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Assessing the Dynamic Effects of Oscillations in the Exchange Rate on Commodity-Wise; Trade Flows between Pakistan and Saudi Arabia: Evidence from ARDL Approach

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ABSTRACT

A plethora of literature on the nexus between exchange rate volatility and trade is available in the context of Pakistan; however, the majority of studies suffer from the exigency of aggregation bias because of using aggregated level data. To tackle the issue of aggregation bias, the current research deploys disaggregated level (commodity-wise) data to explore the effects of oscillations in the exchange rate on bilateral trade between Pakistan and its major trading partner Saudi Arabia. Employing the annual data from 1981 to 2018, ARDL bound testing approach confirms the long-run association among the modeled variables. The application of the ARDL approach reveals the following results. First, exchange rate volatility exhibits dynamic effects on 72% of total exporting industries in the short-run, while this impact reduces to 51% of exporting industries in the long-run. Second, 56% of total importing industries demonstrate a significant response to the volatility in the short-run, while these effects expand to 73% of importing industries in the long-run. Third, the current study's unique finding is that three big industries of exports function coded as 42, 66, and 75 with a share of 35%, 7% & 6%, respectively, enjoying the positive effects of the volatility in the long-run. Also, the current work suggests some appropriate policy recommendations.

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1. Introduction

The balance of payment problem cripples the economic achievement of most of the developing countries. While the imbalance in the current account is the major contributing factor in the crisis of balance of payment. The authorities in developing countries can handle this problematic situation by adopting different policies i.e. to promote exports and to restrict imports (Arif and Chishti, 2020). However, there is another policy that is being used by the authorities of developing countries to counter the problem of deficit in the current account and that is a devaluation of domestic currency (Chishti et al., 2020). The devaluation of domestic currency is supposed to increase the exports of that country because the demand for domestic goods increases as domestic goods become cheaper due to the devaluation. At the same time, devaluation is also supposed to make the prices of imports high and may result in a decline in imports. In both ways, devaluation is assumed to affect the trade balance of a country (Ho Don and Cheng Lang, 2012).

As we know, the exchange rate is the cornerstone of trade as well as an essential variable of macroeconomics. The devaluation is not only the reason to volatile the exchange rate but the depreciation is also. The variance and volatility in the exchange rate create instability in the exchange rate. Hence, some channels explain how the exchange rate volatility affects the trade flows positively as well as negatively Firstly, the investors avoid investing and this thing reduces the exports due to a decrease in the production. Secondly, the risk-averse investors prefer to invest in foreign currency ($) and this activity makes foreign currency stronger, and as a result price uncertainty comes that decreases the exports. Thirdly, due to the uncertainty in domestic prices, domestic producer replaces inputs produced domestically with inputs that are imported (Bahmani- Oskooee, 2007; Kemal, 2005).

