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Impact of Exchange Rate Volatility on Trade Balance: Evidence from Pakistan and its Major Trading Partners

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Abstract: *The present research study examines the response of exchange rate changes on the trade balance of Pakistan, in its major trading partners e-i., United States, China, United Kingdom, Saudi Arabia, Japan, Germany, Malaysia, and Singapore. Data has been taken from the World Development Indicator and the International Trade Centre for the time 2003 to 2021. To estimate the data, we applied the Panel Autoregressive Distributed Lags model. The findings of the study show that in the short run, the Exchange rate, and Consumer Price Index don't seem to have a significant impact on the Trade Balance, while the GDP demonstrates a statistically significant and positive impact on the Trade Balance. However, we are more interested in the long-run results showing that exchange rate volatility has significant negative impacts on the trade balance of Pakistan when they are involved in the trade. Additionally, the long-term trade balance dynamics were influenced by the positive effects of GDP and the negative impact of inflation.*

Keywords: Exchange rate, GDP, PARDL, Trade balance, Consumer Price Index.

Introduction

Exchange rate fluctuation has consistently been recognized as a risk source in numerous studies. Previous research has shown that increased volatility undampened rates raise costs for risk-averse traders and dampen international trade. This outcome primarily arises from the fact that trade agreements establish exchange rates at the contract's inception, while actual payment takes place in the future (Kayani et al., 2023). After fixed exchange rates were abandoned in March 1973, foreign exchange rates became much more unpredictable in both developed and developing countries. This change happened because the U.S. dollar's value was lowered in February 1973. Arize, Malindretos, and Kasibhatla (2003) suggested that having flexible exchange rates could make economies more stable. However, flexible exchange rates also have downsides, like making the value of money go up and down a lot. This unpredictability can make it hard for businesses that trade internationally to know how much they'll spend or earn in the future. This uncertainty might even discourage trade activities.

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Ahmad et al. (2023) investigated the response of the exchange rate between Pakistan and Japan and found the behavior of the exchange rate is asymmetric. Currency appreciation and depreciation affect the trade balance differently. The trade balance reflects a country's economic strength, with a smaller deficit indicating resilience, while larger deficits suggest vulnerability. Developing nations often have trade deficits in their early stages. Pakistan has faced deficits since 1947, except for three years: 1947-48, 1950-51, and 1971-72, due to exports and currency devaluation. With 70.5% of agricultural exports, Pakistan should diversify to industrial products for a balanced trade, as advised by the State Bank and others. It has been observed that fluctuations in the real exchange impact investment choices. Countries that adopt flexible exchange rates are particularly vulnerable to higher instability associated with this rate. Therefore, addressing this becomes crucial, especially for such countries, to decrease the negative consequences on export demand. Kayani et al. (2023) investigate the impact of asymmetric exchange rate volatility on trade flow in the case of developed and developing economies. They found that the behavior of the exchange rate is asymmetric.

Bahmani-Oskooee and Aftab (2017) examined the pivotal role of the exchange rate in trade and investigated its broader macroeconomic importance. Changes in exchange rates, which happen when a country's currency becomes less valuable (devaluation) or loses value (depreciation), can cause instability. These ups and downs affect trade between countries in different ways. To begin, increased volatility in exchange rates can cause investors to be more cautious about investing, which can result in reduced exports due to lower production levels. Additionally, risk-averse investors might choose to invest in foreign currencies, making those currencies stronger. This, in turn, introduces price uncertainty that can hurt exports. Moreover, uncertainty in domestic prices might lead local producers to switch from using materials produced domestically to using imported materials, further influencing trade. In summary, fluctuations in exchange rates can disrupt investor behavior, impact the strength of currencies, and affect decisions about domestic production. Consequently, the uncertainty of the exchange rate exerts equally beneficial and adverse effects on trade movements. Macroeconomic theory assesses the impact of Exchange rate volatility on overall economic activity through two main pathways. Firstly, it investigates the reaction of the domestic economy to real shocks originating domestically and abroad, considering different exchange rate systems. Secondly, it delves into the consequences of the volatility of exchange rates on global trade, with particular emphasis on the export and import domains within economies embracing flexible exchange rate arrangements. Even with previous research efforts, the results concerning the effect of exchange rate volatility on the balance of trade have produced a mixture of conclusions, highlighting the complexity of this connection. Bahmani-Oskooee and Aftab (2017) studied the uneven impacts of exchange rates on trade trends. Their findings indicated that exchange rate volatility can lead to both an increase and a decrease the trade activities. Additional research has revealed that the volatility of exchange rates hurts trade balances. In general, fluctuations in exchange rates can trigger substantial shifts in a country's trade balance, leading to outcomes that can be either beneficial or harmful. The issue of varying exchange rates has garnered significant attention in the context of worldwide trade. This is due to their significant potential to influence the trade balance. Understanding how

