighter tailed which could be seen by the value of kurtosis which is less than 3.

Correlation analysis is being used to find the relationship between Exchange Rate and other variables. From the above table we can see that ER has a positive and strong relationship with CPI (r= 0.945319, p<0.05) followed by GDP (r= 0.811904. p<0.05). This shows that an increase in CPI and GDP does have a significant and positive impact on ER. The correlation value of IR (r= -0.810658, p<0.05) shows that it has a negative and significant relationship with ER.

Table 4. Ordinary Least Square Method

Endogenous Variable	Exogenous Variable	Coefficient	T-Stat	P value	F- Stat	R²	DW
ER	Constant	15.1916	3.3850**	0.0010	353.2458 (0.000)	0.9021	0.4334
	GDP	-0.0122	-1.5845	0.1158			
	IR	0.5876	2.4551**	0.0156			
	CPI	0.3861	14.589**	0.0000			

Note: **indicates significant at 5% level

Ordinary Least Square method has been used in Table 4 to check the influence of exchange rate on GDP, IR and CPI. This could be shown by the coefficient of determination *i.e.* R square which is 0.902106. It shows that 90.2 per cent fluctuation in the exchange rate is due to variations in GDP, IR and CPI. The beta coefficient (B) describes whether the exogenous variable has a positive or negative influence on the endogenous variable.

IR and CPI have a positive and significant impact on the exchange rate since the p value is less than 0.05. It means that 1% change in IR and CPI will have 0.5876 and 0.3861 percent change on Exchange Rate. GDP has a negative impact. The F statistic (F=353.2458, p<0.05) depicts that GDP, IR and CPI have a jointly significant impact on the exchange rate. According to Durbin Watson test, R^2 is more than DW test. Thus the model avoids spurious results in estimating regression model.

Further, the study investigated the cointegration of ER, GDP, IR and CPI with the help of F Bound test. Table 5 shows the summary of F-Bound Test. The following hypothesis is formulated to check the presence of cointegration among the variables.

H0- There is no co integration among ER, GDP, IR and CPI
H1- There is cointegration among ER, GDP, IR and CPI

Table 5. F-Bound Test

Level of Significance	Critical Values		
	Lower Bound I(0)	Upper Bound 1 (1)	F-Calculated
1 %	3.65	4.66	4. 7290*
5%	2.79	3.67	
10%	2.37	3.20	

* denotes computed F statistics more than the critical value at one percent significance level.

Here, the F-statistics (*i.e.* 4.7290) is greater than the lower and upper bound test. Hence, it is inferred that there is long run association among the ER, GDP, IR and CPI at 1,5 and 10 percent significant level. It indicates ER, GDP, IR and CPI are moving together for a longer period of time. In addition, the study also analyzed the impact of GDP, IR and CPI on exchange rates in the long run as well short run which is presented in Table 6 and 7.

The volatility of exchange rate has positive and significantly influenced by its own lagged values of one month *(β=0.786, p<0.01)*, CPI *(β=0.073, p<0.01)* and IR *(β=0.3662, p<0.01)* at one percent significant level. Changes in these factors do significantly causing the movement of exchange rate in the long run. On the other hand, two months lag of interest rate *(β=-1.4379, p<0.01)* has negatively impacted on the movement of exchange rate in the long run. Hence, the result is aligned with the study of Khan's (2010). The degree of determination (R^2) represents that 0.96 percent which indicates variation in the exchange rate is explained by changes in the CPI, IR and lags of ER.

