Journal of Contemporary Macroeconomic Issues **https://doi.org/10.36923/jcmi.v5i2.600**
Vol. 5(2). PP: 81-91

The Asymmetric Effects of Exchange Rate Volatility on Trade Flows of Pakistan

Nimra Gul[1]; Misbah Nosheen[2]; Muqdas Bibi[3]

[1] MPhil scholar, Hazara University, Mansehra, Pakistan
[2] Associate Professor of Economics, Hazara University, Mansehra, Pakistan
[3] MPhil scholar, Hazara University, Mansehra, Pakistan

Abstract

This research investigates the effects of asymmetric exchange rate volatility on Pakistan's trade performance with major trade partners. The effects of exchange rate trade (import & export) by utilizing variables such as real bilateral exchange rate, bilateral exchange rate volatility, and economic activities measured for Pakistan's major trading partners from 1985 to 2020. The researcher uses non-linear ARDL and linear ARDL techniques for estimation. They also apply co-integration tests, with the F-test being used for lagged value significance and the t-test for establishing significance. The linear ARDL of exports and imports in the short run reveals that exchange rate volatility positively impacts Pakistan's exports. In the long run, all the partners positively impact imports.

Keywords: Volatility exchange rate, ARDL, Nonlinear ARDL, F-test, T-test

Information:

Received: 18 October, 2024

Accepted: 13 November, 2024

Published: December, 2024

Corresponding Author's email: misbah.nosheen@yahoo.com

Copyright: © 2024, The Authors

This article is published under the Creative Commons Attribution 4.0 International License (CC BY 4.0). https://creativecommons.org/licenses/by/4.0/

Cite this article as

Gul, N., Nosheen, M., & Bibi, M. (2024). The asymmetric effects of exchange rate volatility on trade flows of Pakistan. *Journal of Contemporary Macroeconomic Issues*, 5(2), 81–93. https://doi.org/10.36923/jcmi.v5i2.600

1. Introduction

International trade plays a significant role in economic development by facilitating the exchange of goods and services across borders. However, fluctuations in exchange rates influence trade costs, international competitiveness, and the profitability of cross-border transactions. For developing economies such as Pakistan, exchange rate instability poses particular challenges because currency movements affect import costs and export earnings (Azid et al., 2005; Khan et al., 2014). Limited access to financial hedging instruments further increases firms' exposure to currency risk. Exchange rate volatility creates uncertainty regarding future currency values, thereby influencing production, pricing, investment, and international trade decisions (Hodge, 2005). Therefore, understanding its implications for bilateral trade remains important for economic policymakers and international businesses.

Currency depreciation can improve export competitiveness by reducing the foreign-currency prices of domestic products. However, the benefits depend on imported inputs, production capacity, and demand conditions in trading partner economies. Similarly, appreciation may reduce import costs while weakening export competitiveness. Exchange rate movements consequently influence international prices and trade-policy decisions (Nicita, 2013). Pakistan has experienced several exchange rate regimes, including administratively managed arrangements, devaluations, and increasingly market-oriented exchange rate determination. These transitions have exposed businesses to changing currency risks and increased the importance of examining exchange rate volatility in international trade (Khan et al., 2014).

Existing empirical research provides mixed evidence regarding the relationship between exchange rate volatility and international trade. Greater uncertainty may discourage risk-averse exporters and importers by making expected revenues and transaction costs less predictable (Hodge, 2005). However, other studies report positive, negative, or statistically insignificant effects depending on the economic environment, trading partner, and estimation period (Hall et al., 2010; Shaikh & Hongbing, 2015). These inconsistencies suggest that exchange rate volatility does not affect all trading relationships uniformly. In addition, differences in financial development, risk-management capabilities, and trade structures may influence firms' responses to exchange rate fluctuations (Hussain et al., 2015).

Pakistan's historical exchange rate adjustments provide an important context for investigating these relationships. Since independence, the country has experienced substantial changes in exchange rate management, particularly during the early 1980s and late 1990s. These reforms reflected evolving external-sector policies and pressures associated with international competitiveness and balance-of-payments management. However, nominal currency adjustments alone cannot explain changes in trade performance because inflation, foreign demand, and trade composition also influence international transactions. Therefore, examining real bilateral exchange rates and their volatility provides a more comprehensive basis for understanding Pakistan's trade relationships (Khan et al., 2014). Institutional factors, including foreign-exchange financing and limited access to internationally accepted currencies, may further influence trading activities (Siddiqi, 2006).

Previous studies have examined exchange rate volatility and trade in Pakistan, although their findings differ across trading partners and methodological approaches. Khan et al. (2014) identify the importance of bilateral exchange rate fluctuations, while Shaikh and Hongbing (2015) provide country-specific evidence involving China, Pakistan, and India. Similarly, Bahmani-Oskooee et al. (2020) investigate asymmetric volatility effects in trade between Pakistan and China. These studies highlight the importance of examining individual trading relationships rather than relying exclusively on aggregate trade estimates. However, the possibility that increases and decreases in exchange rate volatility produce different short-run and long-run responses requires further partner-specific investigation.

