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CAN ECONOMIC GROWTH BE CAUSED BY THE FOREIGN EXCHANGE RATE OR VICE VERSA? AND CHALLENGES TO THE ECONOMIC GROWTH OF INDIA

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Abstract

This study examines economic growth and the foreign exchange rate relationships in India, using an ARDL model and time-series data from 1995 to 2025. Descriptive analysis finds that India's average GDP growth rate was 6.76%, while its foreign exchange reserves averaged $55.6 billion. ARDL results indicate that a two-period lagged exchange rate significantly increases GDP growth with a coefficient value of 17.77. The F-test of F Bounds, with an F-statistic of 7.25, verifies the long-term relationship among key macroeconomic variables at the upper critical value. Granger causality tests indicate that economic growth Granger-causes transposition in the foreign exchange rate, but not the reverse. The analysis identifies ongoing challenges to India's growth, including exchange rate volatility, external shocks, and rising inequality. Policy recommendations include strengthening macroeconomic fundamentals, promoting export competitiveness, and improving remittance allocation to support sustainable and inclusive growth.

Keywords: ARDL Model; Causality; Economic Growth; Foreign Exchange Rate; India.

1. INTRODUCTION

The dynamic interplay between economic growth and foreign exchange rates remains a central theme in international economics, particularly for emerging economies like India. Exchange rate fluctuations can significantly affect macroeconomic stability, export competitiveness, and import costs, thereby shaping a country's growth trajectory (Singh, Kumar, & Gupta, 2023; Shukla & Sharma, 2024). Conversely, sustained economic growth may influence the foreign exchange market by bolstering investor confidence, increasing capital inflows, and affecting the demand for domestic currency (IMF, 2023). The potential for bidirectional causality between exchange rates and economic growth remains debated, and recent empirical studies using advanced econometric models have sought to clarify this complex relationship (Mishra & Banerjee, 2024). Since the Reserve of Indian Bank put out its report on monetary policy (MPR) in October 2024, the global economy has stayed steady. However, it is still performing below past averages. Recent data shows that growth could slow in 2025. Trade tensions and new tariffs add to the uncertainty in the outlook. Headline inflation is coming down but remains above target in many countries. Disinflation is slow and uneven. The drop in headline inflation, mostly due to lower core inflation (CPI without food and fuel), is a positive sign. However, high

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service inflation remains a concern. Countries are now taking different approaches to monetary policy. After a period when most raised rates together, some have started to cut rates slowly and carefully (MPR, 2025). Despite notable achievements in insolvency downturn and India's economic growth and technological progress continues to face persistent challenges. These include exchange rate volatility, external shocks, fiscal and monetary policy constraints, sectoral bottlenecks, and rising inequality (World Bank, 2023; RBI, 2024). Such factors have at times constrained India's growth potential and complicated macroeconomic policy formulation. Against this backdrop, it is essential to systematically examine the empirical proof regarding the causal relationship between economic growth and foreign exchange rates in India, while also identifying the structural and policy challenges that shape this nexus. Such an inquiry is not only academically valuable but also crucial for informing effective policy aimed at fostering sustainable and inclusive growth. Recent empirical research confirms that exchange rate volatility and the regime under which an exchange rate operates significantly affect economic growth. Ameziane & Benyacoub (2022) find that, across 14 emerging economies (1990–2020), higher conditional exchange rate variance (i.e., greater volatility) negatively affects growth, especially under flexible regimes. Another recent paper, *The Threshold Effect of Growth of Economic on Rates of Exchange in BRICS Countries* (2025), shows that for China, Russia, South Africa, Brazil, and, India, the consequence of exchange rate changes depends on thresholds: beyond certain levels of exchange rate depreciation or appreciation, growth responds differently. Additionally, Chikwira & Jahed (2024) demonstrate that stable exchange rates are associated with more favorable growth outcomes, in part by lowering inflation and making trade and investment flows more predictable, compared with periods of instability. This study empirically examines the cause-and-effect link between foreign exchange rates and economic growth in India, aiming to determine whether fluctuations in exchange rates drive economic expansion or whether economic growth itself influences currency movements. In doing so, it also aims to identify and analyze the key challenges and structural constraints that impede India's economic growth, including exchange rate volatility, policy constraints, sectoral bottlenecks, and external shocks. By systematically investigating these issues through robust empirical analysis, the research endeavors to provide informed policy recommendations that address both the way the foreign exchange market works and the broader macroeconomic challenges facing India. Ultimately, the study is intended to offer actionable insights for policymakers seeking to booster long-lasting and open to all economic growth in the Indian context.

