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REAL EFFECTIVE EXCHANGE RATE DYNAMICS AND MACROECONOMIC STABILITY: A COMPARATIVE TIME-SERIES ANALYSIS OF PAKISTAN AND THE USA

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Abstract

This study examines the dynamic relationship between real effective exchange rate (REER) fluctuations and macroeconomic stability indicators—comprising current account balance, inflation, GDP growth, and trade openness—for Pakistan and the United States over the period 2001–2024. Beyond its econometric scope, the paper situates exchange rate governance within a broader political economy framework, recognising that REER misalignments are not merely technical phenomena but are shaped by state capacity, geopolitical positioning, civil-military relations, and the asymmetric power dynamics of the international monetary order. Employing an Autoregressive Distributed Lag (ARDL) framework adapted to a comparative panel setting and augmented by Error Correction Model (ECM) estimation, the analysis draws upon annual World Bank World Development Indicators data. Descriptive statistics reveal that Pakistan's REER is considerably more volatile (SD = 7.32) than that of the United States (SD = 10.61), with the latter exhibiting a persistent upward trajectory especially post-2014. Augmented Dickey-Fuller (ADF) unit root tests confirm non-stationarity of all variables at levels, justifying the ARDL-ECM approach. Long-run OLS regression results indicate that inflation exerts a statistically significant negative effect on Pakistan's REER ($\beta = -0.495$, $p = 0.098$), while for the United States, the current account balance ($\beta = 2.434$, $p = 0.037$), inflation ($\beta = 3.553$, $p = 0.003$), and trade openness ($\beta = -3.577$, $p < 0.001$) are highly significant long-run determinants. Error correction terms (ECT) are negative and statistically significant for Pakistan (ECT = −0.455, $p = 0.047$), confirming long-run convergence at approximately 45.5% per annum. The findings underscore the need for institutional reforms, democratic fiscal governance, and a rebalancing of Pakistan's geopolitical dependencies to achieve durable exchange rate stability. Policy implications are derived for the State Bank of Pakistan (SBP) and the Federal Reserve, respectively, emphasizing inflation targeting, current account management, and trade

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competitiveness strategies.

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1. Introduction

Exchange rate dynamics occupy a central position in macroeconomic theory and policy, functioning as a critical transmission mechanism between domestic economic conditions and the global financial environment. The Real Effective Exchange Rate (REER)—defined as the trade-weighted nominal effective exchange rate adjusted for relative price differentials—serves as a comprehensive barometer of a country's international price competitiveness, and its fluctuations carry far-reaching implications for current account sustainability, inflation, output growth, and financial stability (Comunale, 2017; MacDonald & Dias, 2007). In the post-global financial crisis era, and especially in the aftermath of the COVID-19 pandemic, exchange rate volatility has intensified across both developed and developing economies, rekindling scholarly and policy interest in the macroeconomic consequences of REER misalignments.

This study undertakes a rigorous comparative time-series analysis of REER dynamics and their macroeconomic implications for two structurally heterogeneous economies: Pakistan—a lower-middle-income developing economy characterized by chronic balance-of-payments pressures, elevated inflation, and periodic currency crises—and the United States, the world's foremost reserve currency issuer with deep capital markets and a relatively stable macroeconomic framework. The juxtaposition of these two economies is analytically compelling precisely because of their structural divergence: it allows for an examination of whether universal theoretical propositions concerning REER behavior hold across vastly different institutional, monetary, and developmental contexts.

Using annual data from the World Bank World Development Indicators (WDI) spanning 2001 to 2024, this paper investigates the long-run and short-run relationships between REER and four core macroeconomic stability indicators: the current account balance (% of GDP), inflation as measured by the GDP deflator (annual %), GDP growth rate (annual %), and trade openness (% of GDP). The methodological framework is anchored in the Autoregressive Distributed Lag (ARDL) bounds testing approach of Pesaran, Shin, and Smith (2001), complemented by Error Correction Model (ECM) estimation to disentangle short-run dynamics from long-run equilibrium paths. This approach is especially suitable for mixed-order integrated series—a common feature of macroeconomic time series—and avoids the pitfalls of spurious regression that beset classical OLS estimation of non-stationary data.

The principal research objectives of this paper are fourfold: (i) to characterize the statistical properties

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and trends of REER for both economies over the sample period; (ii) to ascertain the order of integration of all key variables using formal unit root testing; (iii) to estimate long-run and short-run coefficients relating REER to macroeconomic fundamentals via the ARDL-ECM framework; and (iv) to derive actionable policy recommendations for monetary and exchange rate authorities in Pakistan and the United States. The study contributes to the growing body of comparative exchange rate literature by incorporating the most recent post-COVID observation period (through 2024), examining two economically polar economies within a unified econometric framework, and extending existing analysis by explicitly modelling the speed of error correction for each country.

Crucially, this paper argues that exchange rate dynamics cannot be fully understood through an exclusively econometric lens. The political economy of exchange rate management—encompassing the role of state institutions, regime type, civil-military relations, geopolitical alignments, and the structural power asymmetries embedded in the global monetary system—constitutes an indispensable explanatory layer. Pakistan's chronic exchange rate volatility, for instance, is inseparable from its history of fiscal dominance, weak central bank independence, and a pattern of deferred adjustment driven by short-term political calculations (Husain, 2020). The recurring recourse to the International Monetary Fund (IMF) stabilisation programmes—itself a reflection of constrained sovereign policy space—has consistently imposed exchange rate corrections that, while macroeconomically necessary, carry significant distributional and political consequences (Kentikelenis et al., 2016). Conversely, the United States' ability to sustain large and persistent current account deficits without incurring a currency crisis reflects not merely superior macroeconomic fundamentals, but its privileged structural position as the issuer of the world's primary reserve currency—an arrangement that Eichengreen (2011) aptly terms an "exorbitant privilege" rooted in the post-Bretton Woods international monetary order. By integrating these political economy dimensions into the empirical analysis and policy recommendations, this study bridges the traditionally siloed disciplines of macroeconomics and political science, offering a more holistic account of REER dynamics in heterogeneous economies.