The present study investigates the asymmetric effects of exchange rate volatility on Pakistan's imports and exports with major trading partners during 1985–2020. Although Pakistan maintains trade relationships with several economies, the reported empirical analysis focuses on China, Germany, the Netherlands, and Spain. The study examines whether positive and negative changes in exchange rate volatility have different implications for bilateral trade flows. It also considers the influence of real bilateral exchange rates and trading partners' economic activity on international trade performance.

The study contributes to the existing literature by comparing the responses of imports and exports across individual trading partners and distinguishing short-run adjustments from long-run relationships. In addition, it employs linear autoregressive distributed lag (ARDL) and nonlinear autoregressive distributed lag (NARDL) approaches to assess whether symmetric specifications adequately capture the relationship between exchange rate volatility and bilateral trade. By identifying potential asymmetric and partner-specific

effects, the findings provide evidence relevant to exchange rate management, international trade policy, and economic decision-making in Pakistan.

1.1 Objectives

The study addresses the following objectives, which guide the specification and interpretation of the empirical models:

1. To investigate the asymmetric effects of exchange rate volatility on Pakistan's imports and exports with major trading partners, while accounting for bilateral exchange rates and economic activity.
2. To examine the long-run effects of exchange rate volatility on Pakistan's bilateral trade with significant trading partners and distinguish these relationships from short-run adjustments.

The study is designed to provide evidence on the potentially unequal responses of Pakistan's bilateral trade flows to exchange rate volatility. By considering the relative economic activity of trade partners and movements in the real bilateral exchange rate, the analysis seeks to clarify when currency uncertainty coincides with changes in import and export performance. The results may inform macroeconomic policy formulation and foreign-exchange market decisions. In addition, the findings may help traders understand the risks associated with exchange contracts, although the study does not directly estimate hedging effectiveness or individual firm losses. Its distinctive empirical focus is comparing positive and negative volatility changes, with separate treatment of imports and exports. This distinction is consistent with existing research suggesting that exchange rate effects can be asymmetric (Bahmani-Oskooee et al., 2020; Barguellil, 2021).

2 Literature Review

Studies of exchange rate volatility and international trade report diverse findings, reflecting differences in country settings, data frequency, trade composition, and econometric specifications. Hodge (2005) reviews theoretical reasons why uncertainty may discourage trade, whereas Hall et al. (2010) show that results need not be uniform across emerging-market and other developing economies. Consequently, the empirical literature does not support a single coefficient that can be applied reliably across trading partners. In addition, research on exchange rate misalignment emphasizes the importance of policy and market conditions in shaping trade outcomes (Nicita, 2013). This diversity provides the rationale for partner-specific analysis in the present study. In a closely related bilateral setting, Bahmani-Oskooee et al. (2020) examine the asymmetric effects of exchange rate volatility on commodity trade between Pakistan and China. Their topic demonstrates the value of disaggregating trade relationships and distinguishing the direction of exchange rate shocks. Similarly, the evidence considered by Shaikh and Hongbing (2015) indicates that results can vary across China, Pakistan, and India. These contributions suggest that the impact of volatility should not be assumed to be identical across importing and exporting activities or across trading partners. The present research extends this comparative perspective to the reported bilateral models for Pakistan and selected partner countries.

The distinction between differentiated and relatively homogeneous products further supports the expectation of heterogeneous responses to exchange rate uncertainty. Firms selling differentiated goods may have different pricing power, contractual arrangements, and adjustment costs from firms trading standardized products. Therefore, an aggregate bilateral trade model may combine responses that differ across industries. While the present study does not estimate commodity-specific relationships, this limitation is relevant when interpreting its partner-level coefficients. Hodge (2005) and Nicita (2013) provide useful contexts for understanding the links among currency uncertainty, trade incentives, and international prices. Hall et al. (2010) analyse exchange rate volatility and export performance across emerging-market, industrial, and other developing economies. Their comparative evidence is important because countries differ in their financial systems and external-sector structures. The findings do not imply that exchange rate volatility has identical effects in every setting. Instead, positive, negative, and statistically insignificant relationships may emerge under different conditions. Therefore, country-specific analysis remains warranted, particularly for a developing economy such as Pakistan. In addition, comparisons across major partners can show whether bilateral trade patterns align with broader cross-country conclusions.

Long-run analysis is relevant because trade relationships may adjust gradually following exchange rate changes. Investment decisions, contract renegotiation, import substitution, and export-market development may unfold over several periods rather than immediately. Consequently, short-run coefficients need not have the same direction or magnitude as long-run estimates. Satawatananon (2014) uses an ARDL framework to distinguish short-run from long-run trade relationships, while Shaikh and Hongbing (2015) examine comparable distinctions for China, Pakistan, and India. These studies provide methodological context for estimating adjustment processes instead of treating exchange rate effects as contemporaneous only. Nicita (2013) examines relationships among exchange rates, international trade, and trade policies, highlighting the

role of exchange rate misalignment in shaping international commercial incentives. This perspective is useful because the exchange rate may influence trade through relative prices and through changes in firms' expectations. However, misalignment and volatility are distinct concepts: the former concerns departures from an equilibrium or benchmark rate, whereas the latter concerns fluctuations over time. The present study therefore focuses on volatility while retaining the real bilateral exchange rate as a separate explanatory variable. In addition, policy implications should be drawn with this distinction in mind so that effects attributed to uncertainty are not confused with those associated with appreciation or depreciation.

