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Research Article

ASYMMETRIC EFFECTS OF EXCHANGE RATE VOLATILITY ON TRADE AND INVESTMENT: A NONLINEAR APPROACH

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Abstract
Exchange rate movements play a central role in shaping external competitiveness, yet their effects are rarely symmetric and are often underestimated in studies that rely on linear models. This article examines how real effective exchange rate (REER) appreciations and depreciations influence the external sector in Morocco, focusing on foreign direct investment (FDI), exports, and imports over 1988–2023. Annual data from the World Development Indicators are analyzed using a Nonlinear Autoregressive Distributed Lag (NARDL) model, which decomposes REER into appreciation and depreciation components. Cointegration is assessed through bounds testing, while Wald statistics evaluate the presence of short- and long-run asymmetries. The results show that appreciations have sharper and more immediate impacts than depreciations across all channels. In the short run, appreciation reduces FDI and exports while boosting imports, though some of these effects are later corrected. Depreciation produces weaker and delayed responses, reflecting the economy's dependence on imported inputs for exports and essential goods. Over the long run, imports display significant asymmetry, exports respond largely symmetrically, and FDI reveals a delayed rebound after appreciation, highlighting the credibility effect of currency stability. The novelty of this study lies in combining a long horizon with a nonlinear approach rarely applied to Morocco, uncovering dynamics overlooked by linear models, most notably the rebound of FDI and exports following appreciation and the structural rigidity of imports. These findings suggest that sustaining competitiveness requires more than exchange rate management; export diversification, financial deepening, and industrial upgrading are crucial to mitigating appreciation shocks and enhancing resilience.

Keywords: Investment, Nonlinear ARDL, Real Exchange Rate, Trade

INTRODUCTION

The global economic environment has become increasingly volatile in the post-pandemic era, marked by surging inflation and tighter financial conditions (Kapçiu et al., 2024). Emerging economies face heightened uncertainty as global interest rate hikes and geopolitical shifts disrupt capital flows and

exchange rates (El-Khodary, 2024; Kelmendi et al., 2025). In this context, understanding how exchange rate fluctuations influence key economic variables is a matter of urgency for policymakers. Exchange rate fluctuations can swiftly alter a country's international competitiveness and investment attractiveness, especially amid recent inflationary pressures and worldwide financial tightening. These concerns are amplified by geoeconomic shifts such as realigned trade partnerships and supply-chain reorientations, which together underscore the importance of assessing the exchange rate's impact on trade and investment in vulnerable, open economies.

Morocco provides a strategic and timely case for such an investigation. The country has positioned itself as a vital link between Africa and Europe through proactive trade agreements and economic reforms. It is the only African nation with free trade agreements encompassing the European Union, the United States, and the Gulf Cooperation Council, giving it unique access to global markets. Over the past decade, Morocco has aggressively pursued foreign direct investment (FDI), leveraging its renewable energy potential, modern infrastructure, and industrial zones to attract multinational manufacturers and energy projects. As a result, its share of total FDI inflows into Africa doubled between 2018 and 2023, reaching nearly 10%. Concurrently, Morocco's export basket has diversified (notably into automotive, aerospace, and clean energy technology), even as the nation remains a net importer of key commodities. This high trade openness means that fluctuations in the real effective exchange rate (REER) directly affect Morocco's trade balance and investment climate. In light of recent global volatility, including commodity price swings and tighter liquidity, Morocco's policymakers are acutely interested in whether a stronger or weaker dirham would bolster exports, contain import costs, or encourage FDI inflows. Its strategic role as a regional trade hub and clean-energy frontrunner makes the Moroccan experience particularly relevant to broader debates on exchange rate policy in emerging markets.

A rich body of economic theory and evidence suggests that exchange rate changes can have asymmetric effects on macroeconomic indicators. Classical reasoning holds that a depreciation of the home currency tends to boost exports and inward investment by improving cost competitiveness, whereas an appreciation can dampen export performance and FDI by making the home economy relatively expensive. However, these effects are not necessarily mirror images; a given depreciation may influence exports or FDI to a different extent than an equivalent appreciation would reduce them. For FDI, a weaker currency lowers the foreign-currency cost of domestic assets, increasing investors' purchasing power and encouraging acquisitions or greenfield projects. An appreciation, by contrast, may discourage inflows or divert them elsewhere. In trade, depreciation can foster export-led growth and restrain imports, while appreciation of the same size may not proportionally suppress exports, reflecting factors such as price stickiness, the import content of exports, and firms' pricing-to-market behavior. Despite these nuanced possibilities, earlier empirical studies in Morocco and other developing economies have often assumed linear relationships, treating appreciations and depreciations as having equal and opposite effects. This leaves a critical knowledge gap: we do not yet fully know whether REER appreciations and depreciations exert distinct impacts on Morocco's exports, imports, and FDI inflows. Given that Morocco's exchange rate regime has evolved (from a tightly managed peg toward a more flexible band) and its economy has undergone structural shifts since the late 1980s, linear approaches may overlook important nonlinear dynamics.

The present study addresses this gap by investigating the asymmetric effects of REER movements on FDI, export, and import performance in Morocco over the period 1988–2023. In doing so, we employ a recently developed nonlinear autoregressive distributed lag (NARDL) framework that allows positive (appreciation) and negative (depreciation) exchange rate changes to have distinct short-run and long-run coefficients. This approach enables us to test whether, for example, a 1% REER appreciation has an effect on export values that differs in magnitude or significance from a 1% REER depreciation. Our analysis spans 36 years, a notably long-time horizon that covers multiple business cycles, policy regimes, and external shocks – from the structural adjustments and trade liberalizations of the late 1980s–1990s, through the global financial crisis of 2008, to the recent COVID-19 shock and its aftermath. By focusing on such an extended period, the study captures broad trends and regime changes (including Morocco's gradual exchange rate regime transition and deepening global integration) that shorter samples might miss.

In summary, this research offers two main contributions. First, it provides new empirical evidence on how exchange rate appreciations versus depreciations differentially affect a developing economy's trade and investment metrics, using Morocco as a pertinent case study. Second, it is the first study (to the best of our knowledge) to apply a nonlinear (asymmetric) ARDL approach to Morocco's

REER–FDI–trade nexus over a multi-decade span. By unifying FDI, exports, and imports in one analytical framework, our results will shed light on whether Morocco faces trade-offs in managing its exchange rate for external competitiveness versus investment attraction. The findings aim to enrich the literature on exchange rate economics in emerging markets and to inform Moroccan policymakers (and others in similar economies) about the potential asymmetric repercussions of currency movements – knowledge that is especially valuable amid today's uncertain global economic landscape.

In line with the above, the study's primary objectives are: (1) to examine the long-run and short-run effects of REER changes on Morocco's export and import volumes, distinguishing between REER appreciations and depreciations; (2) to evaluate the corresponding asymmetric impact of REER movements on FDI inflows to Morocco; and (3) to discuss the policy implications of any asymmetries found, particularly in the context of Morocco's post-pandemic recovery and strategic economic goals. By clearly identifying whether "upside" and "downside" exchange rate swings have unequal consequences for trade and investment, the paper aims to offer nuanced insight into exchange rate management for sustained growth and external balance.

Exchange Rate and Trade

Early theoretical models emphasized the adverse role of exchange rate fluctuation. Hooper & Kohlhagen (1978) argued that exchange rate uncertainty increases transaction costs and discourages trade, especially for firms without access to hedging. Cushman (1983) extended this to highlight the risk premium in international contracts. Later work (Broll & Eckwert, 1999; Hall et al., 2010; Li et al., 2025; Mandrinos & Lim, 2023) showed that the ability to hedge, financial depth, and firm size condition these effects. Empirical studies broadly confirm the negative impact of exchange rate volatility on trade flows (Arize et al., 2000; Ćorić & Pugh, 2010), particularly in developing countries with underdeveloped financial systems. Ozturk & Kalyoncu (2009) found volatility reduced exports in South Korea and South Africa, while Rahman & Serletis (2009) and Ekanayake & Dissanayake (2022) showed U.S. exports remain vulnerable despite hedging tools.