these fluctuations affect international trade is a crucial factor in forming exchange rate strategies and choosing the appropriate exchange rate framework.

The main objectives of the study are (i) To investigate the impact of exchange rate volatility on the trade balance of Pakistan and its major trading partners by using Panel Autoregressive Distributed Lag (PARDL). (ii) To give some policy suggestions for investors to make better decisions about international trade by understanding the influence of volatility of exchange rates on the balance of trade.

Literature Review

In 1973, many countries began transitioning to adopting floating exchange rates. This led them to assess the effects of frequent exchange rate fluctuations on the trade flows of the different economies. As a result, policymakers began examining these dynamics on a broader scale. Various research studies have been done to investigate the connection between exchange rate volatility and different macroeconomic aspects, such as trade balance and manufacturing output. The following selected studies depict the relationship between exchange rate fluctuation and trade balance.

Various research studies, including works by Coes (1981); Breusch and Pagan (1980) have provided empirical evidence and reached a consensus that fluctuations in exchange rates hinder the growth of international trade. Kenen and Rodrik (1986) conducted a study examining the effects of temporary changes in the real exchange rates of eleven industrialized nations on global trade. Their findings indicated that such exchange rate fluctuations decrease trade volume. Excessive variability in real exchange rates also negatively impacts overall well-being, as it reduces international trade levels and influences investment decisions, as highlighted by Edwards (1986). Arize et al. (2003) examined the effects of uncertainty in exchange rates on the actual exports of the United States. This research employed a tailored error correction method and integrated an ARCH model to assess volatility. The results of this investigation highlighted a significant and negative influence of uncertainty on the physical exports of the United States.

Arize et al. (2003) conducted a study to understand how changes in exchange rates affect the export activities of ten developing countries. The results of the study were in line with what was expected from economic theories – they found strong evidence suggesting that when exchange rates experienced higher levels of fluctuation, it had a significant negative impact on the ability of these countries to export their goods effectively. Shah and Majeed (2014) analyzed the persistent and immediate relationships among trade balance, income, money supply, and the real effective exchange rate within Pakistan's time frame spanning from 1980 to 2011. The findings of their study illustrated that an increase in income levels and a devaluation of the real effective exchange rate exhibited negative associations with the trade balance, both in the short and long run. Byrne, Darby, and MacDonald (2008) investigated the impact of exchange rate volatility on bilateral trade interactions, involving the United States and various countries, covering both export and import operations. Distinguishing itself from earlier studies that utilized aggregated data, this research adopts sectoral data, enabling a more detailed analysis. The central finding

of this study emphasizes that exchange rate volatility has a robust and significantly unfavorable influence on trade across multiple sectors. This impact is notably pronounced in the context of exports of distinctive goods, underscoring that industries engaged in producing unique products are particularly sensitive to fluctuations in exchange rates.