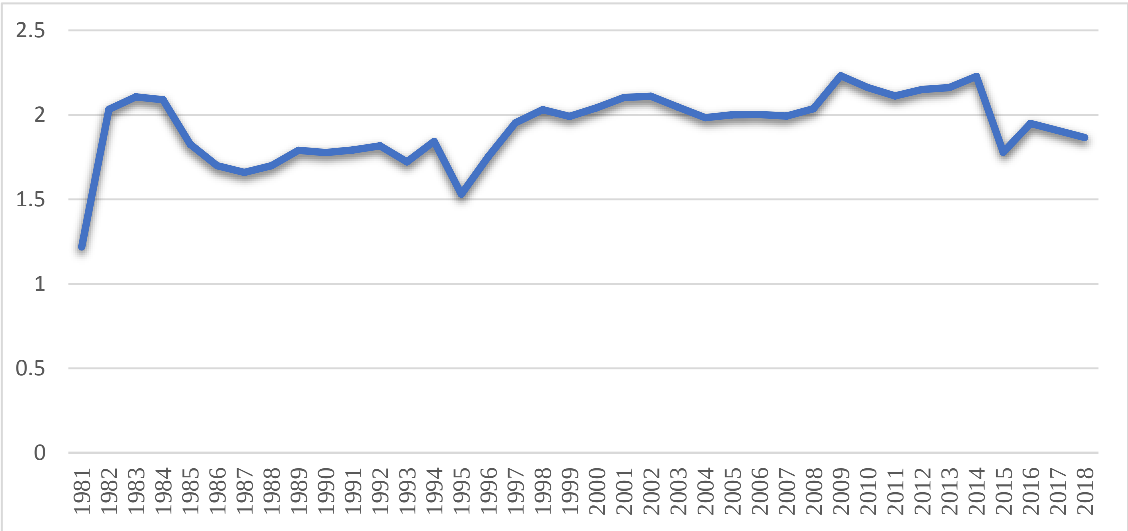

Figure 1. Nominal Rupee-Dollar Rate, Nominal Bilateral Exchange Rate Volatility
Source: Research findings.

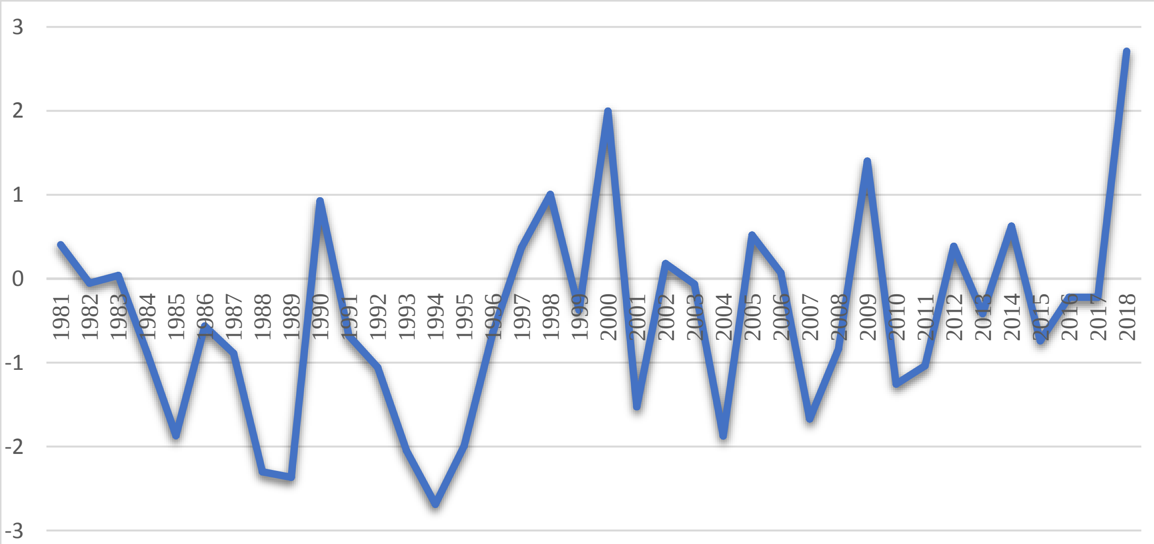

Figure 2. Nominal Rupee-Dollar Rate, Real Bilateral Exchange Rate Volatility
Source: Research findings.

On the other hand, exchange rate volatility can also affect positively increasing exports. Unlikely risk-averse investors and traders, risk lover investors and traders invest during volatility in the exchange rate and maximize their profits due to the high-risk premium. This activity increases exports (Kemal, 2005). Hence, the uncertain exchange rate has positive as well as negative impacts on trade flows.

This study focuses on the commodity trade between Pakistan and its 4th major trading partner, i.e., Saudi Arabia bilateral trade. Out of Pakistan's total trade, it has a trade share of 9 percent with Saudi Arabia. Further, 9 percent of trade includes Pakistan's 12.2% of imports from and 8.5% of exports to Saudi Arabia. Further, Figures 1 and 2 depict the overall scenario of bilateral EXR and EXR volatility, respectively, for Pakistan-Saudi Arabia trade.