Yet heterogeneity exists. Under certain conditions, this fluctuation provides competitive advantages by lowering relative export prices. Hall et al. (2010), Bosupeng et al. (2024) and Nguse et al. (2021) highlight cases where exchange rate movements improved trade balances. For imports, evidence generally shows negative effects (Poon & Hooy, 2013; Choudhry et al., 2014; Sharma & Pal, 2019; Li et al., 2022), though some contexts produce neutral or positive outcomes (Hwang & Lee, 2005; Meniago & Eita, 2017; Tarasenko, 2021). A growing strand emphasizes asymmetry: appreciations and depreciations do not have equivalent effects. Studies using nonlinear models (Bahmani-Oskooee et al., 2020; Bampi & Colombo, 2021; Wang & Yu, 2021; A. Rahman et al., 2024; El Kadri & El-Khodary, 2025) demonstrate that trade flows are more responsive to appreciations, underscoring the limits of linear models.

For Morocco, evidence is more limited but highly relevant. Bouoiyour & Rey (2005) showed that REER volatility reduces both exports and imports, while overvaluation deteriorates the trade balance with the EU. Sakli et al. (2022) confirmed that REER appreciation reduces long-term growth by eroding competitiveness. Mohamed et al. (2024) revealed strong agricultural sector sensitivity: undervaluation enhances competitiveness, while overvaluation reduces profitability. Pouya et al. (2024) analyzed REER misalignments and found long-term overvaluation undermines external competitiveness, confirming risks for Morocco's stability. Elhadj & Brahim (2020) linked REER appreciation to productivity gaps through the Balassa-Samuelson effect, highlighting structural drivers of currency dynamics. Regionally, Alsamara et al. (2022) found a J-curve effect in Algeria using a nonlinear ARDL, while Ashour (2023) showed asymmetric REER effects on Saudi non-oil exports, reinforcing the importance of nonlinearity in MENA contexts.

Exchange Rate and FDI

Theoretical foundations parallel those for trade: exchange rate fluctuation increases uncertainty in profit forecasts, deterring investment (Cushman, 1983). Empirical evidence in advanced economies shows mixed outcomes. Some studies confirm volatility dampens FDI (Vita & Abbott, 2007; Milas et al., 2024), while others stress the role of uncertainty reduction rather than fluctuation per se (Pozo, 2001). Sectoral differences also matter—manufacturing FDI tends to be more sensitive than services (Chowdhury & Wheeler, 2008; Schmidt & Broll, 2009). Cross-country evidence highlights that institutional quality, openness, and policy credibility condition outcomes (Moraghen et al., 2019; Alshubiri, 2022; Haque et al., 2022; EL-Khodary et al., 2025).

In developing and transition economies, findings are more consistent: fluctuation reduces FDI inflows (Kiyota & Urata, 2004; MacDermott, 2008; Dal Bianco & Loan, 2017; Tan et al., 2021). Long-term instability undermines investment (Jamal & Bhat, 2023; Balaban et al., 2025), though effects vary by sector and time horizon (Moraghen et al., 2023). Institutional safeguards, such as bilateral investment treaties, can mitigate risks (Udomkerdmongkol et al., 2009; Li et al., 2025). In the Moroccan case, Bouoiyour & Rey (2005) found REER fluctuation and misalignments did not significantly affect FDI, suggesting that other drivers dominate inflows. However, more recent and regional evidence points to possible nonlinear asymmetries. (Benzid, 2023) showed that in Tunisia, REER appreciations attract FDI more than depreciations, both in the short and long run, using a NARDL framework. Bahmani-Oskooee & Gelan (2019), across 18 African countries, confirmed asymmetric REER effects on domestic investment. Alsamara et al. (2022) and Ashour (2023) extended this evidence to other MENA economies, reinforcing the importance of nonlinear approaches. More broadly, recent work shows that FDI is shaped not only by exchange rates but also by structural determinants such as market size, institutional stability, and firm-level capabilities (Yadewani et al., 2024; Spahija et al., 2025).

The reviewed literature converges on three insights. First, exchange rate fluctuations affects both trade and FDI, but the magnitude and direction of these effects vary depending on structural, sectoral, and institutional factors. Second, nonlinear approaches reveal that appreciations and depreciations often have asymmetric impacts, with trade flows typically more sensitive to appreciations and FDI responses depending on sector and policy context. Third, while these findings are increasingly established in both advanced and developing economies—including MENA countries such as Tunisia, Algeria, and Saudi Arabia—Morocco remains underrepresented. Existing studies provide valuable insights into trade vulnerability and sectoral sensitivity (Bouoiyour & Rey, 2005; Mohamed et al., 2024; Pouya et al., 2024), but FDI effects are inconclusive and nonlinear asymmetries remain largely unexplored.

In this context, Morocco stands out as a particularly relevant case for further research. Its growing integration into global value chains, combined with its gradual transition toward greater exchange rate flexibility since 2018, makes it important to understand how REER movements affect trade and FDI. The Nonlinear ARDL framework offers an appropriate tool for this purpose, as it captures both short- and long-run dynamics, accommodates mixed orders of integration, and explicitly models asymmetric responses (Wicaksana & Widodo, 2024; Shaikh et al., 2025). By applying this approach to Morocco over 1988–2023, the present study extends regional evidence and provides country-specific insights with direct policy relevance.

RESEARCH METHOD

This study is quantitative and explicative, applying time-series econometric analysis to examine the asymmetric effects of Morocco's real effective exchange rate (REER) on foreign direct investment (FDI), exports, and imports. The nonlinear autoregressive distributed lag (NARDL) model of Shin et al. (2014) is employed because it decomposes REER into appreciations and depreciations, accommodates mixed integration orders provided none is I(2), and is well suited for relatively small samples. The dataset covers annual observations for 1988–2023 (36 years), drawn entirely from the World Development Indicators (WDI) database. Morocco is chosen purposively because of its structural dependence on external sector performance and its 2018 transition toward a more flexible exchange rate regime. To illustrate the key dynamics motivating the study, Figure 1 plots REER appreciations and depreciations over the sample period, showing alternating phases of currency strength and weakness.