Table 6. ARDL Long Run Coefficient

Dependent Variable- ER				
Regressor	Coefficient	Standard Error	t-statistic	Probability
Constant	6.508505	3.1363	2.0751	0.0403**
ER(-1)	0.786408	0.0546	14.399	0.0000*
CPI	0.073289	0.0266	2.7486	0.0070*
IR	0.366246	0.3885	0.9425	0.3480*
IR(-1)	1.065598	0.5563	1.9151	0.0581
IR(-2)	-1.437998	0.4200	-3.423*	0.0009*
GDP	-0.005147	0.0045	-1.1353	0.2587
R- squared	0.966003	F-statistic	520.9292	
Adjusted R-squared	0.964149	Prob(F-statistic)	0.0000	
Durbin-Watson stat	1.8697			

* denotes 1% significance level ** denotes 5% significance level

Table 7. Error Correction Model

| Variables	Coefficients	Std. Error	t-statistic	Probability	Results
D(IR)	0.3662	0.3756	0.9748	0.3318	Insignificant
DIR(-1)	1.4379	0.3757	3.8265	0.0021*	Significant
Coint Eq(-1)	-0.2135	0.0431	-4.9502	0.0000*	Significant
Serial Correlation LM Test	-0.2135 (0.5615)	R-Square	0.230564		
Heteroscedascity Test	1.747678(0.0968)	Adjusted R-Square	0.217065		
		Durbin- Watson Stat	1.869770		
F- statistic	4.729	Prob(F-statistic)	0.0000		

* denotes 1% significance level

The estimated results of error correction mechanism presented in Table 7. It is observed that the beta coefficient shows that exchange rate is positive and significantly *(β=1.4379, p<0.01)* influenced by one month lag of interest rate at one percent level but however the exchange rate does not have significantly influenced by current interest rate in the short run. On the other side, the CPI and GDP do not have impact on volatility of the exchange rate in the short run.

The coefficient of error correct term has negative and significant at one percent level. It indicates the short run deviation is gets corrected or adjusted by 0.21 percent towards the long run equilibrium for every month. The explanatory power of the model represented by R^2 indicates 0.23 percent variation in the exchange rate is explained by the selected explanatory variables in this model. Moreover, the probability of F statistics shows jointly significant at one percent level and this model eliminated spurious results through DW test ($R^2<DW$). Also, there is no heteroscedastic and no autocorrelation in the error term since the p value is greater than five percent.

3.3.3 Stability Test

Graph 2. CUSUM of Squares
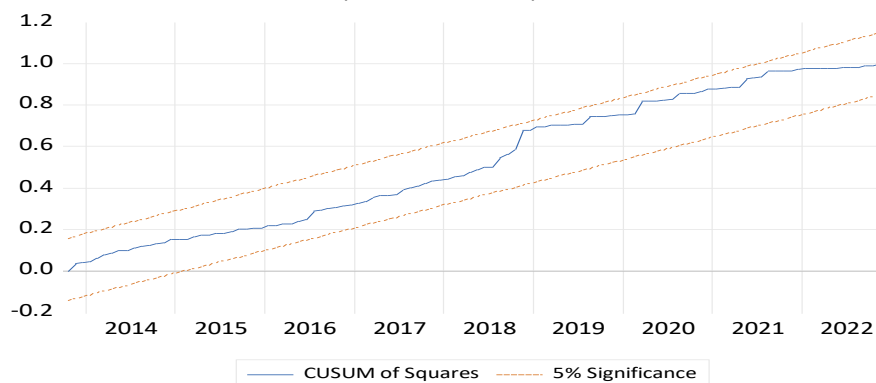
The plot CUSUMSQ shows the blue line lies between the two dotted red lines, that is all the estimated coefficient in the given regression output indicates stable. Since, stability test stay within the critical bound test at five percent significant level indicates long run and short run dynamic coefficients are stable in the ARDL-ECM model. Hence, the model is stable, and it could be used for policy marking decisions.

3.4. Implications

CPI and IR have a long-term relationship with Exchange Rate. A long-term relationship between the Consumer Price Index (CPI), interest rates, and the exchange rate can signify the overall health and stability of a country's economy. If a country has a consistently low and stable CPI, it may indicate that inflation is under control, and that the economy is growing at a sustainable pace. This can lead to a stronger currency, as investors and traders are more likely to want to buy and hold the currency due to the potential for higher returns on investments in that country. Similarly, if a country has consistently high and stable interest rates, it may indicate that the economy is strong and that there are good investment opportunities in that country. This can also lead to a stronger currency, as investors and traders are more likely to want to buy and hold the currency due to the potential for higher returns on investments.