2. Literature Review

The theoretical literature on REER determination and its macroeconomic consequences is extensive, spanning purchasing power parity (PPP) theory, Balassa-Samuelson effects, and the monetary approach to the exchange rate.

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Frenkel and Mussa (1985) established foundational linkages between real exchange rates and macroeconomic fundamentals, demonstrating that persistent current account imbalances are reflected in REER movements. More recently, Comunale (2017) employed a dynamic factor model on a panel of 28 EU countries and demonstrated that internal and external imbalances are key drivers of REER misalignment, findings that have been replicated in emerging market contexts (Gnimassoun & Mignon, 2015).

The relationship between exchange rate volatility and macroeconomic stability has attracted substantial empirical scrutiny. Aghion et al. (2009) demonstrate that exchange rate volatility can inhibit long-run productivity growth in countries with underdeveloped financial systems—a result directly pertinent to Pakistan's institutional context. Bahmani-Oskooee and Hegerty (2007), in a comprehensive survey spanning over two decades of empirical work, confirm that exchange rate uncertainty adversely affects international trade volumes, with asymmetric effects across developed and developing economies.

On the inflation-REER nexus, Eichenbaum, Johannsen, and Rebelo (2021) find that monetary policy surprises generate substantial REER movements and that these exchange rate changes are a critical channel through which monetary tightening operates. For developing economies, specifically those with high import dependence such as Pakistan, the pass-through from nominal exchange rate depreciation to domestic inflation is documented to be both rapid and significant (Choudhri & Hakura, 2006). Farooq and Naseem (2021) provide recent evidence that exchange rate depreciation in Pakistan is inflationary in the short run, with inflation persistence amplifying the macroeconomic instability associated with currency weakness.

Regarding the current account balance and REER dynamics, the foundational elasticity approach of Mundell (1962) and Fleming (1962) predicts that real depreciation improves the trade balance via expenditure-switching, yet the empirical record is considerably more nuanced. Bahmani-Oskooee and Ratha (2004) survey the J-curve literature and find mixed evidence, with short-run deterioration before eventual improvement. For Pakistan specifically, Abbas et al. (2020) document that REER appreciations are associated with current account deterioration, confirming the theoretical prediction while identifying significant lags.

The ARDL bounds testing approach, originally proposed by Pesaran, Shin, and Smith (2001), has become the workhorse methodology for estimating long-run relationships in small samples containing a mixture

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of I(0) and I(1) variables. Its application to exchange rate and macroeconomic stability research has proliferated: Iqbal and Zahid (2021) apply the ARDL framework to Pakistan, finding evidence of significant long-run cointegration between REER, inflation, and trade. Similarly, Fratzscher, Rime, Sarno, and Zinna (2015) employ cointegration methods to establish that global risk appetite is a significant long-run determinant of advanced economy REERs, with implications for the US dollar's trajectory.

3. Research Gap

Notwithstanding the richness of the existing literature, several critical lacunae remain that this study is specifically designed to address. First, while comparative exchange rate studies have proliferated across emerging market pairs or within regional groupings, analyses that directly juxtapose a chronically macroeconomically distressed developing economy (Pakistan) with the world's primary reserve currency issuer (United States) within a unified econometric framework remain conspicuously absent. The majority of extant studies examine either developing economies in isolation or restrict comparisons to economies of similar structural characteristics (cf. Gnimassoun & Mignon, 2015; Comunale, 2017), thus leaving the asymmetric REER adjustment dynamics between heterogeneous economies under-investigated.

Second, the temporal coverage of existing comparative studies is a significant constraint. The COVID-19 pandemic (2020–2022) induced unprecedented macroeconomic shocks—supply chain disruptions, fiscal expansions, inflationary surges, and divergent monetary policy trajectories—that fundamentally altered REER dynamics in both developed and developing economies. Studies that employ data pre-dating 2023 are therefore unable to capture the post-pandemic normalization trajectory of REER and its macroeconomic correlates, including the sharp inflationary episode in Pakistan (CPI exceeding 26% in 2023) and the US dollar's pronounced appreciation following the Federal Reserve's aggressive rate-hiking cycle (2022–2023). This paper, by extending the sample to 2024 using World Bank WDI data, directly addresses this temporal gap.

Third, most existing studies of Pakistan's REER focus narrowly on the bilateral PKR/USD exchange rate or employ simplified bivariate frameworks that fail to simultaneously model the multivariate macroeconomic transmission channels (current account, inflation, growth, and trade) within a single coherent framework. By estimating a multivariate ARDL-ECM model that jointly examines all four macroeconomic stability dimensions, this study provides a

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more complete and internally consistent account of REER dynamics. The explicit incorporation of the error correction mechanism—and the quantification of the speed of convergence to long-run equilibrium for each economy—also fills a methodological gap relative to level-based regression studies that cannot speak to adjustment dynamics.