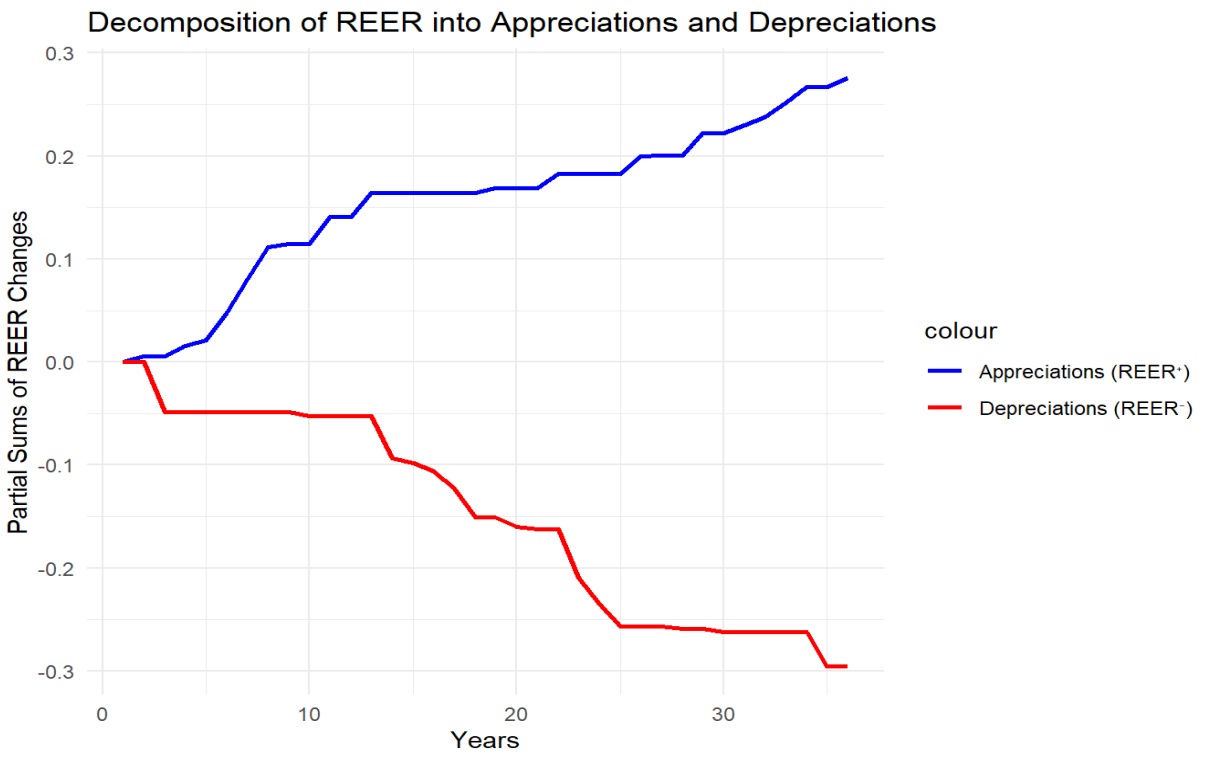

Figure 1: Partial sum decomposition of REER into appreciations ($REER^+$) and depreciations ($REER^-$) for Morocco, 1988–2023

The variables include FDI inflows, total exports, total imports, REER, and gross domestic product (GDP). All are expressed in current local currency units and transformed into natural logarithms where appropriate. GDP is consistently retained as the central macroeconomic control, reflecting market size and absorptive capacity. Alternative controls such as inflation, interest rates, and trade openness were not included to preserve parsimony and avoid collinearity, since REER already incorporates relative inflation and competitiveness effects. This design reduces the risk of overfitting in a small-sample context while still capturing the principal macroeconomic drivers. Moreover, by including GDP, the model mitigates endogeneity concerns, since overall economic activity influences and is influenced by trade, investment, and exchange rate movements.

The three functional relationships estimated are: Exports equation: $Exports_t = f(REER^+, REER^-, Imports_t, FDI_t, GDP_t)$; Imports equation: $Imports_t = f(REER^+, REER^-, Exports_t, FDI_t, GDP_t)$; FDI equation: $FDI_t = f(REER^+, REER^-, Exports_t, Imports_t, GDP_t)$. Where $REER^+$ and $REER^-$ represent the cumulative partial sums of appreciations and depreciations, respectively. The general NARDL error-correction specification is expressed as:

$$\Delta y_t = \alpha + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{j=0}^{q} \left(\theta_j^+ \Delta REER_{t-j}^+ + \theta_j^- \Delta REER_{t-j}^-\right) + \lambda_1 y_{t-1} + \lambda_2^+ REER_{t-1}^+ + \lambda_2^- REER_{t-1}^- + \gamma Z_t + \varepsilon_t \ldots (1)$$

where y_t denotes the dependent variable (exports, imports, or FDI), $REER^+$ and $REER^-$ capture appreciations and depreciations, Z_t contains the GDP control, and ε_t is the error term. Lag orders are determined by the Akaike Information Criterion (AIC).

Cointegration is tested through the ARDL bounds testing approach of Pesaran et al. (2001). The hypotheses are formulated as follows:

Null hypothesis: no cointegration exists among the variables, i.e. $H_0: \lambda_1 = \lambda_2^+ = \lambda_2^- = 0$

Alternative hypothesis: a long-run cointegration relationship exists, i.e. $H_1: \lambda_1 = \lambda_2^+ = \lambda_2^- \neq 0$

Once a long-run relationship is established, both short-run and long-run asymmetries are examined using Wald tests. The hypotheses are:

Short-run asymmetry:

$H_0: \theta_j^+ = \theta_j^-$ (no asymmetry in the short run)

$H_1: \theta_j^+ \neq \theta_j^-$ (short-run asymmetry exists)

Long-run asymmetry:

$H_0: \lambda_2^+ = \lambda_2^-$ (no asymmetry in the long run)

$H_1: \lambda_2^+ \neq \lambda_2^-$ (long-run asymmetry exists)

All data collection relied on the WDI database. Table 1 provides the data collection instrument grid, listing the measurement, source, and justification for each variable.

Table 1. description of variables

Variable	Description	Source
Foreign direct investment inflows (FDI)	Direct investment equity flows in the reporting economy.	WDI
Total exports of goods and services (Exports)	The value of all goods and other market services provided to the rest of the world.	WDI
Total imports of goods and services (Imports)	The value of all goods and other market services received from the rest of the world.	WDI
Real Effective Exchange Rate (REER)	A central measure of a country's international price competitiveness. It integrates both nominal exchange rate movements and inflation differentials with trading partners.	WDI
Gross Domestic Product (GDP)	The sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	WDI

The empirical strategy proceeds in several stages. First, unit-root properties are tested using Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) procedures to ensure none of the series is I(2). Second, the presence of long-run cointegration is evaluated using the bounds testing procedure. Third, once cointegration is confirmed, long-run and short-run coefficients are estimated, and asymmetries are tested using Wald statistics. Finally, robustness is assessed through diagnostic checks, including the Jarque–Bera test for normality, the Breusch–Godfrey LM test for autocorrelation, the ARCH test for heteroskedasticity, and the CUSUM test for stability.

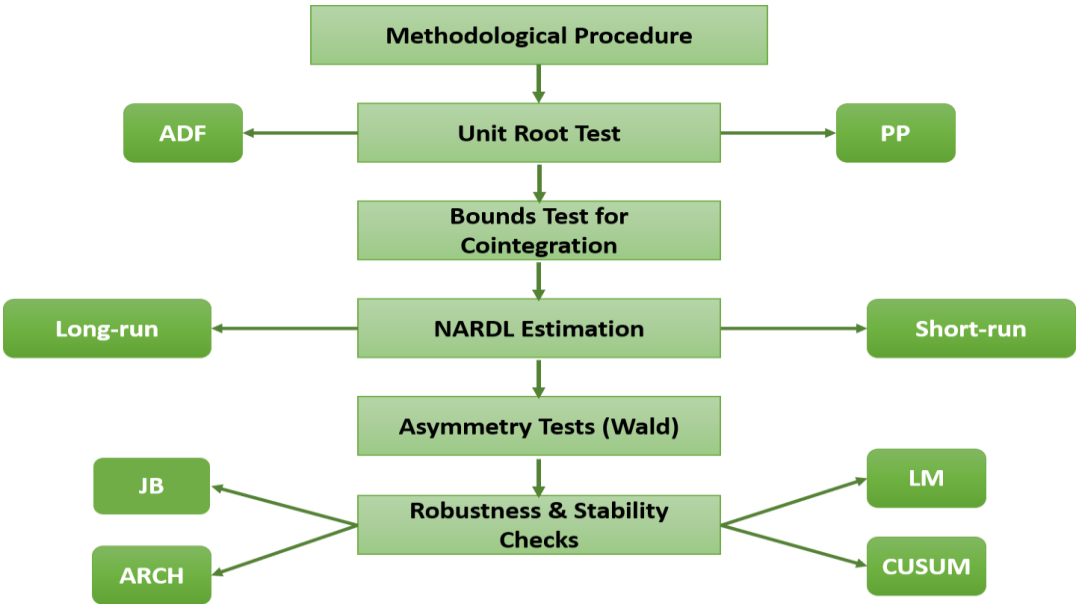

Figure 2. Graphic representation of Estimating Methodology

The statistical analysis was carried out in R (version 4.4.3) using the packages nardl, urca, lmtest, and dynlm. Descriptive statistics and correlation analysis provided preliminary insights, followed by the systematic application of unit-root tests, bounds testing, NARDL estimation, asymmetry tests and diagnostics. The study acknowledges that the sample size is limited to 36 annual observations. While relatively small, the NARDL method is specifically designed for small samples and mixed integration orders. The significance of the error-correction terms and strong bounds test results reported in the findings demonstrate that the models retain sufficient explanatory power. Nonetheless, the limited degrees of freedom are recognized as a constraint, and future research may strengthen the design by incorporating additional controls and testing for structural breaks around Morocco's exchange rate reform.