Satawatananon (2014) investigates exchange rate volatility and commodity trade between the United States and Thailand using an ARDL approach. The study separates short-run and long-run effects through bounds testing and error-correction modeling. Its bilateral commodity setting offers a useful comparison for the present analysis because trade responses can depend on the direction of the trade flow and the characteristics of the trading relationship. However, commodity-specific conclusions cannot be transferred directly to Pakistan's aggregate bilateral imports and exports. This difference provides a reason to interpret the present estimates within their own data and model specifications. Shaikh and Hongbing (2015) examine exchange rate volatility and trade flows for China, Pakistan, and India using an ARDL framework. Their analysis illustrates the importance of comparing short-run and long-run relationships across countries rather than imposing identical responses. They report differences in the direction and statistical relevance of estimated effects. For Pakistan, this evidence is particularly pertinent because it situates the country's trade response within a regional comparative context. Nevertheless, the present study differs by considering the possibility of positive and negative volatility changes separately in nonlinear ARDL specifications, which may help identify responses hidden by a single symmetric coefficient.

The possibility of asymmetric exchange rate effects is important for trade modeling because an increase in uncertainty may not have the same consequences as an equivalent decrease. Adjustment costs, risk preferences, and the timing of trade contracts can cause firms to react unevenly to changes in currency conditions. Bahmani-Oskooee et al. (2020) provide a directly relevant example through their investigation of asymmetric effects in Pakistan–China commodity trade. In addition, Barguellil (2021) applies an asymmetric ARDL framework to relationships involving the exchange rate, foreign trade, and economic growth. These studies motivate separating positive and negative changes rather than relying exclusively on a linear specification. Fidrmuc and Horváth (2008) study exchange rate volatility in selected new European Union members using high-frequency data and volatility-oriented methods. Their research demonstrates that currency variability can exhibit complex dynamics, which simple summary measures may not capture completely. However, volatility measurement and the estimation of trade responses are separate tasks: models designed to identify exchange rate fluctuations do not by themselves establish their effects on imports and exports. The present study measures exchange rate volatility using a standard-deviation approach, as indicated in the variable definitions. Accordingly, its findings should be interpreted in light of the chosen volatility measure and the limitations of annual data.

Pakistan-specific studies provide useful background for interpreting exchange rate uncertainty. Khan et al. (2014) investigate volatility and trade with Pakistan's trading partners, showing the relevance of bilateral comparisons. Similarly, Hussain et al. (2015) consider volatility under different exchange rate regimes and its relationship with Pakistan's exports. These contributions suggest that institutional arrangements and partner characteristics can affect estimated relationships. However, their findings do not eliminate the need to further examine nonlinear responses. The present study therefore supplements the existing evidence by analyzing import and export models separately and considering positive and negative volatility components in the reported NARDL results.

Ikechi and Nwadiubu (2020) examine exchange rate volatility and international trade in Nigeria, comparing it with another developing economy. Their research reinforces the importance of the external-sector context in evaluating currency instability. However, differences in economic structure, market size, trade composition, and exchange rate arrangements mean that results for Nigeria cannot be assumed to hold for Pakistan. The comparison is nevertheless valuable because it illustrates that the effects of uncertainty are an empirical matter rather than a universal relationship. In addition, the study's focus on both exports and imports supports examining these trade flows separately. Wiseman et al. (2021) investigate asymmetric exchange rate pass-through in Southeast Asian rice trade. Their work draws attention to the possibility that currency adjustments may affect trade prices and quantities differently across trading relationships. Because the analysis is commodity-specific, its findings cannot be interpreted as direct evidence on Pakistan's aggregate exports and imports. Nevertheless, the methodological emphasis on asymmetric adjustment is relevant to the present study. In addition, this research highlights an avenue for future investigation: examining whether commodity-level responses explain the heterogeneity observed in Pakistan's bilateral trade aggregates.

Barguellil (2021) uses an asymmetric ARDL panel framework to examine the indirect impact of the real exchange rate on economic growth through foreign trade. This approach illustrates how trade may serve as a channel linking exchange rate conditions to broader economic outcomes. However, the object of analysis differs from the present study, which treats Pakistan's bilateral exports and imports as dependent variables. The connection is principally methodological and theoretical: allowing asymmetric responses can provide information that symmetric specifications may conceal. Therefore, this literature supports testing whether the effects of positive and negative volatility changes differ significantly. The effect of exchange rate uncertainty may vary across regional trading arrangements and between countries with different degrees of financial integration. Risk-averse traders may reduce their international activities when future foreign-currency receipts and payments become less predictable. However, firms with established hedging arrangements or more adaptable supply chains may respond differently. Hodge (2005) discusses the adverse incentives associated with currency risk, while Hall et al. (2010) provide comparative evidence across different groups of economies. These considerations indicate that interpreting bilateral coefficients requires attention to partner heterogeneity and to the limitations of an aggregate econometric specification. Research on nonlinear exchange rate relationships suggests that increases and decreases in volatility should be investigated separately. Bahmani-Oskooee et al. (2020) focus on asymmetric responses in Pakistan–China commodity trade, whereas Wiseman et al. (2021) consider asymmetric exchange rate pass-through in regional commodity trade. The two approaches are not identical, but both demonstrate why a single symmetric coefficient may conceal differences in adjustment. Building on this perspective, the present study estimates both linear and nonlinear ARDL models for Pakistan's bilateral imports and exports. Nevertheless, the existence of statistically meaningful asymmetry should be established by appropriate formal tests rather than inferred solely from differences in coefficient signs.

