EFFECTS OF MACROECONOMIC VARIABLES ON EXCHANGE RATE VOLATILITY: EVIDENCE FROM INDIA

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Abstract

Exchangerate volatility is the fluctuation in the rate of change of domestic currency with respect to the other foreign currency. The depreciation of Indian currency is becoming a burning concern for the country. Foreign exchange is one of the most important term used in any developed or developing countries to measure the economic health. Devaluing the domestic currency lowers the trade balance impacting the balance of payment. The major objective of this paper is to investigate the macro variable factors affecting the exchange rate with respect to USD for a period of thirty years. The paper employs time series analysis to test the relationship and long run and short run causality among GDP, inflation, foreign exchange reserve, interest rate and foreign exchange rate. The result depicts that GDP and Inflation are directly related to foreign exchange rate whereas foreign exchange reserve and interest rate is inversely related to the Foreign exchange rate.

Keywords**:** Exchange rate, Depreciation, Devaluation, GDP, Causality.

1. INTRODUCTION

Foreign exchange is the rate of conversion of home currency with respect to any foreign currency. In Indian context the concept of foreign exchange can be traced back to the time introducing the first Five Year Plan. To execute the objective set by the government, country started funding from foreign borrowings which required devaluation of the domestic currency.at the beginning India followed fixed rate currency where the rupee was pegged at 4.79 against US dollar.Recently the rupee had devalued to 73.8 per USD. The exchange is considered on of the key variable that can determine economic health. India has witnessed a sharp fall in the

value of domestic currency, the depreciated value have affected the international trade as well as investment decision.

Foreign exchange rate (XR) is affected by many internal and external factors. Most of the macroeconomic variables can also explain the volatility of the exchange rate. In a paper by Paula and Edison (1991), reveals that the interest rate does not affect the exchange rate in the long run.Inflation is directly and positively related to exchange rate and current account in small economies (Simon,1997).Rakovski, et.al. (2000) found that GDP and interest rate does not have any connection to exchange rate. Later in the same year (2000), Nagayasu and Macdonal contradicted the results and established that interest rate is related to foreign exchange rate. Due (2006)indicated that the real exchange rate, level of capital flows, volatility of flows, fiscal and monetary policy indicators and current account cointegrate and each Granger causes to the real exchange rate.Kumar (2008) carried out a study and validated that the stock price is associated with foreign exchange in the long run. Ashima, et.al. (2012) found bi-directional relationship between exchange rates and foreign exchange reserves,sensex and reserve money. Interest rate, inflation and GDP growth strongly influence the exchange rate of developing as well as developed countries (Raza & Fatima 2016).

The existing literature gives conflicting result, however the reason may be the study area and also the period of the study.

2. OBJECTIVE

The main objective of the present paper is

a) To study the trend and pattern of exchange rate over the years.
b) To explore the relationship between macroeconomic factors and exchange rate volatility.

3. RESEARCH QUESTION

The following are the research question that is to be fulfilled

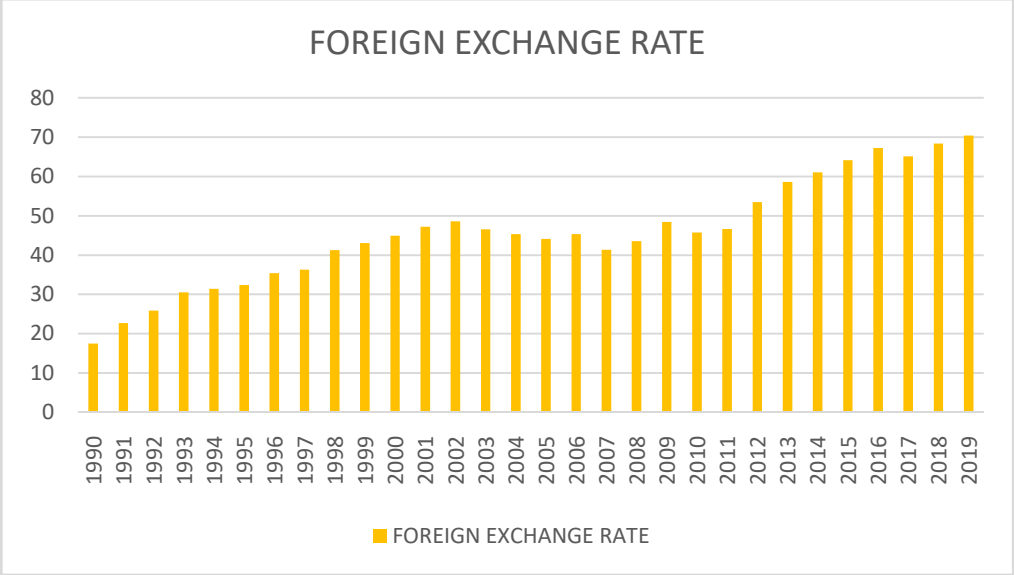
a) Is there any relationship between exchange rate and inflation rate?
b) Is there any relationship between exchange rate and interest rate?
c) Is there any relationship between exchange rate and gross domestic product?
d) Is there any relationship between exchange rate and foreign exchange reserve?