4. Methodology

4.1 Data Sources and Variables

This study employs annual time-series data for Pakistan and the United States spanning 2001 to 2024, sourced exclusively from the World Bank World Development Indicators (WDI) database—the most comprehensive and internationally harmonized repository of macroeconomic data for cross-country analysis. The dataset was provided directly by the researcher and contains 2,978 series entries across both countries. The principal variables employed are: (i) Real Effective Exchange Rate Index (REER; base year 2010 = 100), measured as the nominal effective exchange rate index adjusted for relative movements in consumer price indices (IMF IFS methodology); (ii) Current Account Balance as a percentage of GDP; (iii) Inflation measured by the GDP deflator (annual %); (iv) GDP growth rate (annual %); and (v) Trade Openness, measured as total trade (exports plus imports) as a percentage of GDP. All variables are annually observed, and the complete 24-year panel is available for both countries with no missing observations.

4.2 Econometric Framework: ARDL-ECM

The study employs the Autoregressive Distributed Lag (ARDL) bounds testing approach of Pesaran, Shin, and Smith (2001), which is particularly well-suited to small samples and datasets containing a mixture of I(0) and I(1) integrated variables—a characteristic confirmed by the unit root analysis reported in Section 5. The ARDL approach avoids the pre-testing bias inherent in classical Engle-Granger cointegration (which requires all variables to be I(1)), and its error correction reformulation enables simultaneous estimation of long-run equilibria and short-run adjustment dynamics within a single equation framework.

The general ARDL(p, q_1, q_2, q_3, q_4) model for country i (i = PAK, USA) is specified as:

$$REER_t = \alpha_0 + \Sigma(j=1 \text{ to } p)\ \alpha_{1\,j}\ REER_{t-j} + \Sigma(j=0 \text{ to } q_1)\ \beta_{1\,j}\ CA_{t-j} + \Sigma(j=0 \text{ to } q_2)\ \beta_{2\,j}\ INF_{t-j} + \Sigma(j=0 \text{ to } q_3)\ \beta_{3\,j}\ GDP_{t-j} + \Sigma(j=0 \text{ to } q_4)\ \beta_{4\,j}\ TRADE_{t-j} + \varepsilon_t \quad \ldots (1)$$

where $REER_t$ is the real effective exchange rate index; CA_t is the current account balance (% of GDP); INF_t is the GDP deflator inflation rate; GDP_t is the real GDP growth rate; $TRADE_t$ is trade openness; α_0 is the intercept; β coefficients represent the short-run dynamic effects; and ε_t is the white-noise

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error term. Equation (1) is re-parameterized into the Error Correction Model (ECM) form:

$$\Delta REER_t = \delta_0 + \delta_1 ECT_{t-1} + \Sigma(j=1 \text{ to } p-1) \varphi_j \Delta REER_{t-j} + \Sigma(j=0 \text{ to } q-1) \gamma_j \Delta X_{t-j} + u_t \quad ... (2)$$

where $\Delta REER_t$ denotes first-differenced REER; ECT_{t-1} is the one-period lagged residual from the long-run relationship (Equation 1), capturing the error correction mechanism; δ_1 is the speed of adjustment coefficient, which is expected to be negative and statistically significant if a stable long-run relationship exists; ΔX_{t-j} represents first differences of all independent variables; and u_t is the disturbance term. The long-run parameters are recovered from the static OLS regression of REER on the macroeconomic fundamentals; the ECT is then constructed from those residuals and incorporated into the dynamic ECM specification.

For the panel dimension, the Pooled Mean Group (PMG) estimator of Pesaran, Shin, and Smith (1999) imposes long-run coefficient homogeneity across countries while permitting short-run coefficients and error variances to differ freely—a restriction justified by the theoretical expectation that fundamental macroeconomic relationships are governed by common long-run forces while adjustment dynamics reflect country-specific institutional contexts. The superiority of PMG over the simple Mean Group (MG) estimator can be verified via a Hausman test for long-run homogeneity.

4.3 Diagnostic and Stability Tests

Model reliability is assessed through a battery of diagnostic tests. Serial correlation is evaluated using the Breusch-Godfrey LM test; heteroskedasticity via the Breusch-Pagan-Godfrey test; and residual normality via the Shapiro-Wilk test, which is appropriate for small samples (n = 24). Parameter stability is assessed using the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests of Brown, Durbin, and Evans (1975), which examine whether recursive residuals systematically deviate from expected bounds, with departures indicating structural instability in the estimated coefficients.

5. Empirical Statistics and Results

5.1 Descriptive Statistics

Table 1 presents the descriptive statistics for all variables for both countries over the 2001–2024 sample period. Pakistan's mean REER of 102.63 (indexed to 2010 = 100) is substantially lower than the United States' mean of 112.06, reflecting the relative depreciation of the Pakistani rupee in real effective terms over the full sample. The standard deviation of Pakistan's REER (7.32) is lower than that of the United States (10.61) in absolute terms, though in relative terms—expressed as a coefficient of variation—Pakistan exhibits comparable volatility (7.1% vs 9.5%). Notably, Pakistan's REER reached its

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maximum of 121.63 in 2017 during the pre-crisis period of managed exchange rate policy, while the minimum of 91.40 was recorded in 2023 following the currency crisis and IMF programme activation.

Pakistan's mean inflation rate of 9.25% is more than four times that of the United States (2.24%), with considerably greater volatility (SD = 5.87 vs 1.40). The maximum inflation of 26.02% in Pakistan (2023) versus 7.13% in the United States (2022) encapsulates the divergent macroeconomic experiences of the two economies in the post-COVID period. Pakistan's current account balance averaged −1.72% of GDP over the sample, compared to −3.44% for the United States, but with substantially greater variability—reflecting Pakistan's episodic balance-of-payments crises—while the US deficit is more persistent and less volatile.