2.1 Research Gap and Theoretical Rationale

The preceding literature identifies mixed and partner-specific relationships between exchange rate volatility and trade. However, symmetric models constrain positive and negative volatility movements to have the same response, potentially obscuring adjustments associated with uncertainty, trade contracts, and foreign demand. The present study addresses this issue by comparing linear and nonlinear ARDL specifications for imports and exports with selected trading partners. Its contribution lies in assessing whether the estimated long-run patterns differ between trade flows, across partners, and between positive and negative volatility components. This framework is motivated by related evidence on Pakistan–China bilateral trade and asymmetric exchange rate relationships (Bahmani-Oskooee et al., 2020; Barguellil, 2021). Nevertheless, causality cannot be inferred solely from a statistically significant ARDL coefficient, and the direction of asymmetry must be assessed using appropriate model-based restrictions.

2.3 Hypotheses

The following null and alternative hypotheses correspond to the trade relationships examined. Statistical significance is assessed within the estimated model rather than assumed in advance:

H01: Exchange rate volatility has no statistically significant effect on Pakistan's exports to its major trading partners.

H11: Exchange rate volatility has a statistically significant effect on Pakistan's exports to its major trading partners.

H02: Economic activity has no statistically significant effect on Pakistan's exports to its major trading partners.

H12: Economic activity has a statistically significant effect on Pakistan's exports to its major trading partners.

H03: The real bilateral exchange rate has no statistically significant effect on Pakistan's exports to its major trading partners.

H13: The real bilateral exchange rate has a statistically significant effect on Pakistan's exports to its major trading partners.

3 Econometric Model

This study examines the asymmetric effects of exchange rate volatility on Pakistan's trade performance with selected major trading partners. Imports and exports are modeled separately using economic activity, the real bilateral exchange rate, and bilateral exchange rate volatility. Linear ARDL models are used to estimate symmetric relationships, while nonlinear ARDL models distinguish positive and negative movements in volatility. The annual dataset covers 1985–2020. The selection of partner-specific models follows the evidence that exchange rate effects need not be uniform across trading relationships (Khan et al., 2014; Bahmani-Oskooee et al., 2020). The empirical specifications should be read together with the reported variable definitions and diagnostic tests.

The relationships are expressed in the following export and import specifications, with the original numbered model expressions retained below. The dependent trade flows are interpreted with reference to domestic and partner economic activity and movements in the bilateral real exchange rate:

Export and import models:

$$X_t^{Pak} = \alpha_0 + \alpha_1 Y_t^i + \alpha_2 REX_t^i + \alpha_3 V_t^i + \varepsilon \quad (3.1)$$

In the export equation, Pakistan's bilateral exports are expected to be related to the economic activity of its trading partner, the real bilateral exchange rate, and exchange rate volatility. Higher partner income may support demand for Pakistani goods. However, the direction of the exchange rate coefficient depends on the definition of the real bilateral rate and the response of export prices and quantities. The sign and statistical significance of each estimated coefficient must therefore be assessed empirically.

The bilateral real exchange rate captures the relative price relationship between Pakistan and the respective trading partner, as defined in Table 1. Its interpretation depends on the currency quotation and deflator conventions used in constructing the series.

Exchange rate volatility represents fluctuations in the real bilateral exchange rate and is measured by its standard deviation in the reported variable definitions. The precise calculation window and data frequency are important for replication; consequently, readers should not treat the standard-deviation measure as equivalent to a GARCH-based conditional volatility estimate (Fidrmuc & Horváth, 2008).

$$M_t^{Pak} = \beta_0 + \beta_1 Y_t^{Pak} + \beta_2 REX_t^i + \beta_3 V_t^i + \mu \quad (3.2)$$

In the import equation, Pakistan's bilateral imports are related to domestic economic activity, the real bilateral exchange rate, and exchange rate volatility. Higher domestic activity may increase demand for imported products; however, price effects can differ when imported goods serve as production inputs. Accordingly, the signs of the exchange rate and volatility coefficients are evaluated using the reported estimates rather than imposed as uniform outcomes across partners. The bilateral real exchange rate is included to capture the relative price incentives associated with importing from each partner. Its construction is summarized in Table 1, and consistent units are essential when comparing partner-specific coefficients. Volatility is measured as the standard deviation of the bilateral real exchange rate, consistent with the variable definitions. In the nonlinear models, positive and negative changes in this measure are entered separately to investigate asymmetric relationships. However, a formal long-run or short-run asymmetry test is necessary before making a definitive statistical claim about unequal effects.

Table 1: Variable Clarifications

S. No.	Variables Name	Variable measurement	Data Source
1	**Import**	Imports % GDP	WDI
2	**Export**	Exports % GDP	WDI
3	**Economic activities**	Annual % growth rate of GDP	WDI
4	**Real bilateral exchange rate**	$(P_{pak} \times NEX_i) / p_i$	WDI
5	**Volatility**	SD of exchange rate	WDI

Source: Authors' calculations based on the study data.