On the other hand, if a country has a consistently high and unstable CPI or a consistently low and unstable interest rate, it may indicate that the economy is not performing well, and that there is a higher risk of inflation or economic downturns. This can lead to a weaker currency, as investors and traders are less likely to want to buy and hold the currency due to the potential for lower returns on investments. When both factors, CPI and Interest rate, are stable and consistent over time, it can also indicate that the central bank of that country is capable of keeping the inflation rate stable and economy growing at a sustainable pace.

Conclusion

The study's primary objective is to analyse the impact of CPI, GDP and IR on Exchange Rate in the long as well as short run. The stationarity test shows that all the variables were stationary at the first level of difference. CPI and GDP have a strong and positive relationship with CPI while Interest Rate has an inverse relationship. Cointegration among the CPI, GDP, IR and ER has been identified with the help of Bound F test. Further, the study empirically proved that one-month lag of ER, CPI and IR has positively impacted whereas two-month lag of IR negatively influenced the exchange rate in the long run. However, it is observed that the interest rate does significantly influence the movement of the exchange rate in short as well as long run.

Limitations and Scope

The current study focuses on the examination of the economic factors affecting exchange rate; however, its scope is limited by data availability. To address this limitation, future studies can consider incorporating other variables such as political, social, and environmental factors, which can provide a more comprehensive understanding of the impact of economic factors on exchange rates. Additionally, the current study is limited to a 10-year period, which may not be sufficient to fully capture the long-term relationship between economic factors and exchange rate. To address this, future research can consider extending the data period for analysis to get a more accurate picture of these relationships. Furthermore, the study is restricted to the Indian market and does not consider the global perspective. To address this limitation, future studies can expand the data sources used in the analysis to include a wider range of countries and regions, thereby increasing the robustness and reliability of the results.