2. LITERATURE ON THIS TOPIC

2.1 A Review of the Literature Based on Evidence

The Exchange Rate as a Factor in Economic Growth

A 2024 study examined India's IT sell abroad from 2012 to 2022 and discovered that changes in the rupee-dollar exchange rate accounted for about 92% of the variation in export revenue. In this case, GDP growth had little direct effect. This shows how important

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a stable currency is for export-led growth in the IT sector. Another 2024 study, examining the real effective exchange rate (REER) from 1994 to 2022, found that exports respond to REER in short term. Imports, meanwhile, are more sensitive in long term. Empirical studies show that India's economic growth has faced major problems in recent years. Unemployment is high, especially among young people. The Periodic Labour Force Survey shows that poor training and lack of jobs block productive work and inclusive growth (ILO, 2023). Over 80% of workers are in informal jobs, leading to low productivity and stagnant wages. This makes it hard for a strong middle class to grow (World Bank, 2022). The World Inequality Database (WID, 2023) notes that income and wealth inequality continue to rise. The top 10% now hold a larger share of assets, which is bad for social stability and long-term growth. India's economy grew from 1997 to 2025 due to links among GDP growth, exports, and foreign exchange reserves. This shows India's deeper ties to the world economy. In 1997, GDP grew by 7.57%, exports were low, and foreign exchange reserves stood at USD 32.43 billion. These numbers came after the 1991 reforms. Export growth during this period was led by labor-intensive manufacturing and IT services. This gave India a new edge in service exports (Siddiqui, 2025). Poverty reduction had been progressing before COVID-19, but the pandemic stalled these gains. Recent World Bank reports confirm that many vulnerable groups have suffered. Infrastructure remains lacking in transport, electricity, and city services. This is especially true in the rural country and peri-populus center, where growth potential remains untapped (NITI Aayog, 2022). The pandemic's shock caused an unprecedented decline in GDP and hit informal workers and small businesses hardest (Reserve Bank of India (RBI), 2021). Changes in global oil prices and supply chain problems have also pushed up inflation and import costs, hurting growth chances (IMF, 2023). Government spending is limited by high public debt. The public debt to GDP ratio is over 80% (Ministry of Finance, 2023). The Reserve Bank of India must balance low inflation with growth, especially given the volatility of food and energy prices (Reserve Bank of India, 2024). Human capital growth is another problem. Many people lack basic literacy and numeracy skills, and investments in public health alone are not enough. These issues reduce productivity and make lasting growth harder (ASER Centre, 2023; The Lancet, 2022). The findings above show how complex it is to sustain India's strong, inclusive growth. There is a clear need for wide-ranging policy reforms and greater investment in all types of infrastructure.

Can Foreign Exchange Rate Caused by Economic Growth?

Recent studies confirm that changes in foreign exchange rate have an effect on economic growth., especially in countries like India. Exchange rate swings influence exports, import costs, and inflation. Shukla and Sharma (2024) found that shifts in the rupee-dollar exchange rate accounted for over 90% of India's IT export income. This shows that a stable exchange rate helps both sectors and the whole economy. Singh, Kumar, and Gupta (2023) used models to show that lowering the real effective exchange rate (REER) can boost short-term exports. However, it also raises import costs and inflation, which can hurt long-term growth. These findings highlight the need for careful exchange rate management to support national development.

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Can Economic Growth Cause Changes in the Foreign Exchange Rate?

Empirical studies indicate that robust economic growth can contribute to the stabilization or appreciation of a nation's currency. The International Monetary Fund (2023) reports that India's strong GDP growth projections are associated with slower rupee depreciation and improved macroeconomic stability. Sustained economic expansion may therefore enhance investor confidence and attract capital inflows, both of which support currency stability. Mishra and Banerjee (2024) emphasize the potential for feedback effects, noting that the connection between economic growth and exchange rate movements is mediated by external shocks, institutional quality, and policy responses. These context-specific dynamics highlight the multifaceted and bidirectional nature of the relationship, shaped by both domestic fundamentals and global economic conditions.

2.2 Theoretical Framework

Theories on (PPP) Purchasing Power Parity

Theories on purchasing power parity (PPP) is a key idea in international economics. It says that, over time, when you use the same currency, exchange rates change so that the same goods cost the same in different countries. This implies that inflation differentials between countries are the primary determinants of exchange rate movements (Cassel, 1918). While PPP provides a useful benchmark for analyzing currency valuation, empirical evidence suggests it is more effective at explaining long-term trends than short-term fluctuations, particularly in economies with market imperfections, capital controls, and policy interventions.

Model of Mundell Fleming

The Mundell-Fleming Model adds to the traditional IS-LM framework by applying it to the open economy. Context, highlighting the interactions among fiscal and monetary policies and the selection of an exchange rate system (Mundell, 1963; Fleming, 1962). According to this model, monetary policy works better under a system with a floating exchange rate. At influencing output and growth, as capital mobility allows for interest rate differentials to impact currency values and aggregate demand. Conversely, a fixed exchange rate system means that budgetary policy tends to be more potent, since monetary autonomy is constrained by the need to maintain currency stability. This model underscores the crucial function of institutions and policies settings in mediating the relationship between exchange rates and growth of economy.