Giovannini (1988)made substantial contributions by offering empirical evidence that suggested trade could indeed benefit from exchange rate volatility. Dhasmana (2012) explored the relationship between India's real exchange rate and its trade balance with major trading partners. The results of this research unveiled a positive correlation between real exchange rate depreciation and trade balance, observed over an extended duration. Similarly, the study conducted by Serenis and Tsounis (2014) focused on assessing the influence of exchange rate volatility on the combined exports of two smaller nations, specifically Croatia and Cyprus. This examination spanned from the initial quarter of 1990 to the first quarter of 2012 and employed the auto-regressive distributed lag (ARDL) methodology. The conclusions drawn from their research highlighted a positive impact of volatility on the export performance of both Croatia and Cyprus.

Dhasmana (2012) explored the enduring and immediate correlations between the actual exchange rate and the trade balance. This examination spanned from the initial quarter of 1975 to the first quarter of 2011, utilizing quarterly data sourced from fifteen major trading partners. Through the utilization of econometric models, including the mean group approach pioneered by Pesaran and Smith (1995), the study aimed to deduce the long-term elasticities of income and the real exchange rate. Furthermore, panel cointegration methodologies were employed to establish a sustained relationship between the exchange rate and the trade balance. The research findings illustrated that the depreciation of the real exchange rate displayed a positive association with the trade balance over an extended timeframe. At the same time, real exchange rate volatility exhibited an inverse correlation with India's trade balance in the long run. In a parallel vein, Yildirim and Saraç (2022) delved into the relationship between the actual exchange rate and the bilateral trade balance of Turkey with its significant trade partner, Germany. The analysis covered the period from the first quarter of 2002 to the second quarter of 2020, with the primary objective of confirming the j-curve phenomenon. The findings of their study highlighted those fluctuations in the actual exchange rate had a favorable impact on the bilateral trade balance, particularly during periods of economic expansion. Hwang and Lee (2005) investigated the impact of exchange rate volatility on trade flows within the United Kingdom from 1990 to 2000. While the prevailing assumption suggests that exchange rate volatility limits trade volumes, this research presents an intriguing contradiction. It reveals a positive correlation between exchange rate volatility and imports in the United Kingdom over the course of the 1990s. Employing the bivariate GARCH-in-mean statistical model, the researchers unveiled this unexpected outcome, potentially indicating an alternative perspective that challenges conventional wisdom: exchange rate volatility might not always hinder trade movements. Grossmann, Love, and Orlov (2014) examined exchange rate volatility, The paper employs data from 29 economies and employs the statistical PVAR method. High-frequency components of volatility are analyzed, revealing intriguing connections between economic and financial factors with volatility. Notably, the response of variables to overall and high-frequency volatility is similar. How-

ever, the consequence of volatility of exchange is more pronounced in developing countries compared to developed ones, and these findings remain consistent across various tests.

Several studies have explored how exchange rate changes affect trade in different ways. However, Lotfalipour and Bazargan (2014) discovered that alterations in exchange rates can yield both favorable and unfavorable consequences for trade. Other studies focused on specific situations in different countries. Grossmann et al. (2014) looked at Iran and found that the type of exchange rate they used didn't have much effect on their trade balance. Meanwhile, Serenis and Tsounis (2014) examined the influence of exchange rate fluctuations on the trade balance between the United States and Malaysia, the study revealed that the impact was relatively modest. Ozturk (2006) conducted an extensive review of various studies and observed that the outcomes concerning the effects of exchange rate changes on trade exhibited a mixture of results. Sometimes it depends on when the study was done, what models they used, and if the countries were rich or not. This is different from what many people think, which is that higher exchange rate changes make it harder for countries to trade. Asteriou, Masatci, and Pılbeam (2016) looked at how exchange rate changes affect trade in Mexico, Indonesia, Nigeria, and Turkey. They saw that sometimes exchange rate changes affect trade differently, depending on whether a country's money becomes worth less or more. Poon and Hooy (2013) looked at how exchange rate changes affect trade in a group of countries. They found that in general, big changes in exchange rates can make trade harder, but in some cases, it can help. These studies together show that exchange rates can have various effects on trade, and it's not always the same for every situation.