4 Estimations

4.1 Descriptive Statistics

Descriptive statistics provide an initial overview of the distribution and variation of exports, imports, economic activity, bilateral exchange rates, and exchange rate volatility. Table 2 reports the mean, median, minimum, maximum, and other summary indicators for each series. The variables have different observation counts, indicating that the available sample is not identical across all measures. Consequently, differences in sample coverage should be considered when interpreting the econometric results. The relatively large maximum values for some exchange rate variables also suggest substantial dispersion, reinforcing the importance of inspecting scale and possible extreme observations before drawing economic conclusions.

Table 2: Descriptive Statistics

	EXP	IMP	GDP	BEX	VBEX
Mean	30.85417	29.22782	3.134910	203.6383	22.36890
Median	24.60109	24.89180	2.772235	2.727777	0.098750
Maximum	101.0030	75.74463	18.32799	4353.983	3078.449
Minimum	6.988073	9.615834	-14.95814	-1.286041	0.000728
Sum	9472.229	8972.940	1015.711	61295.12	6688.302
Sum Sq. Dev.	142714.3	79205.50	4638.583	1.18008	9829479
Observations	307	307	324	301	299

Source: Authors' calculations based on the study data.

Table 3: Correlation Matrix

	EXP	IMP	GDP	BEX	VBEX
EXP	1				
IMP	0.87	1			
GDP	-0.15	-0.20	1		
BEX	-0.05	-0.07	-0.29	1	1

Source: Authors' calculations based on the study data.

Table 3 reports the available pairwise correlations among explanatory and trade variables. The absence of correlations close to either +1 or −1 in the displayed cells is not, by itself, sufficient to establish that multicollinearity is absent. In addition, the displayed matrix does not fully report the correlations involving the volatility variable. Accordingly, these descriptive correlations should be interpreted cautiously, and any definitive assessment of multicollinearity would require a complete matrix or additional diagnostic evidence.

The order of integration of the variables is assessed using the reported panel unit-root tests. Table 4 presents results from Levin–Lin–Chu, Im–Pesaran–Shin, ADF–Fisher, and PP–Fisher procedures. These tests help distinguish stationary series from those requiring differencing and are relevant to the choice of the subsequent ARDL framework. However, the tests differ in assumptions and may produce different inferences; therefore, the reported outcomes should be evaluated jointly rather than relying on a single statistic.

Table 4: Panel Unit Root Test

	Levin, Lin & Chu t stat		LM, Pesaran and Shin W-stat		ADF - Fisher		PP – Fisher	
Variables	**I (0)**	**I (1)**	**I (0)**	**I (1)**	**I (0)**	**I (1)**	**I (0)**	**I (1)**
EXP	-2.15**	-5.27*	-0.34	-7.44*	16.09	90.8*	12.09	166.2*
IMP	-2.09**	-8.65*	-0.58	-9.82*	17.36	124.4*	15.46	202.03*
GDP	-0.40		-3.94*		49.99*		48.55*	
BEX	8.75	1.12	10.12	-1.54**	1.20	36.08*	1.20	65.69*
VBEX	17.26	21.40*	9.63	4.66	8.32	36.37*	12.36	43.69*

Source: Authors' calculations based on the study data. Note. *, **, and *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively, as reported in the original estimations. The relevant test statistics and critical values should be interpreted according to each procedure.

Table 4 suggests that GDP is stationary at level in several reported specifications, whereas the other variables generally show stronger evidence of stationarity after first differencing. However, the unit-root tests do not give identical conclusions for every series and specification. The ARDL bounds-testing approach is suitable for combinations of I(0) and I(1) variables, provided none is integrated of order two. Therefore, the interpretation of long-run relationships depends on the validity of the integration assessment, lag specification, and applicable bounds critical values. The reported panel unit-root results should not be treated as a substitute for all model-specific diagnostics.

Table 5: Long-Run Volatility Coefficient Estimates in the Linear Export Model

Long Run				
	Const	**GDP**	**BEX**	**VBEX**
China	10.39(4.88) *	0.71(1.78) ***	-3.01(-2.42) *	1.00(1.49)
Germany	-11.10(-1.65)	4.33(3.91) *	21.93(3.88) *	0.06(2.79) *
Netherlands	3.94(5.41) *	1.33(1.92) ***	3.27(0.35)	0.005(0.018)
Spain	2.59(2.14) **	-1.22(-2.21) **	0.04(2.23) **	-1.69(-2.42) *
Diagnostic test				
	F test	**LM (p value)**	**Cu-sum)**	**Cu-sum sq**	**Adj r2**
China	4.20**	0.46	S	S	0.89
Germany	3.90***	0.38	S	S	0.98
Netherlands	5.23*	0.48	S	S	0.92
Spain	5.67*	0.14	S	S	0.93

Source: Authors' calculations based on the study data. Note. *, **, and *** indicate significance at the 1%, 5%, and 10% levels, respectively, as reported. The figures in parentheses are the reported test statistics. Estimation software: EViews 10.

The reported F-statistics provide evidence of long-run relationships in the linear export specifications. Nevertheless, a formal bounds-test conclusion depends on the appropriate critical values, the number of regressors, and each model's deterministic components. The CUSUM and CUSUM-of-squares results are reported as stable, while the LM test p-values do not indicate serial correlation at conventional significance levels. In addition, Table 5 shows heterogeneity across partners: the estimated volatility coefficient is positive for Germany and negative for Spain, whereas the China and Netherlands estimates are not statistically

significant at the conventional levels shown. Therefore, a general positive effect across all partners would not accurately reflect the displayed estimates.

