ASSESSING THE IMPACT OF EXCHANGE RATE FLUCTUATIONS ON ECONOMIC GROWTH: A COMPREHENSIVE ANALYSIS

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ABSTRACT

This paper investigates the impact of exchange rate volatility on economic growth in India, using an ARDL model to assess both short- and long-term effects. The results reveal that exchange rate volatility has a significant negative impact on GDP in the long run, supporting the theory that fluctuations in exchange rates hinder trade and economic performance. Additionally, factors such as foreign direct investment (FDI) inflows and the Gross Enrollment Ratio (GER) show a notable influence on growth. The paper concludes with policy recommendations, emphasizing the importance of exchange rate stability, encouraging FDI, improving education, and promoting trade openness for sustainable economic growth.

Keywords: *Exchange Rate, Volatility, ARDL Model, FDI Inflows, GDP.*

1. INTRODUCTION

Exchange rate volatility has been a significant concern for policymakers and economists, as it directly impacts trade, investment, and economic stability. Countries with fluctuating exchange rates, especially in a globalized economy, face challenges in sustaining consistent growth. Exchange rate movements influence export and import prices, creating uncertainty for businesses engaged in international trade, which affects overall economic performance (Tavlas, 2003). This is particularly crucial for emerging economies like India, which rely heavily on trade and foreign investments. Given its expanding population and developmental needs, understanding the impact of exchange rate volatility on growth is essential for India.

The relationship between exchange rate volatility and economic growth is multifaceted. Exchange rate fluctuations can impact trade volumes, foreign direct investment (FDI) inflows, and public resource allocation. Volatility often creates uncertainty, leading to reduced investor confidence, lower investment, and slower economic growth (Edwards & Levy-Yeyati, 2003). In India's case, maintaining stable economic growth is a priority, and understanding these dynamics is crucial for formulating effective policy responses.

While several studies have highlighted the negative effects of exchange rate volatility on trade and growth (Ghosh, Gulde, & Wolf, 2002), comprehensive analyses within the Indian context remain limited. This research seeks to bridge this gap by investigating the impact of exchange rate volatility on India's economic growth using an Autoregressive Distributed Lag (ARDL) model. The study will also account for the roles of FDI inflows, public expenditure, and trade openness in shaping India's growth trajectory.

This paper contributes to the existing literature by offering a detailed analysis of how fluctuations in exchange rates influence economic growth in India. The findings provide valuable insights for policymakers, emphasizing the need for stability in exchange rates, the promotion of FDI, and investment in human capital to foster sustainable economic development.

2. LITERATURE REVIEW

The Solow growth model (Solow, 1956) suggests that physical capital alone cannot explain long-term economic growth. Building on this, Romer (2012) incorporates human capital into the Solow model, indicating that education significantly contributes to human capital formation, which in turn drives economic growth. This paper extends these theories to analyze the correlation between exchange rate volatility and economic growth, considering human capital, gross capital formation per labor, and trade as control variables.

Theories suggest that economic growth can attract foreign direct investment (FDI), which stabilizes the exchange rate (Choe, 2003). Conversely, high exchange rate volatility discourages investments, reducing the capital available in an economy (Tavlas, 2003). Human capital is another crucial factor, with Romer (2012) arguing that the time spent in education directly influences the level of human capital. However, Benhabib and Spiegel (1994) contend that human capital may be more closely related to capital accumulation than to economic growth.

Trade is a vital determinant of growth, and increased trade is positively linked with economic growth (Liu et al., 2002). Exchange rate volatility negatively affects trade, as found by Lin, Shi, and Ye (2018), which leads to reduced economic performance. The literature generally supports the notion that stable exchange rates promote growth (Ghosh et al., 2002), while pegged exchange rates may yield short-term benefits but can slow long-run growth (Edwards & Levy-

Yeyati, 2003). Eichengreen and Leblang (2003) add that high-growth economies often experience higher exchange rate volatility. The choice between real and nominal exchange rates remains contested, as both may yield similar outcomes in growth studies (Rodrik, 2008; Mark, 1990).

3. DATA AND METHODOLOGY

3.1 Data Source and Description of Variables

The dataset used for this investigation consists of annual time-series data on the exchange rate, GDP (Gross Domestic Product), public expenditure, gross fixed capital formation, domestic credit to the private sector, trade openness, FDI inflows, gross enrolment ratio (GER), and public debt from 1980 to 2021. The data is sourced from the World Development Indicators (World Bank) and the Reserve Bank of India. Exchange rate volatility is modelled using a GARCH (1, 1) model.