Credit Authorship Contribution Statement

Sathish Pachiyappan: He has identified the research problem of the study, formulated the research framework and objectives of the study accordingly. Also, contributed for analyzing the econometric model using E-Views.
Ananya Jain: She has contributed to writing of abstract, introduction and literature review of the study.
John Paul Raj: He has contributed to writing of the implications, limitations, future scope of the study followed by conclusion.
Saravanan Vellaiyan: He has written the mathematical equation for each econometric model which has mentioned in the report. Also, contributed for writing the theoretical support for this research work.
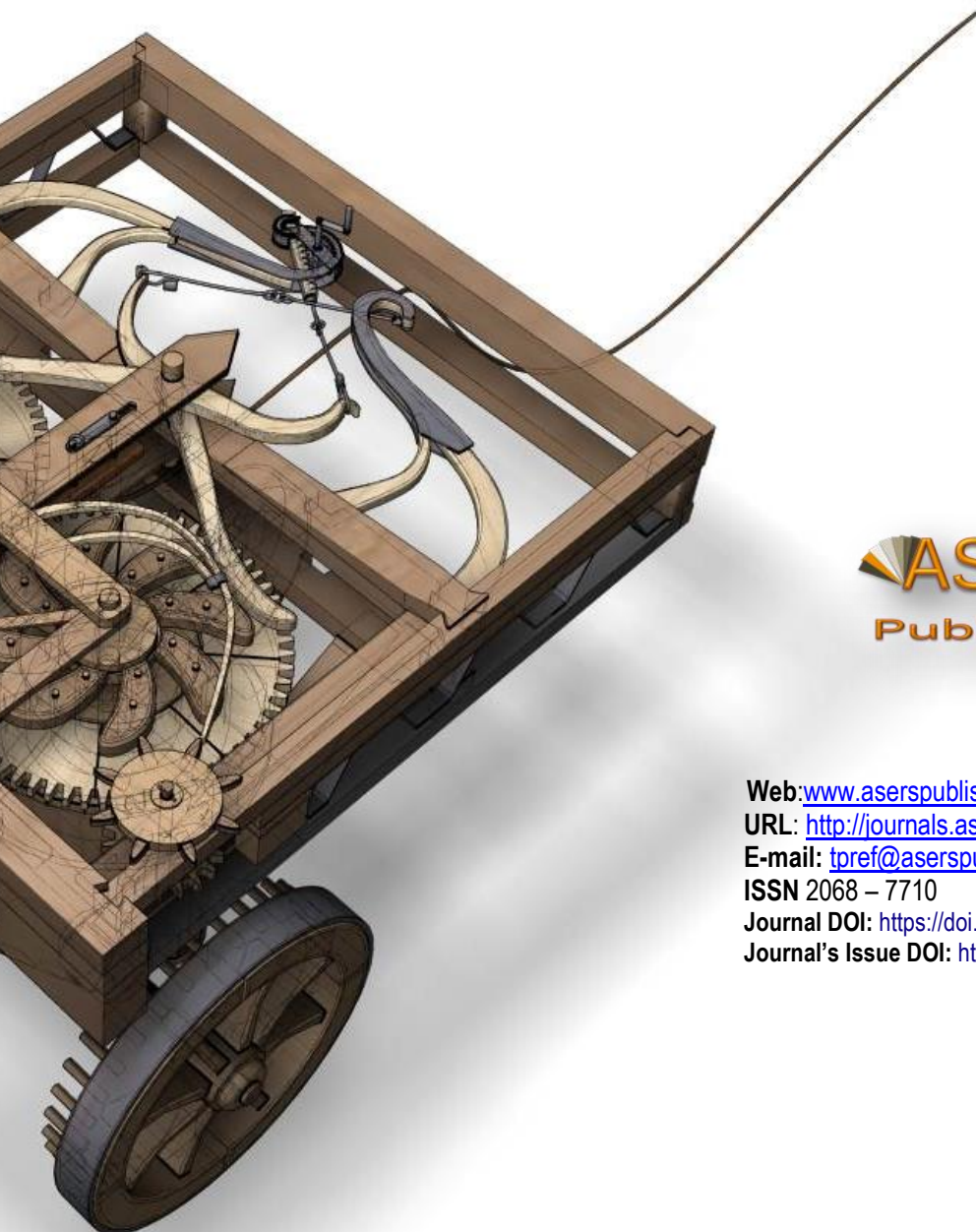
Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Alejandro, C. F. D. 1982. Exchange rates and terms of trade in the Argentine Republic, 1913–1976. In *Trade, stability, technology, and equity in Latin America* (pp. 27-41). Academic Press. DOI:https://doi.org/10.1016/B978-0-12-680050-0.50008-8

[2] Azid, T., Jamil, M., Kousar, A., and Kemal, M. A. 2005. Impact of exchange rate volatility on growth and economic performance: A case study of Pakistan, 1973-2003 [with comments]. *The Pakistan development review*, 749-775. Available at: https://www.jstor.org/stable/41261129

[3] Cassel, G. 1918. Abnormal deviations in international exchanges. *The Economic Journal*, *28*(112): 413-415. DOI: https://doi.org/10.2307/2223329

[4] Charles, A. M., Kiliza, K. R., and Sarwatt, A. C. 2022. Economic Factors Affecting the Volatility of Exchange Rate in Tanzania. In *International Journal of Arts* (Vol. 4, Issue 2). Available at: https://www.ijahss.in

[5] Chen, S. S. 2006. Revisiting the interest rate–exchange rate nexus: a Markov-switching approach. *Journal of Development Economics*, *79*(1): 208-224. DOI: https://doi.org/10.1016/j.jdeveco.2004.11.003

[6] Edison, H.J., and Pauls, B.D. 1993. A re-assessment of the relationship between real exchange rates and real interest rates: 1974–1990. *Journal of Monetary Economics*, 31(2): 165-187. DOI:https://doi.org/10.1016/0304-3932(93)90043-F