Several studies investigate the impacts of volatile exchange rates on Pakistan's trade flows with its major trading partners. For instance, Khan et al. (2014), Humayon et al. (2014), Mustafa and Nishat (2004), and Kemal (2005) explore the dynamic effects of volatile exchange rates on Pakistan's trade with its trading partners. However, the results of all previous studies remain ambiguous and inconclusive. Hence, Bahmani-Oskooee and Satawatananon (2011) claim that the main reason for the ambiguous findings is that the majority of the previous studies in the context of Pakistan deploy aggregated level data that are supposed to be suffering from aggregation bias. To tackle the exigency of aggregation bias and to obtain more detailed and informative results, Bahmani-Oskooee and Satawatananon (2011) suggest employing more disaggregated level data or commodity-wise data. Therefore, this study aims at employing that disaggregated (industry-level) data unlike the previous studies and this is the uniqueness of this study. Further, to the best of our knowledge, this is the first study that focuses on Pakistan's commodity-wise trade with Saudi Arabia to analyze how EXR volatility affects bilateral trade. Hence, it is worth investigating the effects of uncertainty in the EXR on commodity trade between Pakistan and its major trading partner Saudi Arabia.

2. Empirical Literature Review

This part of the literature review presents three types of studies. Firstly, this investigation includes the aggregate level studies which use a set of countries for the empirical analysis. Secondly, bilateral trade analysis employing aggregated data is presented. Lastly, this study includes the literature on disaggregated level studies.

2.1 Aggregate Level Study Taking a Set of Countries

Arize et al. (2006) analyze the effects of RER's uncertainty on the export function of 8 countries of Latin American. This study uses the quarterly data from 1973 to 2004 for empirical analysis. Moreover, the Error Correction technique is employed to estimate the short-run dynamics and for the long-run analysis, this study applies the Fully Modified Least Squares (FMLS) estimator and Dynamic Ordinary Least Square (DOLS) Methods. The results reveal that uncertainty in the REER affects export function negatively in both periods i.e. long and short runs. Similarly, Hayakawa and Kimura (2009) examine the impacts of volatile EXR on the trade flows of East Asia. This study employs the monthly data from 1992 to 2005 for 60 countries. The study discloses that uncertainty in the exchange rate exhibits more negative effects on the exports of East Asian countries as compared to other regions.

Unlikely the previous studies, the upcoming study presents more significant research by using some new tests. As Hall et al. (2010) investigate the impacts of volatile EXR on the exports of ten EME'S and eleven developing economies. This study employs quarterly panel data from 1980 to 2006 for Emerging Market Economies as well as data from 1980 to 2005 for developing economies. Moreover, to remove the endogeneity of independent variables, GMM is applied and to analyze the validity of instrument variables, the Sargan test is deployed. Further, this empirical study applies Time-varying coefficients estimation. Hence, the results show that there is no significant impact of EXVOL on the exports of EME's and the developing economies. Whilst the estimation of the TVC method shows that there are negative impacts of volatile EXR only on the developing economies' exports.

Further, Serenis and Tsounis (2013) also examine the impacts of volatile EXR on the exports of Cyprus and Croatia using the quarterly data from 1991:1q to 2012:q1. Further, this study uses a dummy variable to acquire the eventual effects of unforeseen variations in the exchange rate. The empirical results confirm that the uncertain exchange rate negatively affects the exports of Croatia, while there are no significant impacts of the volatile exchange rate on the exports of Cyprus.

Moreover, Nicita (2013) checks the impacts of volatile EXR on trade among economies using a panel data set of 100 countries from 2000 to 2009. To explore the effects of EXR uncertainty on international trade of 100 countries, this empirical investigation employs two models i.e. Panel Gravity Model and the standard Gravity Model. The empirical results show two main findings. Firstly, exchange rate uncertainty affects international trade only in the presence of currency unions. Secondly, misalignments of the exchange rate affect the flows of international trade significantly.