RESULTS AND DISCUSSION

Descriptive Analysis for Variables

The descriptive statistics in Table 2 reveal substantial variability across Morocco's trade and investment indicators. Imports and exports show wide ranges—approximately 696 billion MAD (6.96×10^{11}) and 575 billion MAD (5.75×10^{11}), respectively—reflecting Morocco's deepening trade integration and exposure to fluctuations in external demand and commodity prices. The volatility of FDI inflows, ranging from less than 1 billion MAD (1.0×10^{9}) to more than 33 billion MAD (3.3×10^{10}), highlights Morocco's episodic attractiveness to foreign investors, often tied to privatization waves, sectoral reforms, or global risk cycles. By contrast, the real effective exchange rate (REER) exhibits a relatively narrow range (19.47 points), consistent with Morocco's managed exchange rate regime. Since the 2018 reform, the dirham has been allowed to float within a gradually widening band, which has prevented extreme misalignments while still exposing firms to moderate currency risks.

Normality tests indicate that most series (FDI, GDP, exports, and imports) are non-normal ($p < 0.05$), suggesting structural shocks and persistent asymmetries in Morocco's macroeconomic data. REER is the exception, displaying approximate normality ($p = 0.084$). This reinforces the use of logarithmic transformations and nonlinear econometric techniques such as NARDL, which are better suited for handling skewed distributions and asymmetric adjustment paths.

Table 2. Variables descriptive analysis

Statistic	Exports	Imports	REER	GDP	FDI
N (Values)	36	36	36	36	36
Minimum	5.04×10^{10}	5.31×10^{10}	95.38	2.57×10^{10}	6.95×10^{8}
Maximum	6.26×10^{11}	7.49×10^{11}	114.85	1.44×10^{11}	3.33×10^{10}
Range	5.75×10^{11}	6.96×10^{11}	19.47	1.19×10^{11}	3.26×10^{10}
Mean	2.19×10^{11}	2.78×10^{11}	103.41	7.81×10^{10}	1.45×10^{10}
Variance	2.35×10^{22}	3.88×10^{22}	26.24	1.56×10^{21}	1.06×10^{20}
Std. Deviation	1.53×10^{11}	1.97×10^{11}	5.12	3.95×10^{10}	1.03×10^{10}
Normality p-value	0.00231	0.00166	0.08408	0.00186	0.01517

Correlation Analysis of Variables

As shown in Figure 3, the correlation analysis reveals clear and theory-consistent relationships between the real effective exchange rate (REER) and Morocco's external sector. REER is moderately and negatively correlated with exports (–0.51, $p < 0.001$), confirming that real appreciation reduces competitiveness. This aligns with trade theory, where a stronger domestic currency raises export prices abroad and dampens demand. A similarly negative correlation is observed with FDI inflows (–0.43, $p < 0.001$), suggesting that appreciation discourages foreign investment by lowering returns in local currency and raising production costs for foreign firms. This supports the view that investors prefer stable or undervalued exchange rates, where profitability is less exposed to currency distortions.

The relationship with imports (–0.56, $p < 0.001$) is more surprising. While theory predicts appreciation should boost imports by raising purchasing power, Morocco's import structure—dominated by essential inputs, energy, and capital goods—makes demand relatively price-inelastic. The managed float regime may also dampen immediate pass-through from exchange rate shifts to import volumes.

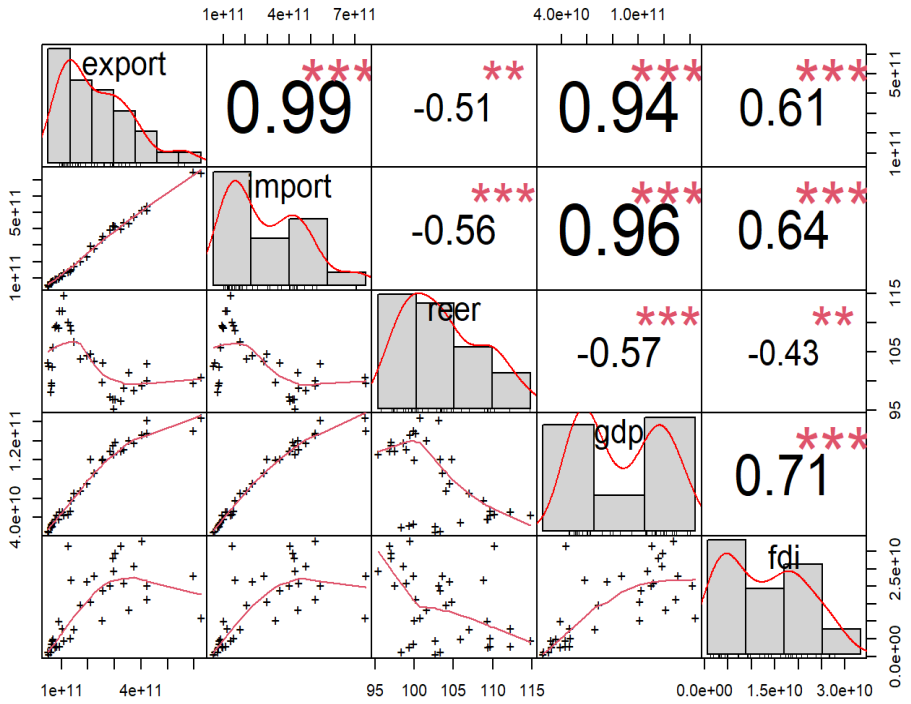

Figure 3. Variables correlation

Stationarity

The Augmented Dickey-Fuller (ADF) test results in Table 3 indicate that all five variables are non-stationary in levels, as their test statistics do not exceed the critical values at conventional significance levels (1%, 5%, or 10%). For example, the test statistic for exports is –0.8987, which is less negative than the 10% critical value (–3.18), leading to a failure to reject the null hypothesis of a unit root. Similar conclusions apply to imports (–1.8833), REER (–1.9977), GDP (–1.8180), and FDI (–2.5056). After first differencing, all variables become stationary, confirming that they are integrated of order one, or I(1). This is consistent with many macroeconomic time series that are subject to long-term trends and structural shifts. It is important to note that stationarity refers to the stability of a series over time, and should not be confused with the normality of its distribution.

From an econometric standpoint, the I (1) property justifies the use of frameworks such as ARDL and NARDL, which allow for cointegration and the estimation of both short-run dynamics and long-run equilibrium relationships despite non-stationarity at levels.

Table 3. Stationarity test

Test type	Variable	Model Type		Critical values 1%	5%	10%	Statistical value	Result	Order of integration
ADF Test	Exports	Trend	Tau3	-4.15	-3.50	-3.18	-0.8987	Non-stationary	I (1)
			Phi2	7.02	5.13	4.31	3.3026		
			Phi3	9.31	6.73	5.61	2.3403		
	Imports	Trend	Tau3	-4.15	-3.50	-3.18	-1.8833	Non-stationary	I (1)
			Phi2	7.02	5.13	4.31	3.8514		
			Phi3	9.31	6.73	5.61	3.2611		
	REER	Trend	Tau3	-4.15	-3.50	-3.18	-1.9977	Non-stationary	I (1)
			Phi2	7.02	5.13	4.31	1.6546		
			Phi3	9.31	6.73	5.61	2.4630		
	GDP	Trend	Tau3	-4.15	-3.50	-3.18	-1.8419	Non-stationary	I (1)
			Phi2	7.02	5.13	4.31	6.8615		
			Phi3	9.31	6.73	5.61	1.9540		
	FDI	Trend	Tau3	-4.15	-3.50	-3.18	-2.5056	Non-stationary	I (1)
			Phi2	7.02	5.13	4.31	2.4064		
			hi3	9.31	6.73	5.61	3.4371		

Test for Cointegration

After the preliminary analysis, we turn to the regression results from the NARDL bounds test, reported in Table 4. The calculated F-statistics for all three models (FDI, Exports, and Imports) exceed the upper bound critical value at the 5% level {F > I(1)}, leading to rejection of the null of no cointegration. This confirms the presence of a stable long-run relationship among the variables, allowing us to examine both the short-run and long-run coefficients of Morocco's external sector responses to REER fluctuations.