3. METHODOLOGY

3.1 Specification of ARDL Model

In time-series econometrics, the Autoregressive Distributed Lag (ARDL) model is frequently employed. It examines how a dependent variable and one or more independent factors change over time. ARDL enables researchers to assess both short-run and long-run effects in economic and financial data. Pesaran, Shin, and Smith (2001) introduced the bounds testing approach for cointegration based on ARDL framework. This

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method inspects both near- and long-term relationships in time-series data. It is especially useful for studies with limited sample sizes. Uniquely, the ARDL approach applies regardless of the stationarity of variables, unlike other cointegration techniques that require stationarity. This study's model specification is based on the Model of Solow Growth. The strategy emphasizes economic expansion propelled by exogenous capital inflows. Methods and findings from previous studies (Adjei et al., 2020; Khan et al., 2019; Qutb, 2022; Islam, 2022) also guide this approach.

$$GDPg = f(Fx, Rem, ED, X, FDI) \quad (1)$$

Where, GDPg stands for gross domestic product growth rate; Rem stands for immigrant remittances; ED stands for external debt; Fx stands for the foreign exchange rate; X stands for exports; and FDI stands for foreign direct investment.

3.2 The Long Run ARDL Model

The updated ARDL model was used to look at how the variables are related over a long

Period of time.

$$\Delta GDPg_t = \psi_0 + \psi_1 GDPg_{t-1} + \delta_1 Fx_{t-1} + \delta_2 Rem_{t-1} + \delta_3 ED_{t-1} + \delta_4 X_{t-1} + \delta_5 FDI_{t-1} + \varepsilon_t \quad (2)$$

Where ψ_0 is the constant, ψ_1 is the coefficient to be estimated for the GDP growth rate, and δ_1 to δ_5 are the coefficients estimated for the independent variables.

3.3 Data Type, Source, and Analysis

Secondary data on time series from 1995 to 2025 were sourced from the World Bank and the Reserve Bank of India (RBI). Analysis was conducted using EViews 12.

Variable definition and Data Sources

Table 1: Variable definition and data source

S/N	Variable Name	Definition	Source
1	Growth rate Gross Domestic Product (GDPg)	Annual Percentage change in GDP	World Bank
2	Exchange rate (Fx)	Official exchange rate	RBI
3	Remittances (Rem)	Personal remittances received (current US$)	World Bank
4	External Debt (ED)	Total external debt on country of India	World Bank
5	Export (X)	Total exports of services and goods	World Bank
6	Foreign Direct Investment (FDI)	Investment by foreigner	RBI

Source: Estimated by the author

4. RESULTS OF DISCUSSION

4.1 Analysis of Descriptive Study

Table 2 summarizes key macroeconomic variables affecting India's economic performance from 1990 to 2025, including GDP growth (GDPg), foreign exchange reserves (Fx), external debt (ED), remittances (Rem), exports (X), and (FDI) foreign direct

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investment. The mean GDP growth rate of 6.76% demonstrates robust and consistent expansion, reflecting the impact of liberalization policies and structural reforms since the early 1990s (World Bank, 2024). A standard deviation of 1.76 indicates moderate volatility, consistent with India's economic diversification and improved macroeconomic management. Foreign exchange reserves average 55.6 and show a steady upward trend, illustrating enhanced external resilience and prudent balance-of-payments policies (RBI, 2023). The FX variable's positive skewness (0.51) reflects sustained reserve accumulation since the 2000s under the managed float exchange rate system (Chakraborty & Ghosh, 2021). From Table 2, the mean external debt (ED) of ₹3.31 × 10^{11} indicates a growing but controlled reliance on external financing. Low skewness (0.29) and kurtosis (1.59) suggest stable debt dynamics. Remittance inflows average ₹5.40 × 10^{10}, confirming India's position as a leading global recipient and supporting household consumption and external stability (World Bank, 2023).