Similarly, Serenis and Tsounis (2014) divulge the effects of volatility in EXR on the aggregate exports of 3 African countries i.e. Malawi, Morocco, and South Africa using quarterly data from 1973:q1 to 1990:q1. They use the MASD of the logarithm of REER to measure the uncertainty in the exchange rate. Further, a dummy variable is also used to investigate the eventual effects of unforeseen variations in the exchange rate. Moreover, this empirical investigation uses ADF to check the stationarity of data and employs ECM to examine the effects of exchange rate volatility on the long-run coefficients and the short-run coefficients. Hence, this empirical study reveals that there are negative significant effects of volatile exchange rates on these 3 African countries' exports when they measure the unforeseen variation in the exchange rate.

Husain and Choudhary (2015) investigate the effects of volatility in EXR on the imports of the UK from the major developing economies, i.e., China, Brazil, and South Africa. Further, this empirical study uses the monthly data from 1991:01 to 2011:12. Employing the ARDL approach, this study explores how the uncertainty of exchange rate affects the imports of the UK from these 3 developing countries -China, Brazil, and South Africa negatively before the crisis and also after the crisis in the UK. Hence, all the previous empirical studies show that the Ex. Rate Vol affects negatively the exports of most countries.

2.2 Aggregate Level Studies Using Bilateral Trade

The following studies employ aggregated data for the bilateral trade to check the effects of the volatility in the EXR on the trade flows. While Sekantsi employs aggregated as well as disaggregated data for analysis. So Sekantsi (2011) analyzes the effects of uncertain REXR on the exports of South Africa to the USA. In this empirical analysis, aggregated and disaggregated monthly data from 1995 to 2007 are used. Further, to measure the variability in the real exchange rate, this study employs GARCH (1, 1) model. Moreover, this empirical investigation uses the ADF test to explore the stationarity of the data series. While to un-bosom the impacts of volatility on the exports of South Africa to the USA in the short run and the long run, This piece of research applies ECM and ARDL approach. Moreover, Dummy variables are also used to indicate the effects of the agreements (which is held in 2000 between S.A and USA) on the exports of South Africa to the USA. Hence, this empirical investigation shows that the uncertainty in the exchange rate negatively affects the exports of South Africa to the USA in both periods i.e. long run & short run.

Similarly, Bristy (2013) finds out the impact of uncertain EXR on the exports of Bangladesh with her major trading partners using the time series data from 1980 to 2010. To check the stationarity of the variables, the ADF test is employed. Further, Johansen Co-Integration Test and Vector ECM are used to explore the short-run and the long-run relations among the variables respectively. Therefore, this study shows that the volatility does not show any impact on the exports except the exports to Japan which are affected negatively in the short run. While the exports of Bangladesh are affected negatively by the volatility in the long run.

Moreover, Nishhimura and Hirayama (2013) analyze the impacts of volatile EXR after its reformation on trade flows between China and Japan using the data from 2002 to 2011. They employ two techniques to measure the volatility in the exchange rate. The first technique is the SD of daily changes in the exchange rate. While the second measure is the EGARCH model. Further, this study uses the ARDL approach to compute the effects of different variables of the model on the trade between China and Japan in both periods. Hence, this study reports Two types of results: Firstly, the exports of China to Japan are negatively affected due to the volatility after the reformation of the exchange rate. Lastly, it is found that the exports of Japan to China are not affected due to uncertainty in the exchange rate.

The following study changes the trend to take just one country in the bilateral trade and employ more than one country to analyze the impacts of EXR Vol. on the trade flow. Therefore, Choudhry and Hassan (2015) explore the impacts of volatile EXR on the imports of UK from three countries i.e. Brazil, China, and South Africa using the monthly data from 1991 to 2011. This empirical research uses GARCH (1, 1) model to compute the EXR Vol. and also applies the Asymmetric Autoregressive Distributed Lag technique to estimate the effects of EXR on the trade in the short run as well as in the long run. The effects of the financial crisis of 2011 in the UK are also analyzed in this study by employing a dummy variable. So this empirical study shows that volatility in exchange has significant effects on the imports of the UK from 3 countries, i.e., results indicate that the variability in the exchange rate increases by 3.23% of the UK's imports from China in the long run. While the volatility in REXR has no significant effects on Brazil's exports to the UK. Moreover, the volatile exchange rate affects negatively the UK's imports from South Africa but a little bit. Further, the results show that the volatility of these 3 countries' EXR negatively affects the exports of those three countries to the UK.