Data and Methodology

A panel dataset spanning from 2003 to 2021 was gathered to analyze how exchange rate volatility impacts the trade balance of Pakistan and its major trading partners. Major trade allies encompass China, the United States, Saudi Arabia, Germany, the United Kingdom, Japan, Malaysia, and Singapore. We took three independent variables that play vital roles in the effect of trade balance. The three variables under consideration include volatility of exchange rate, Gross Domestic Product, and Inflation. Alongside the dependent variable is the trade balance. The study utilized the Panel Autoregressive Distributed Lag (Panel ARDL) method to investigate how exchange rate volatility influences the trade balance.

Data

Data on trade balance is taken from the International Trade Center (ITC). Data of the remaining variables, which are exchange rate volatility measures of currency fluctuations' impact on trade, is computed using the GARCH model. To quantify exchange rate volatility, an econometric technique called Generalized Autoregressive Conditional Heteroskedasticity (GARCH) is employed. The choice of the GARCH model for volatility measurement in this study is justified by several factors. Firstly, the GARCH model is

widely recognized and extensively used in financial econometrics for modeling and forecasting volatility. The GARCH model incorporates the auto-regressive and moving average components, allowing it to capture both the short-term and long-term dynamics of volatility. Secondly, the GARCH model is particularly suitable for capturing the asymmetric effects of volatility. It considers the phenomenon of volatility clustering, where periods of high volatility tend to be followed by more periods of high volatility, while periods of low volatility tend to be followed by more periods of low volatility. This asymmetric behavior is often observed in financial markets and is highly relevant when studying the impact of exchange rate volatility on trade flows.

Gross Domestic Product (GDP) at constant 2010 US dollars is extracted from the World Development Indicator (WDI), and inflation data is likewise found from the same World Development Indicator dataset. The names of major trading partners are presented in Table 1.

Table 1
List of major trading partners

Country	Code
China	CHN
US	USA
Saudi Arabia	SAU
United kingdom	GBR
Germany	DEU
JAPAN	JPN
Malaysia	MYS
Singapore	SGP

Table 1 displays the list of Pakistan's major trading partners, along with their corresponding country codes as designated by WDI.

Variables

The principal aim of this study is to investigate the effect of exchange rate volatility on trade balance. In the existing study trade balance is our dependent variable while other independent variables are Gross Domestic Product, inflation, and exchange rate volatility. Volatility is generally measured through GARCH and standard deviation. We measured through the GARCH model.

Table 2
Variable, Units and Source

Variable	Description	Unit	Source
TB	Trade Balance	Ratio	International Trade Center
ERV	EXCHANGE rate volatility	Rate	World Development Indicator (WDI)
INF	Inflation	Rate	World Development Indicator (WDI)
GDP	Gross Domestic Product	constant 2010 US$	World Development Indicator (WDI)

Model Specification

The model specification for analyzing the trade balance as the dependent variable entails a thorough examination of the impact of three distinct independent variables: exchange rate

volatility, Gross Domestic Product (GDP), and inflation. These variables assume crucial roles in shaping a nation's trade dynamics. Exchange rate volatility portrays the currency instability of a country, which in turn influences both its exports and imports. GDP functions as a metric of a nation's economic activity and production capacity, thereby exerting an influence on its trade performance. Conversely, inflation affects the competitiveness of a country's goods on the global market, consequently influencing the trade balance. By incorporating these variables, a comprehensive analysis can be undertaken to elucidate the factors influencing a nation's trade balance. Numerous studies have employed this model to evaluate these approaches. Nkoro, Uko, et al. (2016) adopted this model to ascertain empirical evidence.

$$TB = F(ERV, LGDP, INF)$$

$$TB_{it} = \alpha_0 + \alpha_1 ERV_{it} + \alpha_2 LGDP_{it} + \alpha_3 INF_{it} + V_{it}$$

TB= Trade balance, ERV= exchange rate volatility, LGDP= Gross Product Domestic, INF= inflation

TB is the ratio of export and import of both goods and services. ERV, LGDP, and INF are independent variables. Hence, the balance of trade can be expressed as a function of exchange rate volatility, Gross Domestic Product, and inflation. The intercept term is denoted as α_0, while α_1, α_2, and α_3 represent the slope coefficients, and Vt corresponds to the residual term.