Table 2: Results of descriptive analysis

Statistic	GDPG	FX	ED	REM	X	FDI
Mean	6.762954	55.60484	3.31E+11	5.40E+10	3.58E+11	2.71E+10
Median	7.479875	48.41	2.90E+11	5.35E+10	3.75E+11	2.76E+10
Maximum	9.689592	86.3	7.36E+11	1.38E+11	1.08E+12	8.75E+10
Minimum	3.086698	32.43	9.38E+10	6.22E+09	3.91E+10	1.24E+09
Standard Deviation	1.767498	15.60566	2.16E+11	3.84E+10	2.78E+11	2.15E+10
Skewness	-0.56293	0.51551	0.289791	0.499643	0.650715	0.624328
Kurtosis	2.315992	2.011603	1.588797	2.309428	2.771217	3.13369
Jarque-Bera	2.16928	2.634914	3.006238	1.905805	2.255332	2.036979
Probability (JB)	0.338023	0.267815	0.222435	0.38562	0.323788	0.36114
Sum	202.8886	1723.75	1.03E+13	1.67E+12	1.11E+13	8.41E+11
Sum of Sq. Dev.	90.59744	7306.101	1.40E+24	4.42E+22	2.31E+24	1.39E+22
Observations	30	31	31	31	31	31

Source: Prepared by the author

Exports and FDI show higher standard deviations (2.78 × 10^{11} and 2.15 × 10^{10}), reflecting India's integration into global markets and vulnerability to external shocks. Jarque–Bera probabilities above 0.05 for all variables indicate approximate normality, supporting their use in econometric models such as ARDL and cointegration (Pesaran et al., 2001). Overall, these statistics demonstrate India's sustained growth, resilience during global crises, and increasing openness to international capital and trade, consistent with recent policy frameworks promoting competitiveness and macroeconomic stability (NITI Aayog, 2022; UNCTAD, 2024).

Since the mid-1990s, Figure 1 illustrates India's economy has experienced steady growth, periodic shocks, and a strong post-pandemic recovery. After liberalization in the early 1990s, the annual average growth rate of GDP was 6% to 8% from 1995 to 2008 (Panagariya, 2008). The 2008 global financial crisis caused a brief slowdown, but growth rebounded to over 7% by 2010 (Ghosh & Narayan, 2020). In 2020, the COVID-19 pandemic caused a dramatic decline in GDP due to nationwide lockdowns and widespread disruptions (Dev & Sengupta, 2021).

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In the recovery phase, India demonstrated resilience, achieving one of the highest global growth rates. Projections for 2024–2025 estimate growth of 6.4%-7% (IMF, 2024; World Bank, 2023). Recent research indicates that, despite short-term volatility, India is moving toward more sustainable and moderate growth.

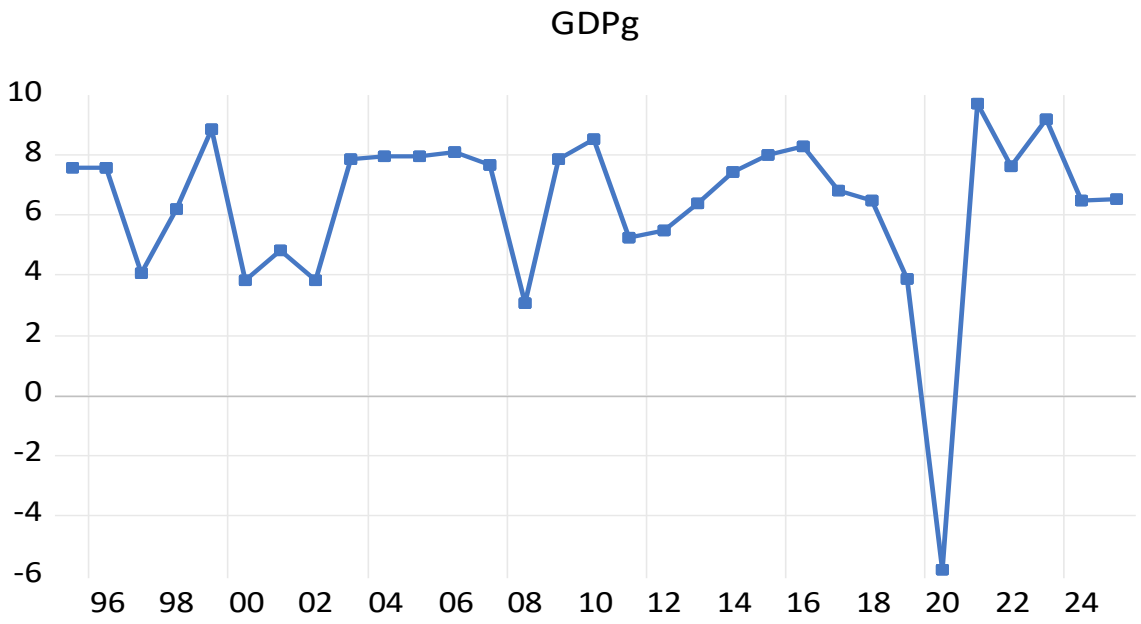

Figure 1: Results of GDP growth rate

Source: self-computed results

The negative GDP growth rate of –5.77% in 2020 from figure 1 constituted one of the most severe economic contractions in India's recent history, primarily resulting from the COVID-19 pandemic and nationwide lockdowns that abruptly halt. The GDP contraction of –5.77% in 2020 was among the most severe in India's recent history, driven by the COVID-19 pandemic and nationwide lockdowns that halted economic activity. Extended restrictions disrupted supply chains, suspended manufacturing and construction, and caused large-scale reverse migration, reducing labor supply and weakening demand (RBI, 2021; Ministry of Finance, 2021). The service sector, which accounts for over half of GDP, was especially affected by travel bans and the collapse of tourism, retail, and hospitality. Internationally, trade disruptions, lower foreign direct investment, and reduced remittances further deepened the downturn (UNCTAD, 2021; World Bank, 2021).