Table 4. Bounds Test for Cointegration

Dependent variable	K (regressors)	F-statistic	5% critical values	Decision
FDI	2	6.996	I(0) = 4.183, I(1) = 5.333	F > I(1) ⇒ cointegration
Exports	2	30.060	I(0) = 4.183, I(1) = 5.333	F ≫ I(1) ⇒ strong cointegration
Imports	2	21.809	I(0) = 4.183, I(1) = 5.333	F ≫ I(1) ⇒ strong cointegration

Model Estimation

Having established the existence of cointegration, we now turn to the long-run estimates. Table 5 reports the effects of REER movements on Morocco's external sector.

Table 5. Long-run Effects

Model	Variable	Short-Run	Long-Run	R^2	Wald asymmetry (p-value)	
					Short-run	Long-run
FDI	$REER^+$	–20.41 (0.0219) *	–22.28 (0.0347) *	0.732	0.1416	0.0972
	$L.REER^+$	23.38 (0.0316) *	25.53 (0.0393) *			
	$REER^-$	–1.64 (0.7323)	–1.79 (0.7315)			
	$L.REER^-$	—	—			
Export	$REER^+$	–1.09 (0.0943).	–1.55 (0.0877).	0.928	0.9011	0.8083
	$L.REER^+$	2.63 (0.0004) ***	3.76 (<0.001) ***			
	$REER^-$	–0.74 (0.0463) *	–1.06 (0.0553).			
	$L.REER^-$	—	—			
Import	$REER^+$	2.33 (0.0148) *	2.91 (0.0131) *	0.941	0.0588	0.0121
	$L.REER^+$	–3.47 (0.0012) **	–4.33 (0.0006) ***			
	$REER^-$	–0.83 (0.2462)	–1.03 (0.2108)			
	$L.REER^-$	1.39 (0.0468) *	1.73 (0.0323) *			

For FDI, appreciation exerts an immediate contractionary effect (–20.41, p = 0.0219), consistent with Cushman's (1983) theoretical prediction that stronger currencies compress local returns, and with evidence for developing economies in Haque et al. (2022) and Kiyota & Urata (2004). Morocco, however, shows a rebound in the lagged term (23.38, p = 0.0316), suggesting that investors ultimately interpret appreciation as a sign of stability. This contrasts with Tunisia, where Benzid (2023) reports a consistently positive link between appreciation and FDI, highlighting structural differences: Tunisia's FDI is stability-driven, while Morocco's is concentrated in cost-sensitive manufacturing. Depreciation remains insignificant, echoing broader evidence that undervaluation does not automatically attract growth-enhancing inflows in economies with strong import dependence and inflationary risks.

For exports, appreciation produces the expected short-run decline (–1.09, p = 0.0943), in line with trade theory (Hooper & Kohlhagen, 1978) and findings for emerging markets (Arize et al., 2000). Yet exporters adjust in the following period, with a strong lagged positive effect (2.63, p = 0.0004), likely through upgrading and non-price competitiveness. Depreciation, however, reduces exports (–0.74, p = 0.0463), echoing Alsamara et al. (2022) for Algeria, where weakening initially worsens trade before eventual recovery (J-curve). This underscores Morocco's structural reliance on imported inputs, which erode competitiveness gains. The weak Wald asymmetry test (p = 0.9011) suggests broadly symmetric

net effects, consistent with Ćorić & Pugh (2010), who emphasize that both directions of exchange-rate shocks can be disruptive in developing economies.

For imports, asymmetry is most evident. Appreciation immediately raises imports (2.33, p = 0.0148), reflecting higher purchasing power, but the effect is corrected by a strong lagged contraction (–3.47, p = 0.0012), pointing to overshooting. Depreciation exerts no immediate impact but generates a delayed positive response (1.39, p = 0.0468), reflecting Morocco's dependence on price-inelastic imports such as energy and capital goods. Unlike Algeria, where depreciation improves the trade balance (Alsamara et al., 2022), Morocco's weaker responsiveness underscores structural rigidities. The near-significant asymmetry test (p = 0.0588) highlights the sector's vulnerability to appreciation shocks.

In the long run, these patterns persist with sharper contrasts. For FDI, appreciation again discourages inflows (–22.28, p = 0.0347) but the lagged rebound remains strong (25.53, p = 0.0393), confirming a time-dependent adjustment. Unlike Tunisia (Benzid, 2023), where appreciation consistently boosts FDI, Morocco's reliance on cost-sensitive industries limits such gains. Depreciation is again insignificant, in line with Haque et al. (2022). Exports exhibit a similar structure: appreciation reduces performance (–1.55, p = 0.0877), but the lagged effect turns strongly positive (3.76, p < 0.001), showing gradual adaptation. Depreciation continues to depress exports (–1.06, p = 0.0553), contradicting the J-curve pattern in Algeria (Alsamara et al., 2022). Instead, Morocco's trajectory mirrors Sakli et al. (2022) for North Africa, where appreciation undermines growth and depreciation remains weak. The absence of significant long-run asymmetry (p = 0.8083) confirms structural rigidities in Morocco's export base.

Imports show the clearest asymmetric dynamics. Appreciation significantly raises imports (2.91, p = 0.0131), but the lagged correction is strong (–4.33, p = 0.0006). Depreciation remains delayed but positive (1.73, p = 0.0323), underscoring Morocco's dependence on essential, price-inelastic goods. Unlike Algeria, where long-run depreciation improves balances, Morocco's significant Wald test (p = 0.0121) shows that appreciation shocks dominate import behavior.

Model Diagnostic Tests

The diagnostic test results in table 6 confirm that all three NARDL models for FDI, exports, and imports meet the standard statistical assumptions required for reliable inference. The Jarque-Bera tests indicate that residuals are normally distributed in each model, with high p-values well above conventional thresholds. The LM tests for autocorrelation show no evidence of serial correlation in the residuals, confirming that the models are correctly specified in terms of dynamics. Furthermore, the ARCH tests suggest that residuals are homoscedastic in all three models, with no signs of time-varying variance. Even in the imports model, where the ARCH test p-value is the lowest (p = 0.0883), it still exceeds the 5% threshold, supporting the conclusion that heteroskedasticity is not a concern. Overall, the models are statistically well-behaved and the results can be interpreted with confidence.

Table 6. Diagnostic Test Results for NARDL Models

Diagnostic Test	FDI Model	Exports Model	Imports Model
Normality (Jarque-Bera)	0.98 (p = 0.7324)	0.99 (p = 0.9585)	0.98 (p = 0.8606)
Autocorrelation (LM)	8.48 (p = 0.2360)	2.97 (p = 0.3348)	9.13 (p = 0.2279)
Heteroskedasticity (ARCH)	1.86 (p = 0.3942)	0.12 (p = 0.7273)	4.85 (p = 0.0883)

In addition to the standard diagnostic checks, the recursive CUSUM stability tests were conducted to assess the structural stability of the three NARDL models. The plots in Figure 4 display the recursive residuals along with their 95% confidence bands. In each case, the CUSUM lines remain comfortably within the critical boundaries, indicating that the models are stable over the full sample period (1988–2023). For the FDI model, the CUSUM test yields a p-value of 0.412, showing no signs of instability. The exports model is particularly stable, with a flat trajectory and a p-value of 0.933. The imports model shows some fluctuations around the 2018 exchange rate reform, but the stability line never crosses the boundaries, and the p-value (0.640) confirms the absence of a structural break.

Taken together, these results demonstrate that the three models are robust, both in terms of statistical assumptions and structural stability, and are therefore suitable for drawing reliable short- and long-run inferences.