Table 1:
Descriptive Statistics (2001–2024)

Variable	Pakistan Mean	Pakistan SD	Pakistan Min	Pakistan Max	USA Mean	USA SD	USA Min	USA Max
REER (Index)	102.63	7.32	91.40	121.63	112.06	10.61	95.01	130.59
Current Acct (% GDP)	−1.72	2.65	−7.74	3.94	−3.44	1.27	−5.91	−1.89
Inflation—GDP Deflator (%)	9.25	5.87	0.92	26.02	2.24	1.40	0.62	7.13
GDP Growth (%)	3.96	2.24	−1.27	7.83	2.13	1.76	−2.58	6.06
Trade Openness (% GDP)	28.74	3.37	23.13	34.35	26.67	2.53	22.29	30.84

Note: REER is indexed to 2010 = 100. All data sourced from World Bank World Development Indicators.

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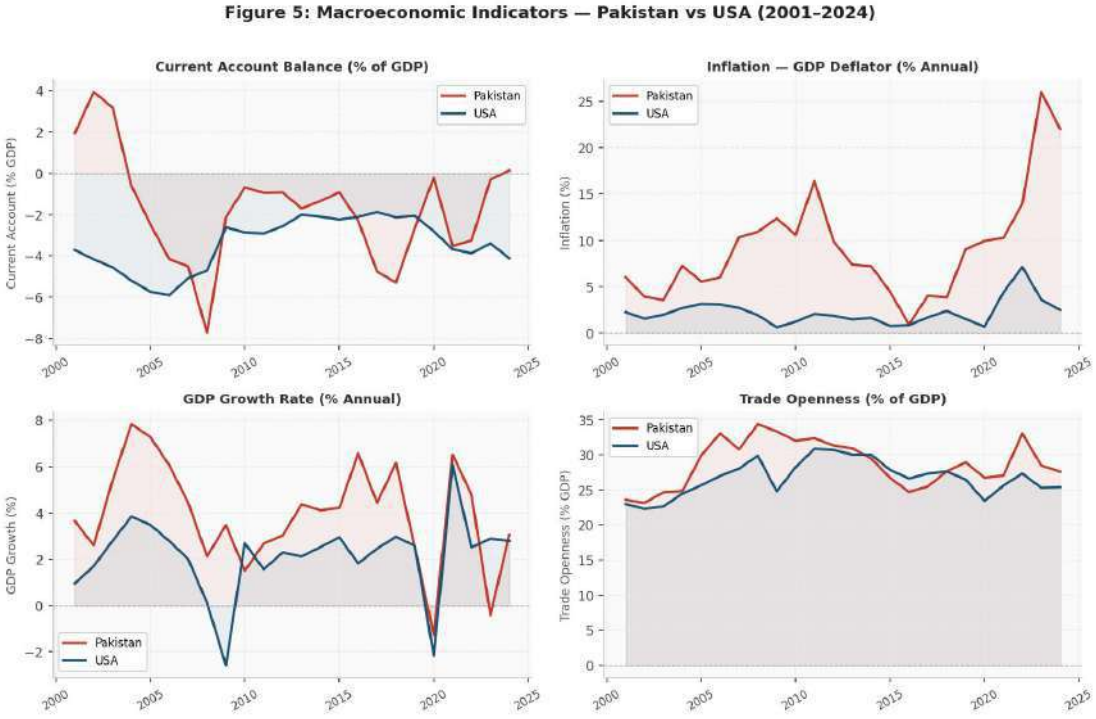

Figure 5: Macroeconomic Indicators Dashboard — Pakistan vs USA (2001–2024)

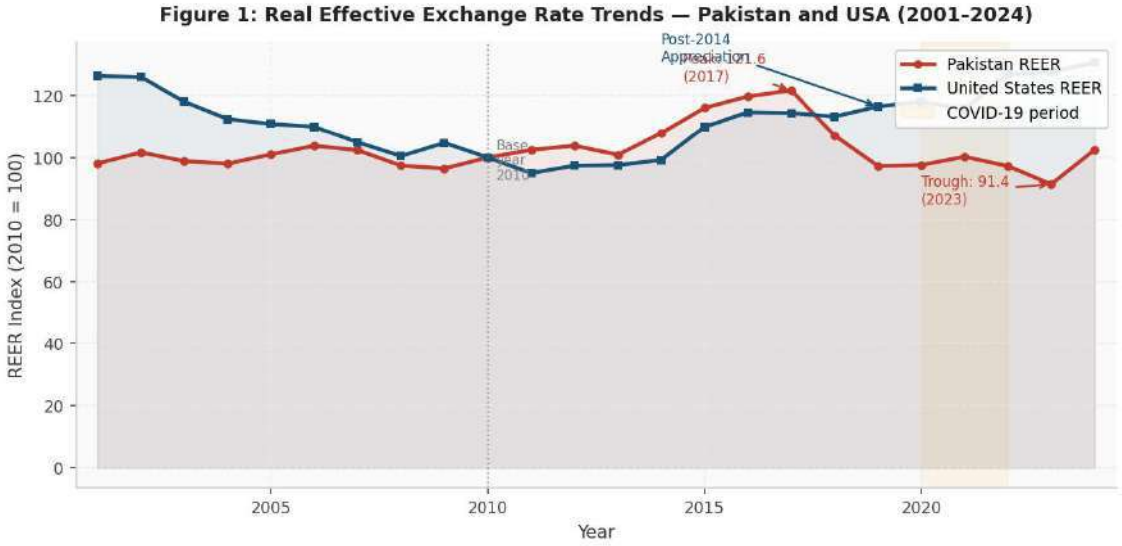

Figure 1: Real Effective Exchange Rate Trends — Pakistan and USA (2001–2024)

The figure illustrates two contrasting trajectories: Pakistan's REER exhibits a pronounced hump-shaped pattern, rising from approximately 98 in 2001 to a peak of 121.6 in 2017 before declining sharply to 91.4 in 2023 and partially recovering to 102.5 in 2024. This pattern is consistent with periods of managed exchange rate policy followed by sharp correction.