From Figure 2, India's macroeconomic performance from 1997 to 2025 shows a strengthening external sector amid fluctuating growth. In 1997, GDP growth was 7.57% and foreign exchange reserves were about USD 32.43 billion, marking the early phase of post-liberalization resilience after the 1991 reforms. The steady accumulation of reserves during this period signaled greater external stability and investor confidence (Siddiqui, 2025).

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By 2010, in Figure 2, foreign exchange reserves had increased significantly to USD 45.73 billion, while GDP growth reached 8.50%. This period reflected the momentum of the mid-2000s, driven by high domestic investment, strong services exports, and favorable global financial conditions (RBI, 2021). By 2019, GDP growth fell sharply to 3.87%, even as reserves climbed to USD 70.42 billion.

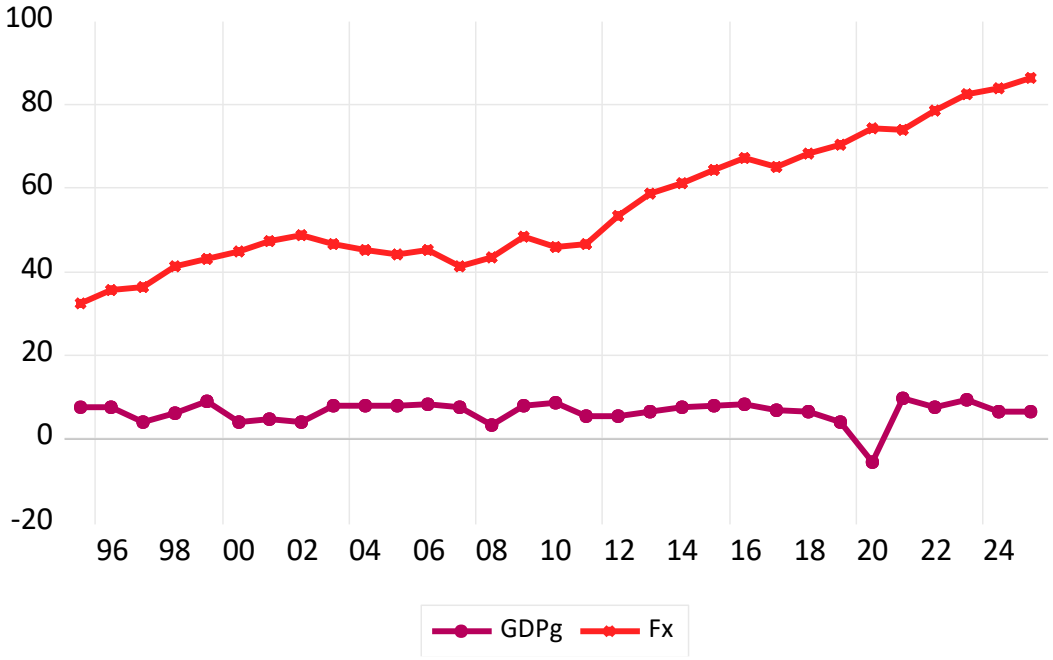

Figure 2: Relationship between GDP growth rate (GDPg) and Foreign Exchange rate (Fx)

Source: Author's owns analysis

This trend suggests that reserve accumulation was increasingly driven by capital inflows and external borrowing rather than growth in the productive real sector (Chakraborty & Sinha, 2023). Projections for 2025 indicate GDP growth of about 6.5% and foreign exchange reserves reaching USD 86.3 billion, pointing to a moderate recovery from the 2020 pandemic contraction.

This rebound shows India's ability to restore growth momentum while maintaining a strong external buffer, which is crucial for protecting the economy from global shocks and exchange-rate volatility (NITI Aayog, 2022; IMF, 2023; World Bank, 2022). The distinct but related trends of GDP growth and foreign exchange accumulation highlight the complex relationship among macroeconomic policy, external balance, and growth sustainability in India's development.