2.3 Disaggregate Level Studies Using Bilateral Trade

All previous studies employ aggregated data taking one country or a set of countries to analyze the impacts of the volatile EXR on the trade balance. However, all these previous studies suffer from the problem of biasness due to using aggregated data as pointed out by Bahmani-Oskooee and Satawatnanon (2011). Hence, using disaggregated data is the solution to this problem.

Therefore, the following studies employ disaggregated data. As Bahmani-Oskooee and Wang (2007) show the effects of EXR uncertainty on trade between the U.S.A and China using the annual data from 1978 to 2006 for 88 industries. To measure the variability in the EXR, this study employs the VAR model. Further, this empirical investigation applies ECM and ARDL approaches to investigate the results of short-run and long-run coefficients. So the results of this study show that almost half of the industries are found affected due to volatility in the exchange rate in the short run. Whilst only 33 industries are negatively affected due to the uncertainty of EXR in the long run. However, another important finding is that most of the imports of the US from China are negatively affected due to the volatility in the exchange rate. Moreover, the uncertainty in the exchange rate affects the majority of US exports to China positively in the long run.

Similarly, Bahmani-Oskooee and Mitra (2008) find out the impacts of EXR uncertainty on commodity trade between the US and India using the data of 40 industries from 1962 to 2004. For the short-run and the long-run analysis, this study applies ECM and ARDL approaches. Further, the VAR model is applied for the measurement of uncertainty in the exchange rate. Therefore, the empirical results indicate that volatility in the exchange rate affects 40% of industries in the short run. Further, on the exports side, 15 industries are affected in the short run. While uncertain exchange rate affects seventeen industries on the import side in the short run. Moreover, only a few industries are affected due to the volatility of EXR in the long run.

Moreover, Bahmani-Oskooee and Hegerty (2009) analyze the impacts of EXR volatility on the bilateral trade between Mexico and the United States. They use the disaggregated annual data (1962-2004). In this study, the data of 102 industries of imports and exports are employed. Further, this study analyzes the effects of NAFTA on the trade between Mexico and the U.S. To explore the short-run as well as the long-run relationship among the variables, this piece of investigation uses Error Correction Model and ARDL bounds testing approach. Moreover, to capture the effects of structural breaks, dummy variables are also used. For the measurement of absolute changes in real effective exchange rate, MASD of 12 months for each year is employed. Hence, the empirical results show that the trade flows of most industries are affected due to highly volatile EXR in the short run. But in the long run, only one-third of the industries are affected (positively or negatively) by the volatility in EXR. However, most of industries show a negative response to the uncertain EXR in the long run.

Further, Bahmani-Oskooee et al. (2010) investigate the impacts of uncertain EXR on the bilateral commodity trade between Mexico and Canada. Using the data from 1973 to 2006, this study analyzes the exports of some specific products. To measure the uncertainty in the exchange rate, this study applies SD of 12-month changes in the REXR for each year. Further, the Bounds testing approach is used to check the co-integration and to analyze the results in the long run as well. Moreover, this empirical research uses ECM for the short-run analysis. Hence, the results of this study find out that nine out of 45 Canadian exporting industries and 17 out of 62 Canadian importing industries experience a reduction in their trade volumes due to the exchange rate uncertainty.

Bahmani-Oskooee and Harvey (2011) analyze the effects of volatile exchange rates on the commodity trade between Malaysia and the USA using data from 1971 to 2006. This uses error correction and bound testing techniques to compute the short-run and the long-run coefficients. Moreover, this study uses aggregated and disaggregated data. So Firstly, using aggregate data, this research finds out that there is no significant effect of EXR uncertainty on trade between Malaysia and the USA in both periods i.e. long run and short run. Lastly, using disaggregated data, the results show that volatile exchange rate affects most US industries in the short run. While 38 out of 101 exporting industries of the USA and 10 out of 17 importing industries of the USA are affected due to the exchange rate uncertainty in the long run. Further, the major part of the affected industries due to volatility in the exchange rate consisted of small industries which have a small share in the trade.