3.2 Model Specification

The model to estimate the effect of exchange rate volatility on economic growth is specified as:

$$lngdp_t = \beta_0 + \beta_1 lngdp_{t-1} + \beta_2 lnpubexp_t + \beta_3 lngfcf_t + \beta_4 lndocps_t + \beta_5 lntrdop_t + \beta_6 lnfdiinf_t + \beta_7 lnger_t + \beta_8 lnpubdebt_t + \beta_9 lnvol_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots (1)$$

Where GDP is the gross domestic product, PUBEXP is public expenditure, GFCF is gross fixed capital formation, DOCPS is domestic credit to the private sector, TRDOP is trade openness, FDIINF is FDI inflows, GER is the gross enrolment ratio, PUBDEBT is public debt, and VOL is the exchange rate volatility. All variables are transformed using natural logarithms, with the coefficients representing elasticities.

3.3 ARDL Estimation Technique

To identify the effects of exchange rate volatility on economic growth, the study chose the Auto-Regressive Distributed Lag (ARDL) model. The ARDL model, first proposed by Pesaran et al. (2001), incorporates both long- and short-term information, where the former is captured by an error correction term, the same as in the error correction model (ECM). Despite this similarity, ARDL differs from traditional error correction models in two ways: first, ARDL allows the regressors to be purely I(0), purely I(1), or fractionally integrated; second, it allows the independent variables to have different lag orders, which mitigates problems related to serial correlations and endogeneity (Pesaran and Shin 1999). In other words, even if the sample size is small or the explained variables are endogenous, we can still obtain reliable estimates and inferences with the ARDL approach.

To express the above equation in an Error Correction Model (ECM) format, we need to include the short-term dynamics and the long-term equilibrium relationship. The ECM format typically separates the long-run relationship from the short-run dynamics by including an error correction term.

Let's denote the long-run relationship as:

$$lngdp_t = \beta_0 + \beta_1 lngdp_{t-1} + \beta_2 lnpubexp_t + \beta_3 lngfcf_t + \beta_4 lndocps_t + \beta_5 lntrdop_t + \beta_6 lnfdiinf_t + \beta_7 lnger_t + \beta_8 lnpubdebt_t + \beta_9 lnvol_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots (2)$$

where ε_t is the long-run equilibrium error term.

3.4 Modelling Exchange Rate Volatility

Exchange rate volatility is measured using the coefficient of variation derived from the conditional variance estimated through a GARCH (1, 1) model. The conditional variance equation is given by the Variance Equation:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \quad \varepsilon_t | I_{t-1} | \sim N(0, \sigma_t^2) \ldots 4$$

4. EMPIRICAL RESULTS AND DISCUSSIONS

4.1 Descriptive Statistics of the Variables

Table 1 presents the summary statistics for the key variables. The results indicate significant variability in FDI inflows and trade openness, while public expenditure and government debt exhibit relative stability.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lngdp	42	27.473	.726	26.325	28.636
lnpubexp	42	4.309	.087	4.184	4.472
lngfcf	42	3.294	.164	2.979	3.578
lndocps	42	3.499	.351	3.023	4
lntrdop	42	3.296	.512	2.503	4.022
lnfdiinf	42	-.94	1.802	-5.958	1.287
lnger	42	4.021	.194	3.693	4.318
lnpubdebt	42	3.862	.114	3.598	4.091
lnvol	42	-7.931	.439	-8.319	-6.277

Source: Author's Calculation

4.2 Matrix of correlations between the variables

Table 2 reveals a strong positive relationship between GDP, gross fixed capital formation, domestic credit, trade openness, FDI inflows, and government expenditure. In contrast, public expenditure shows negative correlations with GDP and other investment variables, suggesting a potential crowding-out effect.

Table 2: Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9
(1) lngdp	1								
(2) lnpubexp	−0.862	1							
(3) lngfcf	0.798	-0.94	1						
(4) lndocps	0.933	-0.84	0.82	1					
(5) lntrdop	0.923	-0.95	0.9	0.91	1				
(6) lnfdiinf	0.869	-0.89	0.85	0.77	0.9	1			
(7) lnger	0.978	-0.9	0.85	0.96	0.95	0.86	1		
(8) lnpubdebt	0.337	-0.37	0.47	0.21	0.3	0.45	0.29	1	
(9) lnvol	0.041	-0.16	0.11	0.06	0.12	0.03	0.06	0.01	1

Source: Author's Calculation

4.3 Lag Order Criteria

Table 3 suggests that Lag 3 is preferred as it has the lowest values for AIC, HQIC, and SBIC, suggesting the best fit among the considered lags.