4.2 Stationarity and lag selection

Fisher Chi-square unit root test results are displayed in Table 3 for the Augmented Dicky Fuller (ADF) test for key macroeconomic series. For all variables, ΔlnGDPg, ΔlnFx,

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ΔlnRem, ΔlnED, ΔlnX, and ΔlnFDI: the null of non-stationarity is not accepted at the 5% significance level because the p-values are low (Maddala & Wu, 1999). This means that every order one series is integrated I (1), so they are good for cointegration analysis or error-correction modeling, which aligns with recent empirical macroeconomic research (Baltagi, 2021; Gujarati & Porter, 2021).

Table 3: Results of stationarity test

Variables	ADF – Fisher Chi-square		Order of Integration	Lag selection criteria
	Statistic	Probability		
ΔlnGDPg	7.2	0%	I (1)	2
ΔlnFx	4.97	0.04%	I (1)	2
ΔlnRem	5.09	0.03%	I (1)	2
ΔlnED	3.76	0.83%	I (1)	2
ΔlnX	4.48	0.14%	I (1)	2
ΔlnFDI	4.97	0.04%	I (1)	2

Source: Author's own analysis

4.3 ARDL model Estimation

The ARDL results show that, beyond FDI, several macroeconomic variables are significantly related to GDP growth. Significant lagged values of GDP growth (LNGDPG (-1), LNGDPG (-2), LNGDPG (-4)) confirm strong autoregressive momentum in economic performance, as widely documented in growth literature (Khan et al., 2021).

The two-period lagged exchange rate (LNFX (-2)) has a significant positive effect, indicating that exchange rate adjustments can enhance competitiveness and stimulate growth, especially when export sectors respond positively to currency movements (Adeoye et al., 2020).

Past external debt (LNED (-1)) is also positively associated with GDP growth, reflecting the potential growth benefits of productive borrowing when managed sustainably (Nguyen & Su, 2022).

The lagged effect of exports (LNX (-2)) is significant and positive, supporting the export-led growth hypothesis and highlighting the importance of international trade in driving output expansion (Menyah et al., 2017).

Conversely, remittances (LNREM) significantly hinder the growth of GDP in this context. This may suggest that remittance inflows are not always invested productively or may create dependency effects that reduce labor market participation, as seen in recent cross-country analyses (Akçay et al., 2022).

These findings highlight the complex ways macroeconomic variables influence economic growth and underscore the need for integrated policy approaches.

Policymakers should leverage the positive effects of trade, prudent debt management, and exchange rate management, while ensuring remittance inflows are directed toward productive uses.

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Table 4: Results of ARDL estimation

Variable's	Coefficient	Standard Error	T Statistic	Probability
lnGDPG (-1)	-2.464115	0.591584	-4.165282	0.0088
lnGDPG (-2)	1.112862	0.385097	2.88965	0.0256
lnGDPG (-3)	0.276021	0.323206	0.85491	0.4321
lnGDPG (-4)	1.105875	0.383351	2.88646	0.0257
lnFX	7.148787	5.237093	1.364319	0.2084
lnFX (-1)	-8.24632	3.320307	-2.484546	0.0547
lnFX (-2)	17.76846	6.519164	2.724145	0.0319
lnFDI	-0.261436	0.49442	-0.529101	0.6154
lnFDI (-1)	1.561481	0.641859	2.432148	0.0577
lnED	-2.014424	1.787527	-1.127567	0.3076
lnED (-1)	2.417788	0.918483	2.632736	0.0362
lnX	0.478778	1.053627	0.454383	0.6662
lnX (-1)	0.477178	0.810455	0.588981	0.6043
lnX (-2)	11.29307	3.198524	3.53127	0.0137
lnREM	-6.131479	2.149582	-2.853414	0.036
C	1.179343	5.219649	0.225394	0.8266

Source: Analyzed by authors

4.4 Estimation of Long-run

The long-term prediction in table 5 shows that exports have a good and accurately significant effect on growth of economic. This is in line with recent empirical evidence that shows the long-term benefits of export-led development strategies (Jha et al., 2023; dos Santos et al., 2024).

Table 5: Outcome of long-term estimation

Variables	Coefficient's	Standard Error	t-Statistic	Probability
LNREM	-1.22926	0.475454	-2.585442	0.0193
LNX	1.46964	0.513925	2.85964	0.0109
LNFX	0.033813	0.406539	0.083173	0.9347
LNPFDI	-0.272945	0.124318	-2.19554	0.0423
LNED	-0.110241	0.44254	-0.249111	0.8063
C	2.723499	4.29478	0.634609	0.533

Source: Estimated by Author

On the other hand, remittances and (FDI) foreign direct investment have big hinder long-term effects. This is in line with recent research that says that remittance inflows and FDI may not lead to growth in some cases because of weak absorptive capacities or their use in unproductive sectors (IMF, 2024; Uddin & Rana, 2024). The effects of foreign exchange reserves and external debt are statistically insignificant, suggesting that, during the studied period, these factors do not directly facilitate long-term economic growth within the model's framework. These results underscore the significance of institutional quality and focused interventions of policy to optimize the developmental advantages of external financial inflows and trade, as well as the imperative to improve local absorptive

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capacities to guarantee that foreign direct investment and remittances substantially contribute to sustainable economic progress.