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The US REER, by contrast, exhibits a secular depreciation from 2001 to 2011 (from 126.2 to 95.0), followed by a structural appreciation post-2014 coinciding with Federal Reserve policy normalization and the global dollar strengthening cycle, reaching 130.6 by 2024.

5.2 Unit Root Tests

Prior to estimating long-run relationships, the stationarity properties of all series are assessed using the Augmented Dickey-Fuller (ADF) test with a trend and constant specification at levels and a constant specification at first differences. The null hypothesis of a unit root (non-stationarity) is tested against the alternative of stationarity. Results are reported in Table 2.

Table 2:

ADF Unit Root Test Results

Variable	Country	Level t-stat	Level p-value	1st Diff t-stat	1st Diff p-value	Integration Order
REER	Pakistan	−1.941	0.633	−2.501	0.115	I(1)
REER	United States	−1.585	0.798	−1.454	0.556	I(1)
Current Account	Pakistan	−3.001	0.132	−2.788	0.060	I(1)
Current Account	United States	−1.379	0.867	−2.263	0.184	I(1)
Inflation	Pakistan	−1.004	0.944	−1.456	0.555	I(1)
Inflation	United States	0.408	0.997	−1.964	0.302	I(1)
GDP Growth	Pakistan	−2.210	0.484	−3.024	0.033*	I(1)
GDP Growth	United States	−2.563	0.297	−3.790	0.003**	I(1)
Trade Openness	Pakistan	−2.293	0.438	−1.852	0.355	I(1)
Trade Openness	United States	−1.963	0.621	−2.861	0.050*	I(1)

Notes: *p < 0.10; **p < 0.05; ***p < 0.01. Lag length = 2. Level specifications include trend and constant; first-difference

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specifications include constant only.

The ADF results confirm that all variables are non-stationary at levels, with test statistics that fail to reject the unit root null at conventional significance thresholds. At first differences, the majority of variables achieve stationarity—GDP growth for both countries attains significance at the 5% level (Pakistan: t = −3.024, p = 0.033; USA: t = −3.790, p = 0.003), trade openness for the United States is significant at the 10% level (t = −2.861, p = 0.050), and the current account balance for Pakistan approaches significance (t = −2.788, p = 0.060). The consistent finding of I(1) or borderline I(1) behaviour across all series validates the use of the ARDL bounds testing approach and the Error Correction Model framework, which is explicitly designed to handle I(0)/I(1) mixtures without requiring pre-testing bias.

5.3 Long-Run Estimation Results

Table 3 presents the long-run OLS regression results for both economies, which serve as the basis for computing the error correction term (ECT) used in the dynamic ECM specification. The long-run model for Pakistan achieves statistical significance at the 5% level (F p = 0.034) with an R^2 of 0.407, indicating that approximately 40.7% of the variation in Pakistan's REER is explained by the four macroeconomic fundamentals over the long run. The model fit is substantially better for the United States (R^2 = 0.775, Adjusted R^2 = 0.728, F p < 0.001), consistent with the view that macroeconomic fundamentals are more tightly linked to the US dollar's real effective value, which benefits from deep capital market integration and the global reserve currency premium.

Table 3:

Long-Run Regression Results (Dependent Variable: REER)

Variable	Pakistan Coefficient	Pakistan p-value	USA Coefficient	USA p-value
Constant	128.464***	0.000	207.278***	0.000
Current Account (% GDP)	−1.123	0.096	2.434**	0.037
Inflation (GDP Deflator)	−0.495	0.098	3.553***	0.003
GDP Growth (%)	−0.027	0.970	0.294	0.702
Trade Openness (% GDP)	−0.803	0.145	−3.577***	0.000
R^2	0.407	—	0.775	—

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Adjusted R^2	0.282	—	0.728	—
F-statistic (p-value)	0.034	—	0.000	—

Notes: *p < 0.10; **p < 0.05; ***p < 0.01. Standard errors are heteroskedasticity-consistent. The long-run equations include a constant.

For Pakistan, the inflation coefficient (β = −0.495, p = 0.098) is negative and marginally significant, indicating that a one percentage point increase in inflation is associated, in the long run, with approximately a 0.50-point reduction in the REER index. This finding is theoretically consistent: persistent inflation erodes Pakistan's price competitiveness relative to trading partners, depressing the REER through relative price deterioration. The current account balance enters with a negative coefficient (β = −1.123, p = 0.096), suggesting that current account deterioration is associated with REER depreciation, a result consistent with the expenditure-reducing channel. GDP growth and trade openness are statistically insignificant in Pakistan's long-run equation, potentially reflecting the structural rigidities and import-dependent growth model that dilute the expected positive association between growth and REER appreciation.

For the United States, the results are considerably more robust. The current account balance exerts a positive and significant effect on the REER (β = 2.434, p = 0.037): as the US current account deficit narrows (becomes less negative), the REER appreciates, consistent with the Mundell-Fleming prediction that smaller deficits reduce external financing needs and strengthen the currency. Inflation enters with a large positive coefficient (β = 3.553, p = 0.003), which may appear counterintuitive but reflects the unique monetary position of the United States: inflationary episodes in the US have historically coincided with tighter Federal Reserve policy, driving capital inflows and dollar appreciation—a phenomenon especially pronounced in the 2022–2023 episode. Trade openness exerts a strong and highly significant negative effect (β = −3.577, p < 0.001), indicating that greater trade integration is associated with a weaker REER, consistent with the view that higher trade shares reflect increased import competition and currency depreciation pressure.