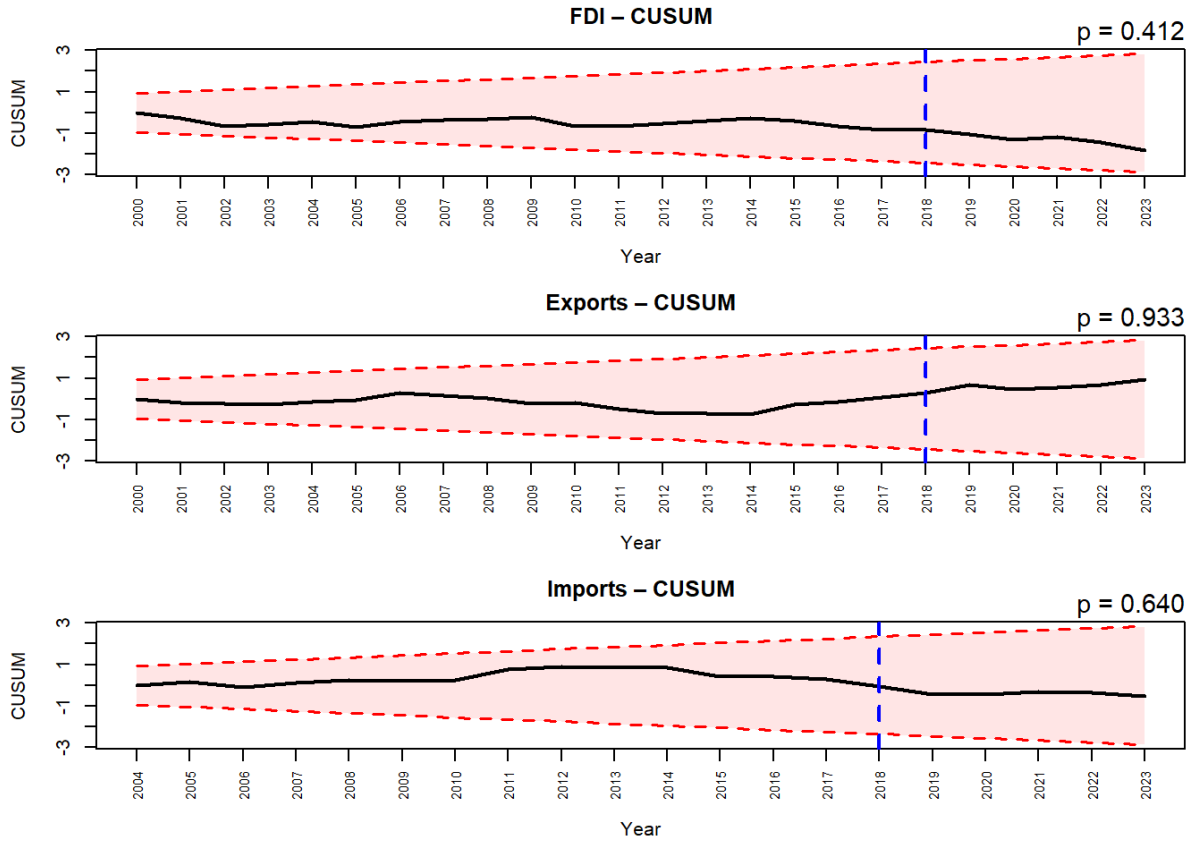

Figure 4: Recursive CUSUM Stability Plots for the NARDL Models

The NARDL results reveal a consistent pattern across Morocco's external sector: appreciations exert stronger and more immediate effects than depreciations, with investment, exports, and imports all showing short-run disruptions followed by mixed long-run adjustments. Depreciations, by contrast, are largely insignificant or produce delayed, weaker, and sometimes counterintuitive effects. These findings highlight Morocco's structural vulnerability to appreciation shocks under its gradual exchange rate liberalization, see Figure 5.

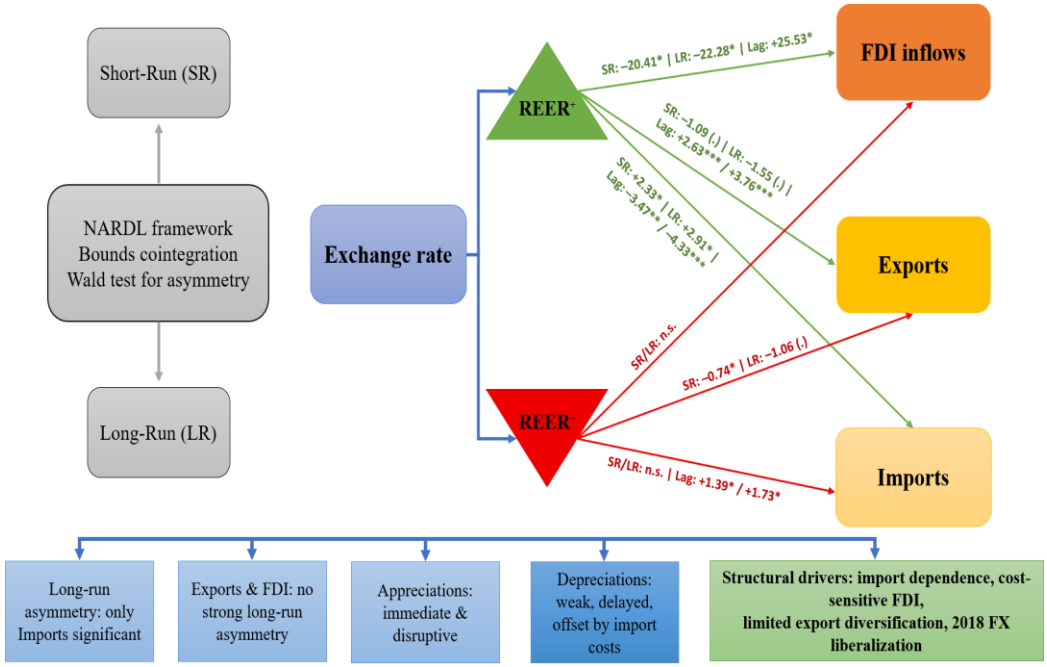

Figure 5. Schematic representation

From an academic perspective, this study contributes to the limited literature on Morocco by applying a nonlinear framework that distinguishes between appreciation and depreciation. Unlike studies on Tunisia (Benzid, 2023), where appreciation consistently boosts FDI, or on Algeria (Alsamara et al., 2022), where depreciation improves trade balance through a J-curve effect, Morocco's dynamics are shaped by its sectoral composition and structural rigidities. In particular, the rebound of FDI and exports after appreciation and the asymmetry in imports reflect features often overlooked by linear models.

For policymakers, the results underline the risks of sustained REER appreciation: it compresses investment and export competitiveness while fueling import demand, thereby widening external imbalances. Managing these pressures has become more urgent since Morocco's 2018 reform, which widened the fluctuation band of the dirham. Policy responses should go beyond exchange rate management by: Expanding hedging instruments to protect firms from volatility; Promoting export diversification and industrial upgrading to offset appreciation shocks; Reducing import dependence through renewable energy investment and deeper integration into global value chains. Together, these measures would strengthen Morocco's resilience to exchange rate fluctuations, support competitiveness, and align with the country's broader transition toward a more flexible exchange rate regime.

CONCLUSION

The NARDL results reveal that REER appreciations exert significant negative effects on Morocco's FDI and exports in the short run, while boosting imports. In the long run, these shocks display partial reversals, with FDI and exports showing delayed rebounds, but imports remaining structurally asymmetric. Depreciations, by contrast, are mostly insignificant or generate weaker, delayed responses. The robustness checks (Jarque–Bera, LM, ARCH, and CUSUM) confirm the validity and stability of the estimated models. The findings indicate that Morocco's external sector is more vulnerable to appreciation shocks than to depreciation incentives, reflecting its reliance on cost-sensitive FDI and price-inelastic imports. Policy-wise, the results highlight the importance of managing appreciation pressures through export diversification, industrial upgrading, and financial deepening, alongside broader strategies to reduce import dependence and strengthen resilience under Morocco's gradual exchange rate liberalization.