Moreover, Bahmani-Oskooee et al. (2013) examine the impacts of volatile EXR on industry-wise trade between the USA and Brazil using the annual data (1971-2010). This study employs the dataset of 123 exporting industries and 103 importing industries in the USA. For the measurement of absolute changes in REER, this study uses a MASD of 12 months for each year. Further, for the short run as well as the long run analysis, the ARDL bounds testing technique is applied. Therefore, the empirical results show that uncertainty in the exchange rate does not affect the majority of industries in the long run. However, exchange rate volatility negatively affects the agricultural exports of Brazil to the USA. Moreover, Volatile EXR has no impact on U.S. imports of machinery.

Bhmani-Oskooee et al. (2014) explore the impacts of uncertainty in the exchange rate on the trade between Spain and the USA using the disaggregated annual data from 1962 to 2009. This study uses the data for 88 export-oriented industries and 131 importing industries of the USA that are involved in trade with Spain. Further, this study applies the Error Correction model and ARDL technique to explore the short-run and long-run effects of uncertain exchange rates on trade flows. Further, 74 export-oriented industries out of 131 industries show co-integration. Whereas, only 37 import-oriented industries are found in co-integrated relationships. Hence, the results indicate that half of the importing and exporting industries are affected due to volatility in the short run. Moreover, the results show that 24 exporting industries are affected negatively due to the volatility, and 11 exporting industries response to the uncertainty in exchange rate positively. However, 11 out of 37 importing industries show a negative attitude towards the uncertainty while 3 imports-oriented industries indicate positive relation to volatility in the exchange rate.

Baek (2014) analyzes the effects of volatile EXR on the trade between Korea and the USA using the quarterly data from 1993:q3 to 2012:q4. This study uses the data of 10 major exporting industries of Korea to the USA. While this research uses the ADF unit root test to check the stationarity of the series. Further, this empirical investigation applies the ARDL approach for the long-run analysis. Hence, the empirical results show that a volatile exchange rate has no significant effects on 7 importing industries in the long run. Moreover, the volatile exchange rate doesn’t affect 8 exporting industries in the long run.

Similarly, Simakova and Stavarek (2015) explore the effects of volatile exchange rates on industrial foreign trade in the Czech Republic. Using the disaggregated panel data from 1993 to 2013, they analyze the foreign trade of the Czech Republic with her five major trading partners and these are Austria, Germany, France, Italy, and Poland. Further, the Gravity Model is employed to reckon the effects of exchange volatility. Moreover, this study uses ARDL and error correction approaches to analyze the short-run and the long-run relationship among the variables. Therefore, this empirical study reveals two things. Firstly, it is found that there are ambiguous impacts of volatile exchange rates on the trade balance of the Czech Republic. While some empirical studies explore that the depreciation in Czech's currency is advantageous for the trade balance of the Czech Republic. Further, some studies show the opposite results of the previous studies. Lastly, the exports of some industrial products are increased due to volatility in the exchange rate.

This study includes the literature on disaggregated level studies. Further, all the previous studies present ambiguous and mixed results on the effects of exchange rate volatility on trade. Hence, this study uses disaggregated data at the commodity level to explore the impacts of EXR volatility on the commodity trade between Pakistan and its MTP's.

3. Data

This study takes the data on commodity trade of importing and exporting industries from the WITS which is an online source that provides data on tariffs and trades freely facilitated by the World Bank. Further, the data collection of WITS is based on a huge amount of information on tariffs and commodity trade. Annual bilateral trade data is taken for empirical analysis between Pakistan and her major Saudi Arabia for the period of 1981 to 2018. Further, overall, a total of 69 commodities of three digits (39 exporting and 30 importing) are taken which have the main share of trade between Pakistan and her major trading partners. Moreover, some major commodity has to give up due to impropriate data availability. Hence, we utilize the SITC data of the first version (Rev.1) of the nomenclature rather than Rev.2 and Rev.3 because it has much more data observations than that of the other two sources. However, these 206 products include only merchandise commodities excluding services.