Table 3: Optimal Lag Length Selection Criteria

Sample: 1984-2021							Number of obs = 38	
lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	241.7				3.90E-17	-12.2472	-12.1092	-11.8594
1	589.04	694.68	81	0	3.60E-23	-26.2651	-24.8851	-22.3866
2	687.17	196.28	81	0	3.10E-23	-27.1671	-24.5452	-19.7979
3	930.65	486.94*	81	0	1.00E-25	-35.7182*	-31.8543*	-24.8584*
4	.		81		-2e-149*			

Source: Author's Calculation

4.4 Unit Root Test Results

The ADF and PP tests indicate that while some variables are stationary at levels, others require first differencing. The results are presented in Table 4, confirming the suitability of the ARDL approach for the analysis.

Table 4: Results of ADF and PP Unit Root Test

	ADF (Augmented Dickey-Fuller)		PP (Phillips-Perron)	
Variables	Level	First Difference	Level	First Difference
	T-statistic	*T-statistic*	*T-statistic*	*T-statistic*
lngdp	0.025	-6.129***	0.04	-6.122***
lnpubexp	-2.082	-4.331***	-1.899	-4.408***
lngfcf	-1.897	-7.284***	-1.903	-7.228***
lndocps	-0.684	-5.526***	-0.761	-5.816***
lntrdop	-0.596	-5.145***	-0.68	-5.203***
lnfdiinf	-1.457	-6.854***	-1.3	-7.083***
lnger	-1.382	-5.483***	-1.315	-5.526***
lnpundebt	-2.632*	-7.743***	-2.546*	-7.732***
lnvol	-7.054***	-15.823***	-7.055***	-18.293***
Standard errors in parentheses and *** p<0.01, ** p<0.05, * p<0.1				

Source: Author's Calculation

4.5 Exchange Rate Volatility Based on GARCH (1,1) Estimation Results

The study uses GARCH [1,1] to estimate exchange rate volatility, finding that past volatility significantly impacts current volatility. Both the ARCH and GARCH terms are statistically significant, with the former at the 1% level and the latter at 5%. The positive coefficients indicate volatility clustering, where high volatility periods are likely followed by more volatility.

Table 5: GARCH (1,1) Results

	ARMA	ARCH	GARCH
L.ar	-0.451		
	(-0.308)		
L.ma	0.590**		
	(-0.277)		
L.arch		0.362***	
		(-0.113)	
L.garch			0.274**
			(-0.124)
Constant	0.00293**	0.000174***	
	(-0.00117)	(-3.05E-05)	
Observations	503	503	503
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Source: Author's Calculation

4.6 Cointegration Results

The results of the ARDL Bounds Test in Table 6 suggest that there is a long-run relationship among the variables being analysed.

Table 6: ARDL Bound Test for Cointegration Results

Test Statistic	Value	Critical Values (k = 8)	Decision	Interpretation
F-statistic	4.914	1.95 (10%) 2.22 (5%) 2.48 (2.5%) 2.79 (1%)	Reject Null Hypothesis	There is a long-run relationship.
t-statistic	-3.493	-2.57 (10%) -2.86 (5%) -3.13 (2.5%) -3.43 (1%)	Reject Null Hypothesis	The variable is significant in the long run.

Source: Author's Calculation

4.7 ARDL Estimation Results

The ARDL model results are divided into long-run and short-run estimations. In the long run, exchange rate volatility has a negative, significant impact on GDP, consistent with theory. FDI inflows and Gross Enrollment Ratio (GER) also significantly affect growth. In the short run, volatility, public expenditure, trade openness, FDI inflows, and GER have notable effects on growth.

Table 7: Long Run Estimation Results

Dependent Variable: lngdp				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**P-Value**
L.lngdp	-0.328	0.094	-3.49	0.04**
lnpubexp	-1.452	1.461	-0.99	0.394
lngfcf	0.166	1.232	0.13	0.901
lndocps	-1.126	0.773	-1.46	0.241
lntrdop	0.824	0.51	1.62	0.204
lnfdiinf	-0.207	0.084	-2.47	0.09*
lnger	4.388	1.649	2.66	0.076*
lnpubdebt	-0.023	0.867	-0.03	0.981
lnvol	-0.671	0.204	-3.3	0.046**
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Source: Author's Calculation