4.2 Long-Run Linear ARDL Import Model

The linear ARDL import specification estimates the relationship between Pakistan's bilateral imports and economic activity, the real bilateral exchange rate, and exchange rate volatility. As with the export models, interpreting the results requires attention to coefficient signs, statistical significance, and diagnostic evidence. In addition, long-run estimates are not interchangeable with short-run effects, which require separate reporting within the estimated error-correction representation.

Table 6: Long -Run Coefficient Estimates of Volatility in the Linear Import Demand Model

Long Run					
	Const	**GDP**	**BEX**		**VBEX**
China	12.46(2.1) *	0.29(0.61)	-2.48(-3.3) *		0.39(2.00) **
Germany	4.58(0.9)	2.30(3.42) *	8.76(2.29) **		0.01(0.80)
Netherlands	3.71(4.7) *	1.38(4.44) *	0.90(0.88)		-0.05(-0.99)
Spain	23.07(4.6) *	1.71(1.40)	0.023(0.65)		-1.80(-1.75) ***
Diagnostic test					
	F test	**LM (p value)**	**Cu-sum)**	**Cu-sum sq**	**Adj r2**
China	4.67**	0.93	S	S	0.88
Germany	3.90***	0.95	S	S	0.96
Netherlands	4.64*	0.87	S	S	0.93
Spain	4.88*	0.12	S	S	0.91

Source: Authors' calculations based on the study data. Note. *, **, and *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively, as reported; values in parentheses are reported test statistics.

The reported F-statistics are used to assess long-run relationships, while the CUSUM tests and LM p-values provide stability and serial-correlation diagnostics. However, the import volatility coefficients differ across partners: Table 6 shows a positive coefficient for China, small and statistically insignificant estimates for Germany and the Netherlands, and a negative estimate for Spain at the reported 10% level. These results do not support describing volatility as uniformly beneficial for imports. Therefore, the discussion should distinguish statistically supported partner-specific relationships from coefficients that are not statistically significant in the presented estimates.

4.3 Long-Run Nonlinear ARDL Export Model

Table 7: Long -Run Coefficient Estimates of Volatility in the Non- Linear Export Demand Model

			Long Run		
	Const	**GDP**	**BEX**	**PVBX**	**NVBEX**
China	11.64 (2.11) **	0.70 (1.68)	-3.91 (-3.19) *	1.25 (2.96) *	-0.75 (-0.21)
Germany	-18.88 (-3.38) *	5.20 (3.38) *	18.31 (2.93) *	0.066 (3.04) *	-90.67 (0.97)
Netherlands	4.1 (10.41) *	1.46 (3.60) *	2.30 (2.68) *	0.04 (0.28)	1.30 (3.70) *
Spain	12.23 (10.35) *	0.03 (0.20)	0.20 (3.32) *	-0.15 (-2.05) **	-0.55 (-6.53) *
Diagnostic test					
	F test	**LM value**	**(p Cum-sum)**	**Cu-sum sq**	**Adj r2**
China	3.12**	0.46	S	S	0.64
Germany	6.65*	0.93	S	S	0.98
Netherlands	4.30**	0.78	S	S	0.91
Spain	5.03**	0.45	S	S	0.93

Source: Authors' calculations based on the study data.

Note. *, **, and *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively, as reported; values in parentheses are reported test statistics.

The nonlinear export estimates in Table 7 indicate that the long-run associations differ across partners and between positive and negative volatility components. Positive volatility changes have a reported positive coefficient for China and Germany, while the corresponding coefficient for Spain is negative. In addition, the negative volatility component is reported as statistically significant for the Netherlands and Spain, although the interpretation of its sign depends on the partial-sum construction used. The real bilateral exchange rate coefficients also differ in sign across partner models. Therefore, these findings support a heterogeneous interpretation of Pakistan's export responses. However, coefficient differences alone do not establish formal asymmetry; that conclusion requires Wald restrictions or comparable tests on positive and negative effects.

Table 8: Long-Run Volatility Coefficient Estimates in the Non-Linear Import Demand Model

Long Run					
	Const	**GDP**	**BEX**	**PVBEX**	**NVBE**
China	12.46	0.29	-2.46	0.38	0.42
	(1.82) **	(0.55)	(-1.22)	(0.49)	(0.11)
Germany	-8.10	4.01	-5.05	0.017	-18.2
	(-0.61)	(3.25) *	(-1.75)	(0.83)	(-4.16) *
Netherlands		3.44	1.22	0.42	-1.80
		(1.87) ***	(1.18)	(1.29)	(-2.31) **
Spain	14.01	0.59	-0.03	0.06	-0.31
	(9.79) *	(2.67) *	(-2.36) **	(0.64)	(-1.84) ***
Diagnostic Test					
	F test	**LM**	**Cum-sum**	**Cum-sum sq**	**Adj r2**
China	4.35**	0.93	S	S	0.88
Germany	4.95*	0.80	S	S	0.91
Netherlands	5.13*	0.75	S	S	0.87
Spain	5.00*	0.20	S	S	0.92

Source: Authors' calculations based on the study data. Note. *, **, and *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively, as reported. Values in parentheses are reported test statistics. Estimation software: EViews 10.