LNGDPG = 2.7235 - 1.2293*LNREM* + *1.4696*LNX + 0.0338*LNFX* - *0.2729*LNPFDI - 0.1102*LNED …… (3)

The long-run equation 3, reveals that economic growth is positively influenced by exports, with a 1% increase in exports leading to an estimated 1.47% rise in growth, underscoring the strong and persistent role of export-led development as supported by recent studies (Dos Santos et al., 2024; Jha et al., 2023). Alternatively, remittances and (FDI) foreign direct investment have negative long-term effects. For example, a 1% increase in remittances or FDI is linked to a 1.23% and 0.27% drop in growth, respectively. This means that without strong absorptive capacities or good investment channels, these flows may not lead to growth and may even slow it down (IMF, 2024; Uddin & Rana, 2024). The coefficients for foreign exchange and external debt are either negative or close to zero and are not statistically significant. This could mean that these factors are not having a direct impact on growth, which is similar to recent findings that show how important it is to spend money on education wisely and effectively (Hanushek & Woessmann, 2023).

Bound Test

The F-Bounds Test results from table 6 show a clear long run connection between the ARDL model's variables. The F-statistic (7.25) is much higher than the upper critical value at all standard significance levels, including the 1% level (I (1) = 4.15 for k = 5). This means, the null hypothesis of no level relationship can be rejected. And verify that the variables are cointegrated. Cointegration supports the use of the approach of ARDL to examine both immediate and long-term consequences of the regressors on the explanatory variable. These results align with recent studies, such as Rahman and Salahuddin (2022), which highlight the value of bounds testing for identifying strong long-run links in macroeconomic time-series models.

Table 6: Outcome of Bound test

F-Bounds Test	Null Hypothesis: There is no association between levels			
Test Statistic	**Value**	**Significance Level**	**I (0)**	**I (1)**
F statistic	7.253536	10%	2.08	3
		5%	2.39	3.38
k	5	2.50%	2.7	3.73
		1%	3.06	4.15

Source: Analyzed by author

4.5 Causality test

The pairwise causality Granger result shows a unidirectional causal association from GDP growth (LNGDPG) to exports of factor services (LNXF). The null hypothesis that LNGDPG does not Granger-cause LNXF is rejected at the 5% significance level (F-statistic = 5.09, p = 0.016). Thus, past values of GDP growth significantly predict current values of LNXF.

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In contrast, the null hypothesis that LNXF does not Granger-cause LNGDPG cannot be rejected (F-statistic = 1.22, p = 0.314). This means past values of LNXF do not help predict GDP growth. These results suggest economic growth leads to more exports of factor services. During the studied period, exports did not drive growth. This aligns with recent research. For example, Sarkodie and Owusu (2022) note that export-led growth depends on context. They argue that economic development may precede and support export growth, especially in emerging economies.

Table 7: Outcome of test on Granger Causality

Test of Pairwise Granger Causality			
Null Hypothesis	**Obs**	**F-Statistic**	**Prob.**
lnGDPG does not Granger Cause lnFX	26	5.09377	0.0157
lnFX does not Granger Cause lnGDPG	26	1.22327	0.3144

Source: Analyzed by author

4.6 Diagnosis test

4.6.1 Stability Test

The CUSUM of Squares test helps assess whether a model's parameters remain stable over time. Using India's macroeconomic data from 1995 to 2025, the CUSUM of Squares plot shows that the test statistic stays within the 5% significance bounds. This outcome indicates there are no significant structural breaks or parameter changes during this period. According to Brown et al. (1975), we cannot reject the null hypothesis of parameter stability. This suggests the model's relationships are consistent across different time frames. Stability is especially important for India, given its evolving economic landscape and exposure to various shocks. The absence of significant parameter instability indicates that the model reliably captures the country's economic dynamics. Thus, it can be confidently used for policy analysis and forecasting (Asteriou & Hall, 2021; Baltagi, 2021). This result line up with recent studies that emphasize the importance of stability tests to ensure robust econometric modeling in rapidly developing economies like India (Pradhan et al., 2020).