Table: 8 Short Run Estimation Results

Dependent Variable: lngdp				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**P-Value**
D.lngdp (L1)	-0.388	0.286	-1.35	0.268
D.lngdp (L2)	-0.804	0.217	-3.71	0.034**
lnpubexp (D1)	0.038	0.747	0.05	0.963
lnpubexp (LD)	1.434	0.829	1.73	0.182
lnpubexp (L2D)	1.492	0.608	2.46	0.091*
lngfcf (D1)	-0.154	0.408	-0.38	0.731
lngfcf (LD)	-0.176	0.33	-0.53	0.631
lngfcf (L2D)	-0.356	0.219	-1.63	0.202
lndocps (D1)	0.063	0.265	0.24	0.828
lndocps (LD)	0.316	0.27	1.17	0.327
lndocps (L2D)	-0.374	0.245	-1.53	0.224
lntrdop (D1)	0.035	0.11	0.31	0.774
lntrdop (LD)	0.162	0.114	1.43	0.248
lntrdop (L2D)	0.175	0.068	2.58	0.081*
lnfdiinf (D1)	0.041	0.02	2.04	0.134
lnfdiinf (LD)	0.048	0.02	2.38	0.098*
lnfdiinf (L2D)	0.036	0.015	2.41	0.095*
lnger (D1)	-1.188	0.25	-4.75	0.018***
lnger (LD)	-1.316	0.258	-5.09	0.015***
lnger (L2D)	-1.339	0.443	-3.02	0.057**
lnpubdebt (D1)	-0.16	0.211	-0.76	0.502
lnpubdebt (LD)	-0.175	0.2	-0.87	0.446
lnpubdebt (L2D)	-0.166	0.149	-1.12	0.345
lnvol (D1)	0.164	0.051	3.24	0.048**
lnvol (LD)	0.071	0.027	2.6	0.08*
lnvol (L2D)	-0.007	0.01	-0.68	0.547
_cons	3.881	3.541	1.1	0.353
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Source: Author's Calculation

4.8 Diagnostic Tests

Diagnostic tests confirm the model's reliability. The residuals are normally distributed, as indicated by the skewness/kurtosis and Jarque-Bera tests. The Breusch-Pagan test shows no heteroscedasticity, and the Durbin-Watson statistic indicates no autocorrelation. The CUSUM test confirms parameter stability over time.

Table 9: Normality Test

Test	Obs	Pr (Skewness)	Pr (Kurtosis)	adj chi2(2)	Prob>chi2
Skewness/Kurtosis	39	0.8356	0.1965	1.82	0.4021

Table 10: Jarque-Bera Test

Test	JB Statistic	Chi(2)	Prob > Chi(2)
Jarque-Bera Test	1.129	2	0.5686

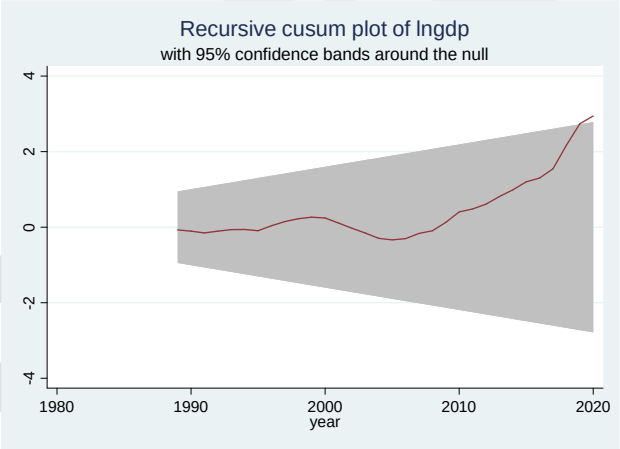
Table 11: Heteroscedasticity and Serial Correlation Test Results

test	Test Statistic	p-value	Conclusion
Breusch-Pagan / Cook-Weisberg Test	Chi2(1) = 0.01	0.9276	No heteroskedasticity (residuals have constant variance)
Durbin-Watson d-statistic	d = 2.294	-	No autocorrelation (residuals are independent)

Table12: Cusum Test Results

Test Type	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Interpretation
Recursive	0.3989	1.143	0.9479	0.85	No structural break detected

Figure 1: Recursive Cusum Plot of lngdp



5. CONCLUSION AND POLICY IMPLICATIONS

The study finds that exchange rate volatility negatively impacts economic growth in both the short and long run. This aligns with economic theory, as exchange rate fluctuations can disrupt trade, investment, and overall economic performance. Additionally, variables such as FDI inflows and Gross Enrollment Ratio (GER) significantly influence growth, highlighting the importance of foreign investment and human capital development.

So, Policymakers should prioritize stabilizing exchange rates to support consistent economic growth, as reducing volatility can mitigate its negative effects on trade and investment. Encouraging foreign direct investment (FDI) through incentives and maintaining a stable economic environment can boost long-term growth. Additionally, improving access to education and enhancing its quality, as reflected in higher Gross Enrollment Ratios, is crucial for sustainable development. While public expenditure showed mixed short-term effects, efficiently allocating resources, especially in infrastructure and education, can foster long-term growth. Lastly, promoting trade openness by encouraging exports and reducing barriers can enhance economic performance and global integration.

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