[7] Edwards, S. 1989. Exchange rate misalignment in developing countries. *The World Bank Research Observer*, *4*(1): 3-21. DOI: https://doi.org/10.1093/wbro/4.1.3

[8] Hasan, S. M., and Islam, R. (n.d.). SADI International Journal of Management and Accounting UNDERSTANDING THE RELATIONSHIP BETWEEN MACROECONOMIC VARIABLES AND EXCHANGE RATES 1. *SADI International Journal of Management and Accounting*, *9*. Available at: https://sadipub.com/Journals/index.php/SIJMA/index|editorial@sadipub.comhttps://sadipub.com/Journals/index.php/SIJMA/index

[9] Karl, H., and Canales, K. 2004. Foreign exchange market organization in selected developing and transition economies: Evidence from a survey "IMF working paper 04/4, Washington international monetary Fund. Available at: https://ssrn.com/abstract=878827

[10] Keynes, J. M. 1923. A Reply to Sir William Beveridge. *The Economic Journal*, *33*(132): 476-486. DOI:https://doi.org/10.2307/2222885

[11] Kraay, A. 1999. "Do High Interest Rates Defend Currencies during Speculative Attacks?" mimeo, World Bank. DOI: https://doi.org/10.1016/S0022-1996(02)00021-1

[12] MacDonald, R., and Nagayasu, J. 2000. The long-run relationship between real exchange rates and real interest rate differentials: A panel study. *IMF staff papers*, *47*(1): 116-128. DOI:https://doi.org/10.2307/3867627

[13] MacDonald, R., and Taylor, M. P. 1991. Exchange rates, policy convergence, and the European Monetary System. *The Review of Economics and Statistics*, 553-558. DOI: https://doi.org/10.2307/2109585

[14] Madura, J. 2006. Exchange rate determination, International Corporate Finance. Thomson/South-Western.

[15] Malekhosseini, H., Tayebi, S. K., Rafat, M., and Yazdani, M. 2019. Evaluation of Exchange Rate Regime's Effect on Real Exchange Rate Misalignment: An Application of Propensity Score Matching Approach. *Iranian Journal of Economic Research*, *27*(93): 87–114. DOI: https://doi.org/10.22054/ijer.2022.62893.1026

[16] McPherson, M. F., and Rakovski, T. 2000. Exchange Rates and Economic Growth in Kenya: An Econometric Analysis. Available at: https://citeseerx.ist.psu.edu/document?repid=rep1andtype=pdfanddoi=7875b2157e1738182feb94d20ce35bd93b8dad92

[17] McPherson, M. F., and Rakovski, T. 2000. Exchange Rates and Economic Growth in Kenya: An Econometric Analysis. Available at: https://citeseerx.ist.psu.edu/document?repid=rep1andtype=pdfanddoi=7875b2157e1738182feb94d20ce35bd93b8dad92

[18] Menkhoff, L. 2013. Foreign Exchange Intervention in emerging markets: A survey of empirical studies. *The World Economy, 36*(9): 1187–1208. DOI: https://doi.org/10.1111/twec.12027

[19] Obstfeld, M., and Rogoff, K. 1995. Exchange rate dynamics redux. *Journal of political economy, 103*(3): 624-660. https://www.journals.uchicago.edu/doi/epdf/10.1086/261997

[20] Rafiq, S., Rafiq, F., Rafiq, R., and Rafiq, F. 2023. Determinants of Exchange Rate: A Case Study of Pakistan. *Review of Education, Administration and Law, 6*(2): 449–456. DOI:https://doi.org/10.47067/real.v6i2.341

[21] Ramasamy, R., and Abar, S. K. 2015. Influence of macroeconomic variables on exchange rates. *Journal of economics, Business and Management, 3*(2): 276-281. DOI: 10.7763/JOEBM.2015.V3.194

[22] Sauer, C., and Bohara, A. 2001. Exchange Rate Volatility and Exports: Regional Differences between Developing and Industrialized Countries. Review of International Economics, 9(1): 133-152. DOI:https://doi.org/10.1111/1467-9396.00269

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