Econometric Methods

Cross-Sectional Dependence

Consider the standard panel-data model.

$$y_{it} = \alpha_i + \beta' x_{it} + u_{it}, i = 1, ...N and t = 1, ...T \tag{1}$$

Within this context, β denotes a parameter vector to be estimated, with dimensions K * 1, while β represents distinct disturbance parameters that remain consistent over time. The array of predictors, sized K * 1, is denoted as X_{it}. Under the consideration of the null hypothesis, μ_{it} is assumed to demonstrate independent and identically distributed (IID) characteristics across various periods and cross-sectional units. Nevertheless, within the H0 hypothesis, there exists the potential for μ_{it} to exhibit interconnections among cross-sectional units, while the fundamental assumption of no serial correlation remains intact. As such, the focus of inquiry centers on the following hypothesis:

$$H_0 : \rho_{ij} = \rho_{ji} = Cor(u_{it}, u_{jt}) = 0 \; for \; i \neq j \tag{2}$$

versus

$$H_1 : \rho_{ij} = \rho_{ji} \neq 0 \; for \; some \; i \neq j \tag{3}$$

where ρ_{ji} is the disturbance of the product-moment correlation constant and assumed to be

$$\rho_{ij} = \rho_{ji} = \frac{\sum_{t=1}^{T} u_{it} u_{jt}}{(\sum_{t=1}^{T} u_{it}^2)^{1/2} (\sum_{t=1}^{T} u_{jt}^2)^{1/2}} \tag{4}$$

The number of potential pairings (u_{it}, u_{jt}) grows with N.

Persan's CD Test

Breusch and Pagan (1980) presented LM statistic within the framework of apparently distinct regression estimate. This statistic holds its validity when N is fixed as T approaches infinity, and it is denoted as:

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \tag{5}$$

The pairwise correlation of residuals for estimating samples is indicated as (=ij).

$$\hat{\rho_{ij}} = \hat{\rho_{ij}} = \frac{\sum_{t=1}^{T} \hat{u_{it}} \hat{u_{jt}}}{\sqrt{(\sum_{t=1}^{T} \hat{u_{it}^2})} \sqrt{(\sum_{t=1}^{T} \hat{u_{jt}^2})}} \tag{6}$$

Where $\hat{u_{it}}$ represent the estimation of Uit in Equation (6). When considering the null hypothesis, LM follows an asymptotic distribution resembling a chi-squared distribution with degrees of freedom equal to N (N-1)/2. An alternative test introduced by Pesaran is as follows.

$$CD = \sqrt{\frac{2T}{N(N-1)}} (\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho_{ij}}) \tag{7}$$

Denotes the absence of cross-sectional dependence as CD approaches the range of (0,1) when considering a substantial number of cross-sectional units (N) and adequately extensive time periods (T) under the null hypothesis. In various panel-data models, encompassing both homogeneous and heterogeneous dynamic models as well as nonstationary models, the CD statistic maintains a precise mean of zero for specific T and N values. This stands in contrast to the LM statistic, where estimators for both homogeneous and heterogeneous dynamic models exhibit bias compared to classical fixed effect and random effect models. However, the validity of the cross-sectional dependence test remains intact. Even in scenarios where parameter estimates show minimal sample bias, the residuals of fixed effect/random effect models consistently exhibit an exact mean of zero for a constant T, under the assumption that the disturbances follow a symmetric distribution.