4. DATA SOURCE AND METHODOLOGY

The data is based on secondary sources from official websites of World Bank and Reserve Bank of India. The data of Foreign Exchange Reserve (FX Res.) has been taken from RBI publication statistics on Indian Economy and the other variables Gross Domestic Product (GDP), Inflation Rate (Inf Rt.),Interest/Lending Rate (Int Rt.) and Foreign Exchange Rate (FX Rt.) have been collected from World Bank data base. The period of the study is 30 years i.e. 1990-2019.

Various graphs and tables have been used to cover the first objective of the paper. The log transformation values of the variables are used in the model and a unit root test is employed to test the stationarity of the series followed by Lag selection criterion. Co-integration, VECM (Vector Error Correction Model) and Granger Causality is performed to investigate the relationship and causality among the variables.

5. TREND AND PATTEN OF EXCHANGE RATES IN INDIA



6. RESULT AND DISCUSSION

The following model is formed to fulfill the objective of the paper.

$$\mathbf{ln\_fx\_rt = \alpha_0 + \alpha_1 ln\_GDP + \alpha_2 ln\_fx\_rsv + \alpha_3 ln\_int\_rt + \alpha_4 ln\_inf + \mu}$$

where,

ln_fx_rt: log of foreign exchange rate (USD)

ln_GDP: log of Gross domestic product (at constant)

ln_fx_rsv: log of foreign exchange reserve

ln_int_rt: log of interest rate (lending rate)

ln_inf: log of inflation (CPI)

Descriptive statistics

	LN_FX_RSV	LN_FX_RT	LN_GDP	LN_INF	LN_INT_RT
Mean	5.633997	1.639463	13.76474	0.832564	1.084398
Median	5.810984	1.656211	13.75537	0.829753	1.079171
Maximum	6.556562	1.847698	14.16684	1.142084	1.276845
Minimum	4.057514	1.243125	13.40045	0.396354	0.920820
Std. Dev.	0.704748	0.143115	0.240525	0.195953	0.091846
Skewness	-0.549618	-0.801799	0.084059	-0.246036	0.389094
Kurtosis	2.163291	3.583048	1.777913	2.082997	2.259209
Jarque-Bera	2.385504	3.639336	1.902200	1.353788	1.442934
Probability	0.303385	0.162080	0.386316	0.508193	0.486039
Sum	169.0199	49.18388	412.9423	24.97693	32.53193
Sum Sq. Dev.	14.40341	0.593977	1.677722	1.113532	0.244636
Observations	30	30	30	30	30

i. Unit Root Test

Unit root test i.e. Augmented Dickey Fuller test helps in detecting if a series is stationary or not or if the series follows some trend. A series should be stationary i.e. should not have any trend to avoid spurious result. If there exist stationarity in any of the series, it could be eliminated by using differentiating method.

H_0: there is a unit root i.e. non stationary series.
H_1: series is stationary.