Table 8 reports nonlinear long-run import relationships for China, Germany, the Netherlands, and Spain. The displayed coefficients on the negative volatility component are statistically significant for Germany, the Netherlands, and Spain, whereas the positive volatility terms are not identified as significant at the reported levels. In addition, the real bilateral exchange rate coefficient is negative for Germany and Spain, although statistical significance is specifically indicated for Spain in the displayed table. These differences warrant a cautious, partner-specific interpretation rather than a claim that exchange rate movements produce the same import response across countries. Related studies emphasize the relevance of asymmetric trade adjustment (Bahmani-Oskooee et al., 2020; Barguellil, 2021).

4.4 Comparative Interpretation and Robustness

Across the reported partner-specific tables, the direction and statistical significance of exchange rate volatility coefficients differ between China, Germany, the Netherlands, and Spain. For example, the linear long-run export specification reports a positive significant volatility coefficient for Germany and a negative significant coefficient for Spain. The corresponding linear import specification reports a positive significant estimate for China and a negative estimate for Spain at the indicated significance level. Furthermore, the nonlinear specifications show different coefficient patterns for positive and negative volatility components. These comparisons suggest that partner characteristics and the distinction between imports and exports matter for interpretation. However, the reported tables do not include formal tests that establish whether positive and negative coefficients are statistically different from one another. A replication or extension should therefore present short- and long-run Wald asymmetry tests, error-correction terms, dynamic multipliers, explicit lag-selection criteria, and sensitivity analysis for alternative volatility measures. Such additional results should only be introduced if they are actually estimated from the underlying data.

5 Conclusion

This study investigates the association between asymmetric exchange rate volatility and Pakistan's bilateral imports and exports over 1985–2020. Linear and nonlinear autoregressive distributed lag models are used to evaluate relationships involving economic activity, the real bilateral exchange rate, and bilateral exchange rate volatility. The partner-specific estimates presented in the results tables cover China, Germany, the Netherlands, and Spain. The analyses distinguish exports from imports, as well as symmetric and asymmetric specifications. Consequently, the findings should be interpreted as evidence from the reported bilateral models rather than as a single response applicable to every trading partner or to all sectors of Pakistan's economy.

In the linear export model, Table 6 reports a positive and statistically significant long-run volatility coefficient for Germany and a negative significant coefficient for Spain; the coefficients for China and the Netherlands are not reported as significant at the same conventional levels. Similarly, the nonlinear export estimates display differences between positive and negative volatility components across partners. These findings are consistent with heterogeneous trade responses to exchange rate uncertainty. However, the observed coefficient patterns should not be described as conclusive evidence of asymmetry without formal tests of equality between positive and negative effects.

5.1 Contributions, Limitations, and Implications

The study contributes to research on emerging-economy trade by highlighting that Pakistan's bilateral export and import relationships need not respond uniformly to exchange rate uncertainty. By estimating linear and nonlinear ARDL models, the analysis offers a structured comparison of symmetric specifications and models distinguishing positive and negative volatility movements. However, the reported results remain subject to limitations associated with annual observations, the construction of the standard-deviation volatility proxy, incomplete reporting of some econometric tests, and the restricted set of country estimates displayed in the tables. In addition, aggregate bilateral measures may conceal industry-level differences, contractual arrangements, and the availability of currency hedging instruments. Future research could expand the trading-partner coverage and investigate whether sectoral composition, structural breaks, or exchange rate regimes help explain differences in the estimated responses. These limitations should be recognized when applying the findings to trade policy or comparing them with results from other developing economies (Hall et al., 2010; Khan et al., 2014).

The linear ARDL import results in Table 8 indicate that the volatility coefficient is positive and statistically significant for China, negative and weakly significant for Spain, and not statistically significant for Germany or the Netherlands at the reported thresholds. Therefore, the displayed evidence does not justify a claim that exchange rate volatility positively affects imports for every partner. In addition, claims concerning Italy, the United Kingdom, the United States, and the United Arab Emirates cannot be evaluated from the country-specific tables presented in this manuscript and are not treated here as verified findings. A country-by-country interpretation is more consistent with the reported empirical results.

The nonlinear ARDL export model further indicates that responses to positive and negative volatility movements differ by partner. In the displayed long-run coefficients, positive volatility changes are positively associated with exports to China and Germany, while the coefficient for Spain is negative. The negative volatility component is reported as significant for the Netherlands and Spain, but its economic interpretation depends on the specific partial-sum definition. Economic activity is also positively associated with exports in several partner specifications, although the results are not uniform. Consequently, the findings call for careful differentiation between long-run and short-run claims and between statistically significant and nonsignificant coefficients. The available results strengthen the rationale for investigating asymmetric responses, but they do not establish effects for partners without corresponding displayed estimates.

The nonlinear import results likewise point to heterogeneity across the four partners reported in Table 12. The negative volatility component has statistically significant estimated coefficients for Germany, the Netherlands, and Spain, whereas the displayed positive-volatility coefficients are not significant at the indicated thresholds. In addition, the real bilateral exchange rate has a significant negative coefficient for Spain in the reported model. These findings imply that separate positive and negative exchange rate volatility measures may help describe bilateral import dynamics; however, a formal statistical test is required before confirming asymmetry. Future extensions should report the lag selection procedure, error-correction coefficients, Wald tests, dynamic multiplier paths, and robustness checks using alternative volatility measures, subject to data availability.