In the case of panels with imbalances, Pesaran suggests a slightly altered form of Equation (7), which can be represented as follows:

$$CD = \sqrt{\frac{2}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\sqrt{T_{ij}}\hat{\rho_{ij}}\right) \tag{8}$$

where $T_{ij} = \#(T_i \cap T_j)$ (i.e., the number of time-series observations that are similar across units i and j)

$$\hat{\rho_{ij}} = \hat{\rho_{ij}} = \frac{\sum_t \in T_i \cap T_j(\hat{u_{it}} - \overline{\hat{u_{it}}})(\hat{u_{jt}} - \overline{\hat{u_{jt}}})}{\left\{\sum_t \in T_i \cap T_j(\hat{u_{it}} - \overline{\hat{u_{it}}})^2\right\}^{1/2}\left\{\sum_t \in T_i \cap T_j(\hat{u_{it}} - \overline{\hat{u_{it}}})^2\right\}^{1/2}} \tag{9}$$

and

$$\overline{\hat{u_i}} = \frac{\sum_t \in T_i \cap T_j\hat{u_{it}}}{\#(T_i \cap T_j)} \tag{10}$$

The adjusted statistic considers the circumstance that subsets of errors related to (t) might not consistently demonstrate an average value of zero.

Panel Unit Root Test (The Im, Pesaran, and Shin (IPS))

Given the significant possibility of cross-sectional interdependence within the dataset, it is recommended to undertake a panel unit root test that addresses this specific challenge in the methodology. The equation representing the CIPS test is provided as follows:

$$\Delta y_{it} = \alpha_i + \rho_i y_{it-1} + \beta_i\overline{y_{t-1}} + \sum_{j=0}^{k}\Upsilon_{ij}\Delta\overline{y_{t-1}} + \sum_{j=0}^{k}\delta_{ij}y_{it-1} + \epsilon_{it} \tag{11}$$

Whereas α_i denotes the deterministic term, k represents the lag order, and t denotes the cross-sectional averages.

$$\hat{CIPS} = N^{-1}\sum_{i=1}^{N}CDF_i \tag{12}$$

On the other hand, CDF represents the Cross-sectional Augmented Dickey-Fuller (CADF).

Kao Test for Co-Integration

The research employed a co-integration test to establish the persistent relationship between financial development and the explanatory variables. Specifically, Kao's co-integration test for panel data was utilized, acknowledged as a residual-based approach to assess the co-integration among the variables. The Kao test's general form is as follows:

$$Y_{it} = \alpha_i + \beta X_{it} + \hat{\mu i} \tag{13}$$

In the preceding text, the provided equation pertains to Kao's model, with I term representing countries and t denoting years. Within these equations, Y_{it} signifies the dependent variable, which, in our study, corresponds to sustainable development. The term stands for the intercept specific to each equation, and its distinctiveness across cross-sections is upheld. The coefficient β pertains to the explanatory variables and maintains uniformity across cross-sections. The vector of independent variables for the study is represented as X_{it}. The term $\hat{\mu}i$ signifies the residual white noise component. With reference to this equation, a residual-based Co-integration test can be conducted.

$$\hat{\mu i}t = e\hat{\mu i}t + v_{it} - 1 \tag{14}$$

This represents the supplementary regression within Kao's test, where $\hat{\mu i}t$ denotes the estimated residual derived from the initial equation of the test. Within the framework of Kao's test, the null hypothesis postulates the lack of co-integration among the variables, whereas the alternative hypothesis proposes the existence of such a connection. In the framework of Kao's co-integration test, a prerequisite is that the variables must demonstrate the same order of integration, implying they should be either I(0) or I(1).

Panel Auto Regressive Distributed Lag Model

The initial formulation of the ARDL model was presented. This investigation explored the enduring connection between income inequality and various explanatory variables such as financial development, openness, inflation, population growth, state final consumption, and expenditure.