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AUTHOR CONTRIBUTIONS

All authors were equally participated in research.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

REFERENCES

Alsamara, M., Mimouni, K., Barkat, K., & Kayaly, D. (2022). Can exchange rate policies and trade partners' income enhance the trade balance in Algeria? Evidence from the nonlinear ARDL model. *International Journal of Emerging Markets*, *19*(5), 1135-1156. https://doi.org/10.1108/IJOEM-02-2022-0341.

Alshubiri, F. (2022). The Impact of the Real Interest Rate, the Exchange Rate and Political Stability on Foreign Direct Investment Inflows: A Comparative Analysis of G7 and GCC Countries. *Asia-Pacific Financial Markets*, *29*(3), 569-603. https://doi.org/10.1007/s10690-022-09360-0.

Arize, A.C., Osang, T., & Slottje, D.J. (2000). Exchange-Rate volatility and foreign trade: Evidence from thirteen LDC's. *Journal of Business & Economic Statistics*, *18*(1), 10-17. https://doi.org/10.1080/07350015.2000.10524843.

Ashour, M.M. (2023). Asymmetric effect of real effective exchange rate and Saudi non-oil export

determinants. *Cogent Social Sciences*, *9*(2), 2278206. https://doi.org/10.1080/23311886.2023.2278206.

Bahmani-Oskooee, M., Akhtar, P., Ullah, S., & Majeed, M.T. (2020). Exchange rate risk and uncertainty and trade flows: Asymmetric evidence from Asia. *Journal of Risk and Financial Management*, *13*(6), 128. https://doi.org/10.3390/jrfm13060128.

Bahmani-Oskooee, M., & Gelan, A. (2019). On the link between real exchange rate and domestic investment: Asymmetric evidence from Africa. *Journal of Economic Development*, *44*(3), 1-17. https://doi.org/10.35866/caujed.2019.44.3.001.

Balaban, S., Milić, M., & Milošević, M. (2025). Short- and long-run exchange rate volatility and FDI: A dynamic panel study of transition economies. *Acta Oeconomica*, *75*(1), 1-18. https://doi.org/10.1556/032.2025.00001.

Bampi, R.E., & Colombo, J.A. (2021). Heterogeneous effects of foreign exchange appreciation on industrial output: Evidence from disaggregated manufacturing data. *The Quarterly Review of Economics and Finance*, *80*, 431-451. https://doi.org/10.1016/j.qref.2021.02.013.

Benzid, L. (2023). Nonlinear ARDL analysis of real effective exchange rate's asymmetric impact on FDI Inflows in Tunisia. In F. Saâdaoui, Y. Zhao, & H. Rabbouch (Éds.), *Data Analytics for Management, Banking and Finance: Theories and Application* (p. 177-195). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-36570-6_8.

Bosupeng, M., Naranpanawa, A., & Su, J.-J. (2024). Does exchange rate volatility affect the impact of appreciation and depreciation on the trade balance? A nonlinear bivariate approach. *Economic Modelling*, *130*(C). https://doi.org/10.1016/j.econmod.2023.106592.

Bouoiyour, J., & Rey, S. (2005). Exchange rate regime, real exchange rate, trade flows and foreign direct investments: The case of Morocco. *African Development Review*, *17*(2), 302-334. https://doi.org/10.1111/j.1017-6772.2005.00117.x.

Broll, U., & Eckwert, B. (1999). Exchange Rate Volatility and International Trade. *Southern Economic Journal*, *66*(1), 178-185. https://doi.org/10.2307/1060843.

Choudhry, T., Ul Hassan, S.S., & Papadimitriou, F.I. (2014). UK imports, third country effect and the global financial crisis: Evidence from the asymmetric ARDL method. *International Review of Financial Analysis*, *32*, 199-208. https://doi.org/10.1016/j.irfa.2013.11.003.

Chowdhury, A., & Wheeler, M. (2008). Does real exchange rate volatility affect foreign direct investment? evidence from four developed economies. *The International Trade Journal*. https://doi.org/10.1080/08853900801970601.

Ćorić, B., & Pugh, G. (2010). The effects of exchange rate variability on international trade: A meta-regression analysis. *Applied Economics*, *42*(20), 2631-2644. https://doi.org/10.1080/00036840801964500.

Cushman, D.O. (1983). The effects of real exchange rate risk on international trade. *Journal of International Economics*, *15*(1), 45-63. https://doi.org/10.1016/0022-1996(83)90041-7.

Dal Bianco, S., & Loan, N.C.T. (2017). FDI inflows, price and exchange rate volatility: New empirical evidence from Latin America. *International Journal of Financial Studies*, *5*(1), Article 1. https://doi.org/10.3390/ijfs5010006.

Ekanayake, E.M., & Dissanayake, A. (2022). Effects of real exchange rate volatility on trade: Empirical analysis of the United States Exports to BRICS. *Journal of Risk and Financial Management*, *15*(2), Article 2. https://doi.org/10.3390/jrfm15020073.

Elhadj, E., & Brahim, M. (2020). Real effective exchange rate dynamics in Morocco: Exploring Balassa-Samuelson effect under capital account liberalization. *Journal of International Studies*, *13*(1), 373-394. https://doi.org/10.14254/2071-8330.2020/13-1/24.

El Kadri, A., & El-Khodary, M. (2025). World crude oil price volatility impacts on domestic fuel-imports and carbon emissions: Short and long-run evidence using ARDL. *Environment, Development and Sustainability*. https://doi.org/10.1007/s10668-025-05969-z.

El-Khodary, M. (2024). Economic growth determinants in Morocco: Short and long-term analysis on the impact of foreign and domestic direct investment and exports. *European Journal of Economic and Financial Research*, *8*(2). https://doi.org/10.46827/ejefr.v8i2.1687.

EL-Khodary, M., EL Kadri, A., & Alami Harrak, S. (2025). Analyzing the impact of competition policy on economic prosperity in the MENA region (2013–2023). *Social Sciences & Humanities Open*, *12*, 101746. https://doi.org/10.1016/j.ssaho.2025.101746.

Hall, S., Hondroyiannis, G., Swamy, P.A.V.B., Tavlas, G., & Ulan, M. (2010). Exchange-rate volatility

and export performance: Do emerging market economies resemble industrial countries or other developing countries? *Economic Modelling*, *27*(6), 1514-1521. https://doi.org/10.1016/j.econmod.2010.01.014.

Haque, M.A., Biqiong, Z., Arshad, M.U., & Yasmin, N. (2022). Role of uncertainty for FDI inflow: Panel econometric analysis of selected high-income nations. *Cogent Economics and Finance*, *10*(1). https://doi.org/10.1080/23322039.2022.2156677.

Hooper, P., & Kohlhagen, S.W. (1978). The effect of exchange rate uncertainty on the prices and volume of international trade. *Journal of International Economics*, *8*(4), 483-511. https://doi.org/10.1016/0022-1996(87)90001-8.

Hwang, H., & Lee, J. (2005). Exchange Rate Volatility and Trade Flows of the U.K. in 1990s. *International Area Review*, *8*(1), 173-182. https://doi.org/10.1177/223386590500800109.

Jamal, A., & Bhat, G.M. (2023). Disentangling the nexus between exchange rate volatility, exports, and FDI: Empirical Evidence from the Indian Economy. *Global Journal of Emerging Market Economies*, *15*(3), 449-472. Scopus. https://doi.org/10.1177/09749101221108788.

Kapçiu, R., Preni, B., Kalluçi, E., & Kosova, R. (2024). Modeling inflation dynamics using the logistic model: Insights and findings. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *8*(1), 364-378. https://doi.org/10.22437/jiituj.v8i1.32605.

Kelmendi, J., Beqiri, A., Shuajibi, E., Talibzade, O., & Ketners, K. (2025). The economic impact of geopolitical tensions on global trade and supply networks. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *9*(2), 839-855. https://doi.org/10.22437/jiituj.v9i2.39481.