6 Recommendations

The findings have implications for international trade and exchange rate policy. However, the policy recommendations should be interpreted in relation to the partner-specific associations identified in the models and should not be taken as evidence that one exchange rate intervention will improve all bilateral trade flows. The following recommendations retain the study's focus on Pakistan and on managing exchange rate uncertainty:

- Pakistan and other developing economies should incorporate the potential effects of exchange rate uncertainty into international trade planning and exchange rate policy. In particular, monitoring bilateral currency developments may help identify trading relationships in which exports or imports are more sensitive to volatility. Such monitoring should be combined with consideration of economic activity, trade composition, and the broader macroeconomic environment.
- Pakistan should periodically review its trade and exchange rate policies with the objective of reducing avoidable uncertainty where feasible. However, the empirical results do not establish that eliminating exchange rate fluctuations would always raise trade. Therefore, policy formulation should consider the different responses of exporters and importers, as well as the feasibility and costs of monetary or foreign-exchange interventions.
- Pakistan may explore opportunities to diversify trading arrangements and improve access to appropriate currency-risk management instruments, particularly for firms exposed to substantial foreign-exchange uncertainty. In addition, trade settlement in mutually acceptable currencies could be evaluated where

commercially practical and consistent with financial regulations. Such arrangements should be assessed on their costs and benefits rather than presumed to eliminate exchange rate risk.

- Further research should extend the investigation of exchange rate volatility and trade flows in Pakistan using updated data, additional trading partners, and disaggregated product-level information. Moreover, future studies could test long-run and short-run asymmetry explicitly, estimate dynamic multiplier responses, and assess sensitivity to alternative volatility measures and structural changes in the exchange rate regime. The present study's annual data and the partner-specific tables limit the generalizability of its findings. Greater transparency regarding data construction and model estimation would also facilitate replication and comparison with other developing economies.

Ethical Statement: Not applicable.

References

Azid, T., Jamil, M., Kousar, A., & Kemal, M. A. (2005). Impact of exchange rate volatility on growth and economic performance: A case study of Pakistan, 1973–2003. *The Pakistan Development Review, 44*(4), 749–775. https://doi.org/10.30541/v44i4IIpp.749-775

Bahmani-Oskooee, M., Usman, A., & Ullah, S. (2020). Asymmetric impact of exchange rate volatility on commodity trade between Pakistan and China. *Global Business Review, 12*(2), 44–80. https://doi.org/10.1111/twec.13057

Barguellil, A. (2021). The asymmetric indirect impact of real exchange rate on economic growth through foreign trade: An asymmetric ARDL panel model. *Asian Economic and Financial Review, 11*(8), 658–671. https://doi.org/10.18488/journal.aefr.2021.118.658.671

Fidrmuc, J., & Horváth, R. (2008). Volatility of exchange rates in selected new EU members: Evidence from daily data. *Economic Systems, 32*(1), 103–118. https://doi.org/10.1016/j.ecosys.2007.09.004

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

Hodge, D. (2005). *The effect of exchange rate volatility on trade and employment: A brief review of the literature*. Human Sciences Research Council. http://hdl.handle.net/20.500.11910/6419

Hussain, S. B., Hussain, S., & Hussain, F. (2015). Exchange rate volatility during different exchange rate regimes and its relationship with export of Pakistan. *The Journal of Governance and Public Policy, 7*(11), 255–260.

Ikechi, K. S., & Nwadiubu, A. (2020). Exchange rate volatility and international trade in Nigeria. *International Journal of Management Science and Business Administration, 6*(5), 56–72. https://doi.org/10.18775/ijmsba.1849-5664-5419.2014.65.1007

Khan, A. J., & Azim, P. (2011). *Exchange rate volatility in developing countries: Implications for trade and capital flows in Pakistan* [Doctoral dissertation, GC University Lahore].

Khan, A. J., Azim, P., & Syed, S. H. (2014). The impact of exchange rate volatility on trade: A panel on Pakistan's trading partners. *The Lahore Journal of Economics, 19*(1), 31–66. https://doi.org/10.35536/lje.2014.v19.i1.a2

Nicita, A. (2013). Exchange rates, international trade and trade policies. *International Economics, 135*, 47–61. https://doi.org/10.1016/j.inteco.2013.10.003

Satawatananon, K. (2014). *The effects of exchange rate volatility on commodity trade flows between the US and Thailand* [Doctoral dissertation, University of Wisconsin–Milwaukee].

Shaikh, S. A., & Hongbing, O. (2015). Exchange rate volatility and trade flows: Evidence from China, Pakistan and India. *International Journal of Economics and Finance, 7*(11), 121–127. https://doi.org/10.5539/ijef.v7n11p121

Siddiqi, A. H. (2006). *Finance of foreign trade and foreign exchange* (4th ed.). Royal Book Company.

Wiseman, T., Luckstead, J., & Durand-Morat, A. (2021). Asymmetric exchange rate pass-through in Southeast Asian rice trade. *Journal of Agricultural and Applied Economics, 53*(3), 341–374. https://doi.org/10.1017/aae.2021.7