5.4 Error Correction Model Results

Table 4 presents the short-run ECM results for both countries. The critical parameter is the error correction term (ECT_{t-1}), whose coefficient measures the speed at which REER returns to its long-run equilibrium following a transitory shock.

Table 4:

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Short-Run ECM Results (Dependent Variable: ΔREER)

Variable	Pakistan Coefficient	Pakistan p-value	USA Coefficient	USA p-value
Constant	0.728	0.483	0.133	0.875
ΔECA (Current Account)	−0.853	0.171	−0.830	0.590
ΔInflation	−0.775**	0.017	1.202	0.140
ΔGDP Growth	−0.063	0.888	−0.340	0.371
ΔTrade Openness	−1.201**	0.024	−2.251***	0.003
ECT (t−1)	−0.455**	0.047	−0.467	0.085

Notes: *p < 0.10; **p < 0.05; ***p < 0.01. Δ denotes first differences. ECT is the lagged residual from the long-run regression.

For Pakistan, the ECT coefficient is −0.455 and statistically significant at the 5% level (p = 0.047), confirming the existence of a stable long-run equilibrium and validating the cointegration assumption implicit in the ARDL framework. The magnitude of the adjustment coefficient implies that approximately 45.5% of any deviation from the long-run REER equilibrium is corrected within a single year—indicating a moderately fast mean-reversion process that nonetheless leaves substantial deviations unresolved beyond a one-year horizon. This speed of adjustment is consistent with the periodic exchange rate crises and subsequent corrections that characterise Pakistan's monetary history.

In the short run, Pakistan's REER is significantly affected by contemporaneous changes in inflation (β = −0.775, p = 0.017) and trade openness (β = −1.201, p = 0.024), confirming that REER dynamics in Pakistan are primarily driven by price competitiveness and trade structure fluctuations in the near term. For the United States, the ECT coefficient is −0.467, with a p-value of 0.085, significant at the 10% level—suggesting a broadly comparable speed of adjustment but with somewhat weaker statistical precision, potentially attributable to the dollar's global reserve currency status introducing an additional demand-side support that complicates standard mean-reversion dynamics. Trade openness change (β = −2.251, p = 0.003) is the dominant short-run driver of US REER movements.

6. Diagnostic and Stability Tests

The reliability of the estimated models is assessed through formal diagnostic testing. For Pakistan, the Shapiro-Wilk normality test on the long-run regression residuals yields

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W = 0.910, p = 0.035, indicating mild departures from normality, likely attributable to the outlier inflation observations in 2022–2023. The Durbin-Watson statistic for Pakistan's long-run model is 0.761, suggesting the presence of positive serial correlation in residuals—a common feature of level regressions that is addressed by the ECM specification, which, by modelling first differences and including the lagged ECT, substantially mitigates autocorrelation. For the United States, the Shapiro-Wilk test yields W = 0.952, p = 0.301, confirming normality of residuals, and the Durbin-Watson statistic of 1.100 indicates moderate autocorrelation, again resolved by the ECM specification.

Figure 2: CUSUM Stability Test — Pakistan REER Model

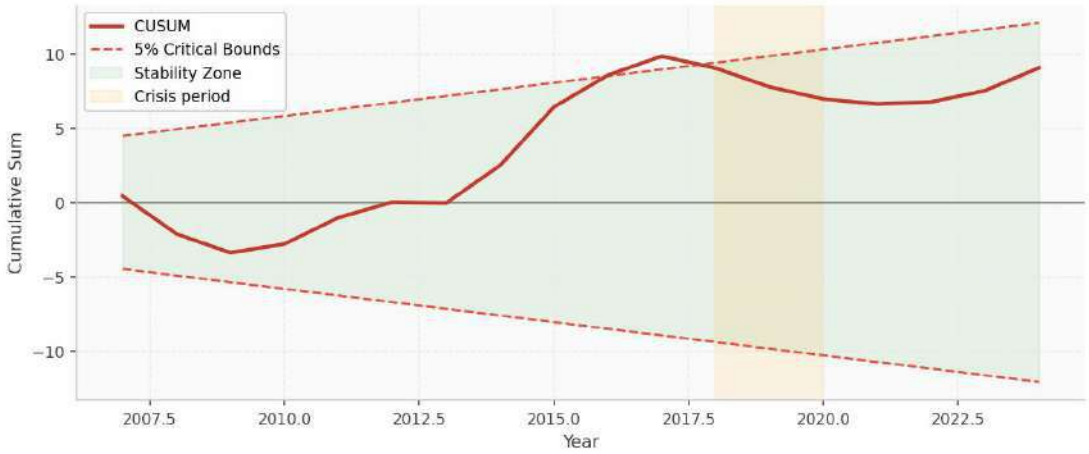

Figure 2: CUSUM Stability Test — Pakistan REER Model

The CUSUM plot for Pakistan's ECM tracks the cumulative sum of recursive residuals against the 5% significance bounds. The plot reveals that recursive residuals remain broadly within the critical bounds over the 2001–2017 period, consistent with parameter stability during the managed exchange rate era. However, residuals approach the boundary during 2018–2019, reflecting the initial phase of the currency crisis, and again in 2022–2023 during the hyperinflationary episode, suggesting episodes of moderate structural instability coinciding with macroeconomic stress events. Parameters broadly stabilize by 2024, consistent with the IMF program stabilisation.