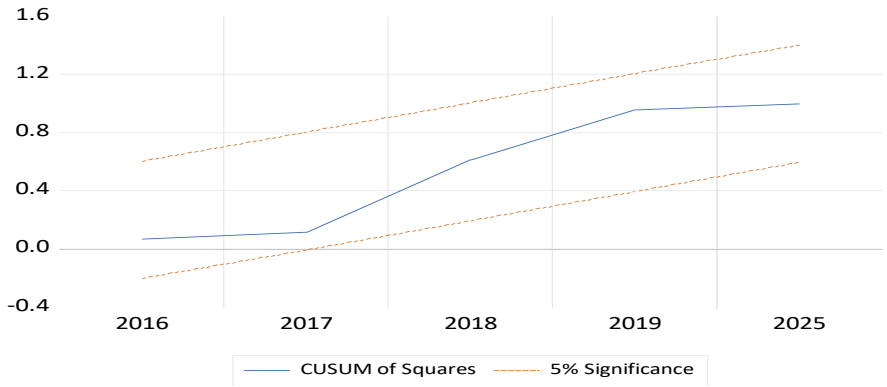

Figure 3: Outcome of Stability test

Source: Estimated by Author

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4.6.2 Test of Serial Correlation

To check whether the model's errors are serially correlated, I used the Breusch-Godfrey test, as reported in Table 7. The test results show that both the Obs*R-squared (1.11, p=0.29) and the F-statistic (0.21, p=0.67) are not significant. This means there is no evidence of a pattern in the errors over the first time period. Table 7 shows that the model's residuals exhibit white noise. This is a desirable property in time-series analysis. Autocorrelation can bias standard errors, invalidate statistical inference, and reduce estimator efficiency (Baltagi, 2021; Gujarati & Porter, 2021). When residuals are free from autocorrelation, confidence in the validity of model estimates and hypothesis tests increases (Wooldridge, 2019).

Table 8: Result of Serial correlation test

Serial Correlation from Breusch-Godfrey LM Test:			
Null hypothesis: There is no serial Correlation at up to 1 lag			
F-statistic	0.21331	Prob. F (1,4)	0.6682
Obs*R-squared	1.113807	Prob. Chi-Square (1)	0.2913

Source: Analyzed by author

4.6.3 Normality test

The Jarque-Bera test statistic (2.09) and its moderate p-value (0.35) provide strong evidence for normality. At any reasonable level of consequence, the null hypothesis of normalcy cannot be rejected. This is also evident in the residual histogram, which shows a bell-shaped distribution. Most residuals cluster around zero. The approximate normality of residuals confirms that the ARDL model specification is appropriate for this dataset. Normal residuals are crucial for valid inference, especially for the validity of confidence intervals and hypothesis testing for the model coefficients. These results also suggest that there are no major issues with model misspecification, outliers, or omitted-variable bias in the residual distribution.

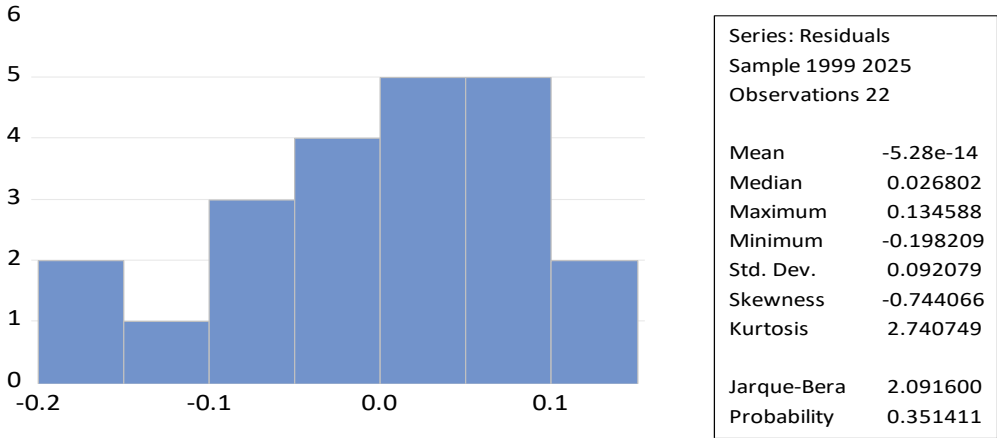

Figure 4: Result of Normality test

Source: Analyzed by author

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5. CONCLUSION AND RECOMMENDATION

This study finds that GDP growth is a key predictor of exchange rate movements in India from 1995 to 2025, with evidence that two-period lagged exchange rates also boost GDP growth, especially through export competitiveness. Persistent challenges such as exchange rate volatility, high public debt, sectoral bottlenecks, limited human capital, and growing inequality persist. Despite large remittances, their current negative impact on growth signals a need for policies that channel these funds into productive uses. The evidence calls for integrated macroeconomic strategies prioritizing exchange rate stability, export competitiveness, targeted remittance use, and investment in human capital. Strengthened coordination of monetary, fiscal, and trade policies will better equip India to achieve sustainable, resilient growth and manage external shocks.

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