VARIABLES	LEVEL			1ST DIFFERENCE		
	t-Statistic	p-value	H_0	t-Statistic	p-value	H_0
LN_FX_RT	-2.7875	0.2146	Accept	-4.7229	0.004	Reject
LN_FX_RSV	-3.1564	0.1129	Accept	-5.5944	0.0005	Reject
LN_GDP	-3.7839	0.0322	Reject			
LN_INF	-2.4694	0.3395	Accept	-6.1513	0.0001	Reject
LN_INT_RT	-3.2267	0.0991	Accept	-5.6116	0.0005	Reject

From ADF test we can conclude that the series are integrated at different orders I(0) and I(1). So, we can proceed for co-integration test but as the order is different we perform bound test. Running optimal lag selection criterion, we found that lag 3 is optimal as suggested by Akaike Information Criteria.

ii. Bound Test

As the series are integrated of different order, hence, to establish the long run relationship we have employed bound test as proposed by Pesaran, Shin and Smith (2001). This test is performed at level values rather than first difference.

H_0: there is no relationship among the variables
H_1: there is a relationship between the variables.

Result of Bound Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.128415	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual Sample Size	28		Finite Sample: n=35	
		10%	2.46	3.46
		5%	2.947	4.088
		1%	4.093	5.532
			Finite Sample: n=30	
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

As the calculated F-Statistics is greater than the upper bound I(1) critical value, we reject the H_o and conclude that is cointegration between the variables. Thus, the variables exhibit a long run relationship.

iii. Vector Error Correlation Model (Short Run and Long Run Causal Test)

The Vector Error Correction model also helps in examining the short run and long run causality between the variables.

The error correct estimates gives the rate at which the model recovers itself to its equilibrium condition after shocks.

Below is the ECT equation signifying long run relationship among the variables.

VECM ESTIMATES

Cointegrating Eq:	CointEq1
LN_FX_RT (-1)	1.000000
LN_GDP (-1)	-18.93437
	-4.90001
	[-3.86415]
LN_FX_RSV (-1)	8.978524
	-1.75144
	[5.12636]
LN_INF (-1)	-8.441549
	-1.43464
	[-5.88409]
LN_INT_RT (-1)	16.52102
	-6.66729
	[2.47792]
C	197.236

$$ECT_{t-1} = 1.000\ LN\_FX\_RT_{t-1} - 18.93\ LN\_GDP_{t-1} + 8.97\ LN\_FX\_RSV_{t-1} - 8.44\ LN\_INF_{t-1} + 16.52\ LN\_INT\_RT_{t-1} + 197.23$$

As the model is in log form the interpretation will be in elasticity form. So, from the result we can say that 1% change in GDP will result in 18.93% of increase in foreign exchange rate and 1% change in inflation will increase the foreign exchange rate by 8.44%. On the other hand, 1% increase in foreign exchange reserve and lending/interest rate will reduce to foreign exchange rate by 8.9% and 16.52% respectively. Therefore, we can conclude

that there is inverse impact of foreign exchange reserve and interest rate on foreign exchange rate whereas, GDP and inflation (CPI) positively impact the foreign exchange rate.

Long-run and Short-run Causal effects: We have run the below equation to test the short and long run causality.

$D(LN\_FX\_RT)= C(1)*(LN\_FX\_RT_{t-1}- 18.934*LN\_GDP_{t-1}+ 8.978*LN\_FX\_RSV_{t-1}- 8.441*LN\_INF_{t-1}+ 16.521*LN\_INT\_RT_{t-1}+197.235)+ C(2)*D(LN\_FX\_RT_{t-1})+ C(3)*D(LN\_GDP_{t-1})+ C(4)*D(LN\_FX\_RSV_{t-1})+ C(5)*D(LN\_INF_{t-1})+ C(6)*D(LN\_INT\_RT_{t-1})+ C(7)$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.009616	0.001848	-5.202564	0.0000000
C(2)	-0.39138	0.144386	-2.710654	0.0078000
C(3)	-2.291597	0.483212	-4.742427	0.0000000
C(4)	-0.055463	0.044094	-1.257835	0.2112000
C(5)	-0.068205	0.018326	-3.721841	0.0003000
C(6)	0.215291	0.069275	3.107774	0.0024000

Long run causal relationship is indicated through the t-statistic of the ECT. So, for the given equation the λ is C(1). Here C1 is the long run coefficient of the model, it is negative i.e. -0.009 and is statistically significant at 5% level of significance showing causality between LN_GDP, LN_FX_RSV, LN_INF and LN_INT_RT to LN_FX_RT in the long run.