Kiyota, K., & Urata, S. (2004). Exchange Rate, Exchange Rate Volatility and Foreign Direct Investment. *The World Economy*, *27*(10), 1501-1536. https://doi.org/10.1111/j.1467-9701.2004.00664.x.

Li, S., Li, R., & Cui, Y. (2025). Exchange rate volatility and foreign direct investment: Do bilateral investment treaties matter? *Applied Economics Letters*, 1-7. https://doi.org/10.1080/13504851.2024.2449559.

Li, Y., Miao, Z., & Tuuli, M. (2022). Exchange rate volatility and import of intermediate inputs: Evidence from Chinese firms. *International Review of Economics & Finance*, *82*, 120-134. https://doi.org/10.1016/j.iref.2022.06.012.

MacDermott, R. (2008). Linking Exchange Rates to Foreign Direct Investment. *The International Trade Journal*, *22*(1), 3-16. https://doi.org/10.1080/08853900701784045.

Mandrinos, S., & Lim, W.M. (2023). De-internationalization: An organizational institutionalism perspective. *Global Business and Organizational Excellence*, *42*(3), 58-73. https://doi.org/10.1002/joe.22195.

Meniago, C., & Eita, J.H. (2017). The effects of exchange rate changes on Sub-Saharan Africa trade. *International Journal of Sustainable Economy*, *9*(3), 213. https://doi.org/10.1504/IJSE.2017.085065.

Milas, C., Panagiotidis, T., & Papapanagiotou, G. (2024). UK foreign direct investment in uncertain economic times. *Journal of International Money and Finance*, *147*, 103132. https://doi.org/10.1016/j.jimonfin.2024.103132.

Mohamed, E.-S., Elmoukhtar, M., Mohammed, F., Yassine, N., & Mounir, B. (2024). Modeling the impact of exchange rate fluctuations on agricultural performance: Evidence from Morocco during the period 2000-2023. *Edelweiss Applied Science and Technology*, *8*(6), 7939-7950. https://doi.org/10.55214/25768484.v8i6.3731.

Moraghen, W., Seetanah, B., & Sookia, N. (2019). Explaining heterogeneity in the effect of the exchange rate and exchange rate volatility on foreign direct investment: A Meta-Analysis approach. *African Development Review*, *31*(3), 275-291. https://doi.org/10.1111/1467-8268.12389.

Moraghen, W., Seetanah, B., & Sookia, N.U.H. (2023). The impact of exchange rate and exchange rate volatility on Mauritius foreign direct investment: A sector-wise analysis. *International Journal of Finance and Economics*, *28*(1), 208-224. https://doi.org/10.1002/ijfe.2416.

Nguse, T., Oshora, B., Fekete-Farkas, M., Tangl, A., & Desalegn, G. (2021). Does the exchange rate and its volatility matter for international trade in Ethiopia? *Journal of Risk and Financial Management*, *14*(12), Article 12. https://doi.org/10.3390/jrfm14120591.

Ozturk, I., & Kalyoncu, H. (2009). Exchange Rate Volatility and Trade: An Empirical Investigation from Cross-country Comparison. *African Development Review*, *21*(3), 499-513. https://doi.org/10.1111/j.1467-8268.2009.00220.x.

Pesaran, M.H., Shin, Y., & Smith, R.J. (2001). Bounds testing approaches to the analysis of level

relationships. *Journal of Applied Econometrics*, *16*(3), 289-326. https://doi.org/10.1002/jae.616.

Pouya, P., Karim, M., Arbia, A., Yazidi, M.E., & Sobhi, K. (2024). Exchange Policy and Misalignments in Morocco: A Quantitative Analysis. *International Journal of Economics and Financial Issues*, *14*(4), 9-17. https://doi.org/10.32479/ijefi.16209.

Pozo, C.A.-D., Susan. (2001). Foreign exchange rates and foreign direct investment in the United States. *The International Trade Journal*, *15*(3), 323-343. https://doi.org/10.1080/088539001753228018.

Rahman, A., Murad, S.M.W., & Wang, X. (2024). Exchange rate asymmetry and its impact on bilateral trade: Evidence from BCIM-EC countries using N-ARDL approach. *Heliyon*, *10*(1), e23886. https://doi.org/10.1016/j.heliyon.2023.e23886.

Rahman, S., & Serletis, A. (2009). The effects of exchange rate uncertainty on exports. *Journal of Macroeconomics*, *31*(3), 500-507. https://doi.org/10.1016/j.jmacro.2008.12.005.

Sakli, H., Lassoued, T., & Talmoudi, F. (2022). The effect of real exchange rate on economic growth: Evidence from Tunisia and Morocco. *Review of Economics and Finance*, *20*, 971-977. https://doi.org/10.55365/1923.x2022.20.109.

Schmidt, C.W., & Broll, U. (2009). Real exchange-rate uncertainty and US foreign direct investment: An empirical analysis. *Review of World Economics*, *145*(3), 513-530. https://doi.org/10.1007/s10290-009-0024-3.

Shaikh, Z.H., Husain, S., Alam, M.N., Baig, I.A., & Rana, M. (2025). Understanding the asymmetric effects of exchange rate on economic growth: Evidence from India. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *9*(2), 788-809. https://doi.org/10.22437/jiituj.v9i2.42633.

Sharma, C., & Pal, D. (2019). Does exchange rate volatility dampen imports? commodity-level evidence from India. *International Economic Journal*, *33*(4), 696-718. https://doi.org/10.1080/10168737.2019.1630467.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles & W. C. Horrace (Éds.), *Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications* (p. 281-314). Springer. https://doi.org/10.1007/978-1-4899-8008-3_9.

Spahija, D., Li, W., Muhammedov, M., Nizamov, A., & Iskhakova, S. (2025). Study of the impact of foreign investment on economic development in emerging markets. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *9*(3), 1025-1036. https://doi.org/10.22437/jiituj.v9i3.42850.

Tan, L., Xu, Y., & Gashaw, A. (2021). Influence of exchange rate on foreign direct investment inflows: An empirical analysis based on co-integration and granger causality test. *Mathematical Problems in Engineering*, *2021*(1), 7280879. https://doi.org/10.1155/2021/7280879.

Tarasenko, I. (2021). The impact of exchange rate volatility on trade: The evidence from Russia. *Russian Journal of Economics*, *7*(3), Article 3. https://doi.org/10.32609/j.ruje.7.57933.

Udomkerdmongkol, M., Morrissey, O., & Görg, H. (2009). Exchange rates and outward foreign direct investment: US FDI in emerging economies. *Review of Development Economics*, *13*(4), 754-764. https://doi.org/10.1111/j.1467-9361.2009.00514.x.

Vita, G.D., & Abbott, A. (2007). Do exchange rates have any impact upon UK inward foreign direct investment? *Applied Economics*, *39*(20), 2553-2564. https://doi.org/10.1080/00036840600749748.

Poon, W-C & Hooy, C.W. (2013). Exchange-Rate Volatility, Exchange-Rate Regime, and Trade in OIC Countries. *Journal of Asia-Pacific Business*, *14*(3), 182-201. https://doi.org/10.1080/10599231.2013.772843.

Wang, Y., & Yu, M. (2021). Imports and RMB exchange rate pass-through: The role of quality sorting. *Journal of Economic Behavior & Organization*, *187*(C), 470-487. https://doi.org/10.1016/j.jebo.2021.04.039.

Wicaksana, T., & Widodo, W. (2024). The nexus between trade openness and environmental degradation: A VECM Analysis. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *8*(2), 703-719. https://doi.org/10.22437/jiituj.v8i2.36595.

Yadewani, D., Pandi, O.D., Syafrani, S., Nurofik, A., & Poddar, S. (2024). Impact of government policies on the knowledge base of sustainable small and medium-sized enterprises. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *8*(1), 251-266. https://doi.org/10.22437/jiituj.v8i1.31884.