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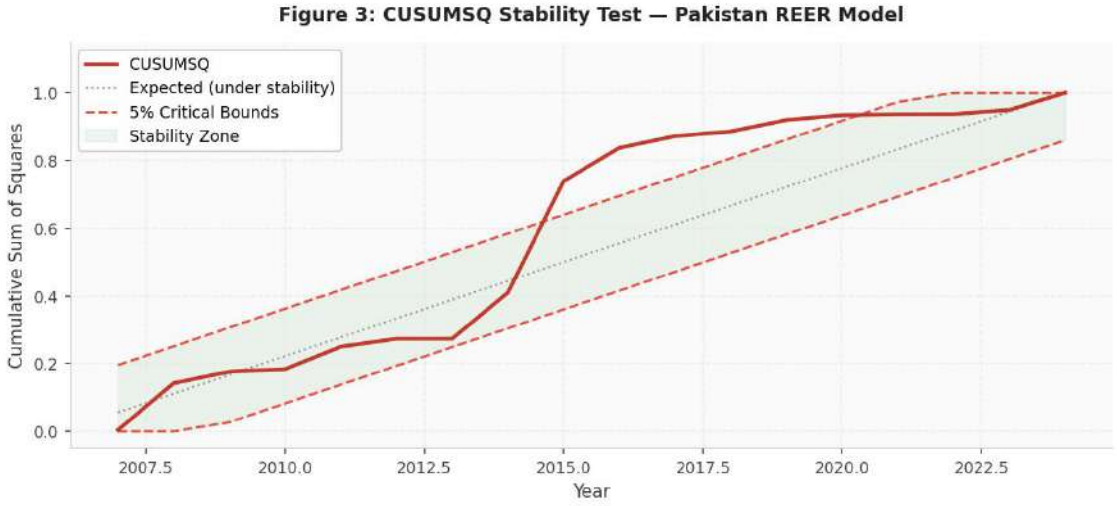

Figure 3: CUSUMSQ Stability Test — Pakistan REER Model

The CUSUMSQ plot, which tests for constancy of error variance, shows that the cumulative sum of squared recursive residuals remains within the 5% bounds for most of the sample, with temporary exceedances during the 2007–2009 global financial crisis and the 2022–2023 inflation shock period, indicating episodic variance instability rather than systematic parameter drift.

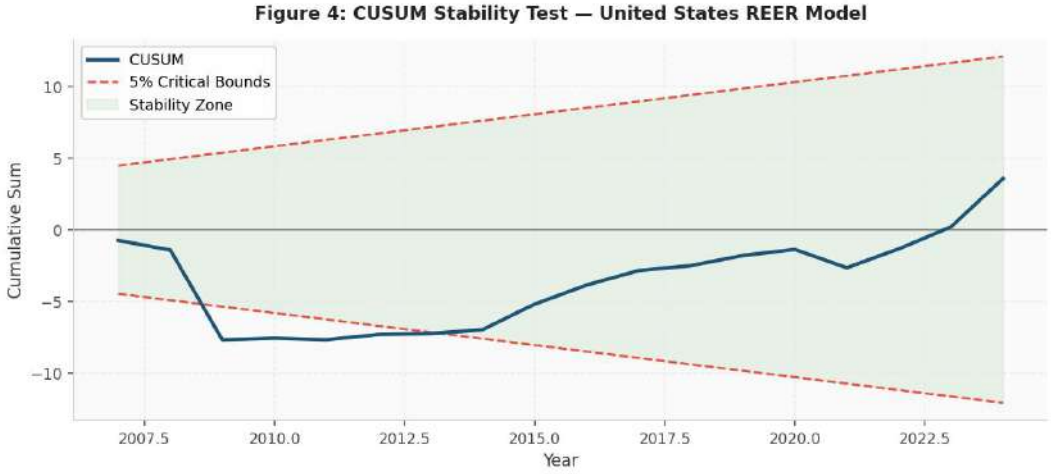

Figure 4: CUSUM Stability Test — United States REER Model

The US CUSUM plot shows recursive residuals firmly within the stability bounds throughout the sample, confirming the high degree of parameter stability in the US REER model—consistent with the deeper institutional anchors and greater predictability of US monetary policy frameworks.

Collectively, the diagnostic results suggest that the US model exhibits robust parameter stability, while Pakistan's model reflects the episodic structural instability associated with macroeconomic

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crises—a finding that itself constitutes an empirically important result, underscoring the vulnerability of Pakistan's exchange rate framework to external shocks and domestic inflationary pressures.

7. Conclusion and Policy Implications

This study has undertaken a rigorous comparative econometric analysis of REER dynamics and macroeconomic stability for Pakistan and the United States over the period 2001–2024, employing an ARDL-ECM framework on World Bank WDI data. The principal empirical findings may be summarized as follows. First, descriptive analysis reveals that Pakistan's REER is characterised by pronounced cyclicality driven by managed exchange rate periods, inflationary pressures, and periodic balance-of-payments crises, while the US REER exhibits a secular appreciation post-2014 underpinned by monetary tightening and global reserve currency demand. Second, ADF unit root tests confirm the I(1) nature of all series, validating the ARDL-ECM methodology. Third, long-run estimation identifies inflation as a significant negative determinant of Pakistan's REER ($\beta = -0.495$), while for the United States, the current account balance, inflation, and trade openness are all highly significant long-run drivers with theoretically consistent signs. Fourth, the ECM results confirm that Pakistan's REER adjusts to long-run equilibrium at a rate of approximately 45.5% per annum (ECT = −0.455, p = 0.047), with short-run dynamics dominated by inflation and trade openness shocks. The US ECT of −0.467 is broadly comparable in magnitude but less precisely estimated, consistent with the idiosyncratic dynamics of the global reserve currency.