Short run causal effect for the required equation will be C3, C4, C5 and C6 i.e. coefficient of the independent variables.The coefficient of GDP (C3), inflation (C5) and interest rate (C6) are statistically significant at 5% significance level concluding that these factor has short run causal effect on foreign exchange rate. Only foreign exchange reserve does not have any causal relationship in the short run on foreign exchange rate.

iv. Pairwise Granger Causality Test

To determine if the series can help in forecasting each other we have performed the granger causality test.

H_0: Does not granger cause
H_1: Granger causes.

Granger Causality Result

Null Hypothesis	F-Statistic	Prob.	Accept/Reject
LN_FX_RT does not Granger Cause LN_FX_RSV	0.68238	0.5154	Accept
LN_FX_RSV does not Granger Cause LN_FX_RT	1.20342	0.3184	Accept
LN_GDP does not Granger Cause LN_FX_RSV	0.41428	0.6657	Accept
LN_FX_RSV does not Granger Cause LN_GDP	1.17651	0.3262	Accept
LN_INF does not Granger Cause LN_FX_RSV	0.60166	0.5563	Accept
LN_FX_RSV does not Granger Cause LN_INF	0.40803	0.6697	Accept
LN_INT_RT does not Granger Cause LN_FX_RSV	0.65723	0.5277	Accept
LN_FX_RSV does not Granger Cause LN_INT_RT	5.85714	0.0088	Reject
LN_GDP does not Granger Cause LN_FX_RT	4.65361	0.0201	Reject
LN_FX_RT does not Granger Cause LN_GDP	0.74424	0.4862	Accept
LN_INF does not Granger Cause LN_FX_RT	2.08826	0.1468	Accept
LN_FX_RT does not Granger Cause LN_INF	0.6089	0.5525	Accept
LN_INT_RT does not Granger Cause LN_FX_RT	1.24638	0.3063	Accept
LN_FX_RT does not Granger Cause LN_INT_RT	8.89111	0.0014	Reject
LN_INF does not Granger Cause	1.26966	0.2999	Accept

LN_GDP			
LN_GDP does not Granger Cause			
LN_INF	1.07716	0.3571	Accept
LN_INT_RT does not Granger Cause			
LN_GDP	0.22271	0.8021	Accept
LN_GDP does not Granger Cause			
LN_INT_RT	3.83551	0.0365	Reject
LN_INT_RT does not Granger Cause			
LN_INF	0.14352	0.8671	Accept
LN_INF does not Granger Cause			
LN_INT_RT	0.10773	0.8983	Accept

The result manifested that out of 20 null hypotheses only four have not accepted the null hypothesis of not granger causing at 5% level of significance. So, we can say that (a) Foreign exchange reserve granger causes Interest rates. (b) GDP granger causes Foreign exchange rates. (c) Foreign exchange rate granger causes Interest rates, and (d) GDP granger causes interest rate.

7. CONCLUSION

The empirical findings of the paper support that there is a relationship between foreign exchange, GDP, inflation, interest rate and foreign exchange reserve of India (1990-2019). From the analysis we can say that the GDP and inflation directly affects the XR and the FOREX reserve and interest rate inversely affect the exchange rate. The result also shows that there is a long run causal relationship among the variables. All the factors except the foreign exchange reserve have short run causality. The trend of the EX rate is upward sloping showing continuous devaluation of the Indian currency.

The findings can help the economy to stabilize its rate and steady the situation. As the exchange rate is volatile in nature the study on effects of macro variables can be an utmost boon. In order to control the behavior exchange rate, government should closely study the macroeconomic variables. Correct policies should be implemented in order to appreciate the domestic currency and achieve prosperity.

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