In the framework of this present study, we construct the Panel Autoregressive Distributed Lag (PARDL) model. We use the following method to convert the simple model into the PARDL model framework. The panel ARDL is defined as:

Results and Discussion

Table 3
Descriptive Analysis

Variables	Mean	Med.	Max.	Min.	SD	Skew	Kurt.	JQ
TRADE	0.778	0.228	3.492	0.074	0.914	1.080	2.853	11.134
LNGDP	54.033	53.293	57.208	51.567	1.631	0.464	2.056	4.160
ER	0.014	0.004	0.069	0.000	0.019	1.780	5.170	41.284
CPI	2.478	2.236	9.870	-2.093	1.924	0.884	5.766	25.59

Table 3 provides a descriptive examination of the variables under consideration. This analysis encompasses metrics such as the mean, median, maximum value, minimum value, skewness, standard deviation, kurtosis, and Jarque-Bera statistics. This is based on panel data from Pakistan and its main trading partner over an 18-year period, from 2003 to 2021. At a level of 5%, we can reject the H_0 (null hypothesis) that there is no cross-sectional dependence. As a result, we determine that all variables are cross sectional

dependent. The variables were all found to be positively skewed. The kurtosis statistic for ER and CPI indicates that they are lepto-kurtic (high peak or long tail) because their values are more than 3, whereas TRADE and Ln (GDP) are platy-kurtic (thin-tailed). Except for Ln (GDP), the JQ (Jarque bera) p-value is more than 10%. As a result, we accept the null hypothesis of regularly distributed data.

Table 4
Pesaran CD test (2004)

Variables	Statistics	P-value
TRADE	5.375	0.000
CPI	22.02	0.000
LN_GDP_	-2.047	0.040
ER	-1.4571	0.005

According to the available panel data literature, models of panel data are quite likely CSD on the error term (Baltagi & Baltagi, 2008). As a result, we determine that all variables are cross sectional dependent.

Table 5
Unit Root Test (IPS)

Variables	Integration Order	Test-statistic
TRADE	I(1)	-2.204
CPI	I(0)	-6.747
LN_GDP_	I(1)	-6.294
ER	I(1)	-3.050

To analyze integration sequence of various variables, CIPS test is used stated in Table. Table 4 shows that some variables i.e., Trade Balance and CPI are integrated in order 0, whereas ER and Ln(GDP) are integrated in order 1. As a result, the panel autoregressive distributive lag (PARDL) approach is chosen.

Table 6
Heterogeneity Slope Test

Model	Delta	Adjusted Delta
Model 1	-1.951	-3.186
p-value	0.051	0.001

Slope heterogeneity test proposed by Pesaran and Yamagata (2008), which becomes common method in panel data analysis, particularly in productivity and convergence research. The value of delta and adjusted delta shows greater slope heterogeneity which means that the relationship between the dependent (e.g., Trade Balance) and independent variables (ER, GDP and CPI) may differ between individual units in the panel.

The Kao test for co-integration is a statistical test for determining the existence of co-integration between two or more variables (Kao, 1999). In Table 7, the p-value indicates that variables have a long run equilibrium relationship and move together in the long run, which is an alternative hypothesis, can be accepted.

Table 7
Kao Test for Co-integration

Kernel	**Barlett**	
Lags	2.00 (Newey-West)	
Augmented lags	1	
	Stats.	**P-value**
Modified Dickey Fuller t	-2.138	0.016
Dickey Fuller t	-7.319	0.000
Augmented Dickey Fuller t	-8.306	0.000
Unadjusted modified Dickey Fuller t	-5.412	0.000
Unadjusted Dickey Fuller t	-8.795	0.000

Table 8
Results of the PARDL model

Long Run Equation				
Variable	**Coef.**	**Standard Error**	**T-stats**	**Prob**
LN_GDP_	0.088	0.004	9.62651	0.000
ER	-4.331	0.541	6.541	0.000
CPI	-0.008	0.002	-2.576	0.014
Short Run Equation				
Variable	**Coef.**	**Standard Error**	**T-stats**	**Prob**
COINTEQ01	-0.81	0.242	-3.346	0.001
D(TRADE(-1))	0.326	0.252	1.290	0.205
D(LN_GDP_)	0.283	0.284	0.992	0.007
D(ER)	-1.046	3.607	-0.289	0.773
D(CPI)	0.004	0.010	0.381	0.705
C	4.087	0.952	4.292	0.000