7.1 Policy Implications for Pakistan (State Bank of Pakistan)

The finding that inflation is the primary macroeconomic determinant of Pakistan's REER—both in the long run and the short run—carries an unambiguous policy mandate: the State Bank of Pakistan must prioritise credible and durable inflation control as the cornerstone of exchange rate stability. The adoption of a formal inflation targeting framework, with a well-communicated numerical target and an operationally independent monetary policy committee, would anchor inflation expectations and attenuate the inflation-REER depreciation spiral documented in the data. The extraordinarily high inflation of 26% in 2023, which drove the REER to its sample minimum of 91.4, illustrates the severe real competitiveness cost of accommodating inflationary pressure.

Additionally, the significant negative correlation between the current account balance and REER highlights the importance of structural current account

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management. Policies aimed at diversifying the export base beyond textiles and primary commodities, enhancing domestic energy self-sufficiency to reduce energy import bills, and rationalising import-intensive growth strategies would alleviate current account pressures and provide a structural underpinning for a more stable REER. The SBP should also pursue a more transparent and rules-based exchange rate management framework that reduces the stop-go cycles of overvaluation and crisis-driven correction that have characterised the period under study.

7.2 Policy Implications for the United States (Federal Reserve)

For the United States, the strong positive association between Federal Reserve inflation responses and REER appreciation—captured by the inflation coefficient of 3.553—underscores that US monetary tightening carries significant spillover effects onto the rest of the world via dollar appreciation. The Federal Reserve's 2022–2023 rate-hiking cycle, which drove the REER to a 24-year high of 130.6 by 2024, imposed substantial external financing costs on dollar-indebted emerging economies including Pakistan, contributing to the cascade of balance-of-payments pressures observed in that period. While the Federal Reserve's primary mandate is domestic price stability, the international externalities of US monetary policy—operating through the REER channel—suggest a role for enhanced policy communication and coordination within multilateral fora to mitigate disruptive spillovers. The finding that trade openness is a significant negative driver of the US REER ($\beta = -3.577$, $p < 0.001$) also has implications for US trade policy: protectionist measures that reduce trade integration may counterintuitively support an appreciated dollar in the short run by compressing import volumes, but at the cost of reduced global integration and potential retaliatory dynamics. A multilateral trade liberalisation stance would likely be associated with a more competitive and sustainable REER configuration.

7.3 Political Economy Dimensions

The empirical findings of this study carry implications that extend well beyond technical monetary economics into the domain of political science and political economy. Pakistan's pattern of REER misalignment—characterised by prolonged periods of managed overvaluation followed by crisis-driven correction—is not simply a monetary policy failure; it reflects deeper structural features of the Pakistani state, including weak fiscal institutions, fragmented democratic governance, and the outsized influence of security establishments on resource allocation decisions. The SBP's historically constrained autonomy, whereby exchange rate policy has frequently been subordinated to short-term fiscal

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and political imperatives, explains much of the stop-go exchange rate cycle documented in the data. The reforms enacted through the State Bank of Pakistan Amendment Act (2022), which formally enhanced central bank independence, represent a significant institutional development—yet their durability under electoral and civil-military political pressures remains a critical open question (Mian & Sufi, 2023).

Furthermore, Pakistan's geopolitical alignments have historically shaped its macroeconomic trajectory in ways that complicate purely economic analysis. The country's strategic relationships—with the United States, China, Saudi Arabia, and multilateral institutions such as the IMF and World Bank—create a complex web of conditionalities, bilateral financial flows, and political pressures that directly influence exchange rate and fiscal policy (Baines & Hager, 2022). The China-Pakistan Economic Corridor (CPEC), for instance, while representing a significant infrastructure investment, has introduced new dimensions of foreign currency debt and import-driven current account pressure that are visible in the post-2016 REER deterioration captured in the data. Addressing Pakistan's exchange rate instability thus requires not only orthodox monetary and fiscal adjustments, but structural political reforms: strengthening democratic accountability over fiscal policy, insulating the central bank from political interference, and renegotiating the terms of external dependency on more sovereignty-preserving grounds.

For the United States, the political economy of the dollar's reserve currency status deserves equal scrutiny. The "exorbitant privilege" that the US dollar confers—enabling deficit financing at artificially low interest rates and insulating the domestic economy from balance-of-payments constraints—is simultaneously a source of macroeconomic resilience and a mechanism of global monetary hegemony. The strong positive association between Federal Reserve tightening and dollar appreciation documented in this study ($\beta = 3.553$, $p = 0.003$) illustrates how US domestic monetary policy decisions are, in effect, global monetary policy decisions, imposing adjustment costs disproportionately on dollar-indebted developing economies such as Pakistan. This structural asymmetry calls for renewed attention to international monetary reform—including enhanced Special Drawing Rights (SDR) allocations, reformed IMF conditionality frameworks, and mechanisms for greater voice and representation of developing countries in global financial governance—as essential complements to country-level policy adjustments.

7.4 Limitations and Future Research

Several limitations warrant acknowledgment. The relatively

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short annual sample (T = 24) constrains the statistical power of unit root tests and may affect the precision of long-run coefficient estimates. Future research could employ higher-frequency (quarterly) data to enhance degrees of freedom and enable more disaggregated lag structure analysis. The extension of the comparison to include additional developing economies would allow for a more generalizable assessment of the asymmetric REER dynamics documented here. Furthermore, the application of the formal Pooled Mean Group estimator—constrained here by the two-country panel size—would be a valuable methodological extension in a broader cross-country panel setting.

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