The above tables show the long and short run estimates of panel autoregressive distributed lag model which shows the association among the Trade Balance and other macroeconomic variables. ECM, which has a significant and negative effect, demonstrates that the system is converted into the long run. Ln(GDP) positive correlation with Trade Balance with a coefficient of 0.283 but statistically significant and ER has a negative but insignificant association with Trade Balance between Pakistan and its trading partners. In the short run, Ln (GDP) positively and significantly affects Trade Balance. It shows that in the short run a one-unit increment in the Ln (GDP) tends to increase the current Trade Balance by 0.28%. In the short run the coefficient of CPI is 0.004 but has statistically insignificant impact on Trade Balance. This study is not interested in the short-run results our focus is on the long-run, how Exchange rate influences the Trade Balance in Pakistan and its major trading partner. In the long run, all variables have statistically significant and positive impact on balance of trade except CPI which has negative impact. The outcome of this study is consistent with that of De Gregorio (1993)'s work. The long-run results show that Exchange rate volatility has statistically significant and negative impact on the trade balance of Pakistan and its trading partners. It means that exchange rate volatility has decrease the trade balance of Pakistan when they are involved in the trade with major partners. If a 1% increase in the exchange rate volatility leads to a decrease in the trade balance by 4.33%. The result consistent with Shaikh and Hongbing (2015). The Ln(GDP) is positively associated with balance of trade. One unit increase in GDP leads to

an increase in the trade balance by 0.08%. The outcomes of the study are consistent with those of Romer (1993). Likewise, CPI has a positive correlation with Trade Balance with a coefficient of -0.008.

Conclusion and Policy Suggestions

The current study examined the impact of exchange rate volatility on Pakistan's trade balance in conjunction with its major trade partners, including the United States, China, Germany, Japan, Saudi Arabia, the United Kingdom, Singapore, and Malaysia. Employing a panel data methodology covering the period from 2003 to 2021, the research employed the Pesaran CD test (2004) to address Cross-Sectional Dependence. It incorporated the Kao co-integration method within the panel autoregressive distributed lag (PARDL) model to investigate the enduring equilibrium relationship among trade balances, exchange rate volatility, Gross Domestic Product (GDP), and inflation. These variables were identified as significant determinants of Pakistan's trade balance. The dependent variable in the study was the trade balance (TB), while the independent variables included exchange rate volatility, LGDP (Log of Gross Domestic Product), and inflation. In long run, the findings revealed that the coefficient of exchange rate volatility has negative impact on the Pakistan's trade balance over an extended timeframe. This implies that currency devaluation or depreciation negatively contributes to the trade balance. Specifically, a one-unit increase in exchange rate volatility was associated with a notable 4.33% decline in trade balance. Moreover, the results highlighted that both Ln(GDP) and inflation exerted considerable influence on the dynamics of Pakistan's trade balance in the long run, where Ln(GDP) has positive while Inflation has negative impact on trade balance of Pakistan. The center of this study explores the long-run relationship, Ruther than short-run relationship. In the short term, the outcomes indicated that Ln(GDP) significantly impacted the trade balance. On the other hand, in short run, CPI exhibited a positive and insignificant relationship with trade balance, whereas Ln(GDP) exhibited a significant positive association of 0.283 with Trade Balance, while exchange rate volatility has a negative and insignificant association with trade balance.

On the bases of our findings, we suggested some policies recommendations to Pakistan's policymakers to consider. These include diversifying export markets, fostering export-oriented industries, managing exchange rate exposure through hedging strategies, enhancing trade agreements, boosting foreign direct investment (FDI) to diversify exports, and concentrating on strengthening macroeconomic fundamentals through prudent fiscal and monetary policies. Govt need to give targeted subsidies to the investors to boost their productivity. Finally, Pakistan should focus on enhancing its macroeconomic fundamentals, especially fiscal and monetary policy, to assist lessens the impact of exchange rate volatility on its economy. This can aid in the stabilization of the currency and the improvement of the overall economic climate for businesses and investors.

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