Further, the key variable of this study is the volatile exchange rate which is computed by the average moving standard deviation of the exchange rate (Bahmani-OSkooee et al., 2013). This study uses monthly data on bilateral exchange rates for empirical analysis. While computing the model of exports and imports functions through ARDL Approach, this study employs annual data from 1981-2018. The detail of each variable along with its source is presented below.

Table 1. Definitions and Sources of the Variables

Variable	Introduction/Construction	Sources	Symbol
Nominal Exchange Rate	Domestic Currency/ US ($)	IFS	$lnREX$
G.D.P	At Market Prices (constant 2005) US dollars	WDI	lnY
Exchange Rate Volatility	Computed by the average moving standard deviation of the exchange rate	Research findings	$ln\ Vol$

Source: Research findings.

Employing classical linear regression for the analysis of the non-stationary data produces spurious findings (Irandoust et al., 2006). While there are two other popular techniques i.e. Engle-Granger Approach and Johanson- Jesulios Approach to handle this problem of data. So, these approaches are employed for non- stationary data. Almost every technique has some limitations. That's why these both techniques have also some limitations. As Engel-Granger Approach that is residual-based can make only one vector of co-integration (Toda, 1994). Similarly, Johanson- Jesulios Approach requires significantly big samples of observation to co-integration and even a sample size of one hundred observations is not enough to differentiate the rank of co-integration properly (Irandoust et al., 2006).

However, there is another approach that is better than the previous two approaches called the ARDL technique to estimate the short-run as well as the long-run relationship between dependent and Independent Variables. Further, ARDL Bound Testing Approach is better than that of previous approaches due to the pre-condition of those 2 approaches that all series must be co-integrated in the same order, i.e. at I(1), not at I(0) (Tang, 2003: 421). However, the ARDL approach does not require it. Moreover, another benefit of using ARDL is that it can be employed at a small sample size as Bahmani-Oskooee (2009) certifies that ARDL Bound Testing Approach is preferable over other approaches due to its small sample properties.

There are some specific benefits of the ARDL Bound Testing Technique presented by Pesaran and Shin (1999). Firstly, it can be applied to series that are integrated at I(0) and I(1). Secondly, this approach has a single equation of estimation (i.e. one step approach) that is easy to implement and for interpretation. Lastly, different lag-lengths can be allotted to different variables in the equation of this approach (Chishti et al., 2020a; 2020b). Therefore, we confidently prefer to deploy the ARDL approach to estimate our proposed econometric model.

It is necessary to check the stationarity of data before the estimation. Because the estimation of non-stationary data gives spurious results. Therefore, to check the stationarity, the most famous method is the Dickey and Fuller (1979) test. It is represented as:

$$y_t = a y_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta y_t = \delta y_{t-1} + \varepsilon_t \quad (2)$$

While $\delta = a - 1$. To check the stationarity (unit root) of the series, the hypothesis is: $H_0: \delta \geq 0$ (means that the data series are not stationary), and $H_1: \delta < 0$ (means that there is stationarity in the data series). The basic assumption of the DF test is that the epsilon should be white noise. If the epsilon (ε) is not white noise, the DF test collapse to invalidity. For the correction or adjustment of this problematic situation, Dickey and Fuller introduce ADF Test and its mathematical representation is:

$$\Delta yt = at - 1 + \sum pi + 1\ ai\Delta y - 1 + \varepsilon_t \quad (3)$$

While $\delta = \sum_{i=1}^{p} \propto_i - 1$. Further, Intercept and trend can be added to check time impact. This study employs Akaik Information Criteria (AIC) for lag selection.

This current work employs ARDL bound testing approach to check co-integration in this study introduced by Pesaran and Shin (1995). Further, Engel Granger and Johanson- Jesulios approach are also used to check co-integration, however, they require all variables should be integrated in the same order, while the ARDL approach doesn't requires same order (valid at I(0) and I(1)) (Chishti 2020; Ullah et al., 2020a; 2020b; Teng et al., 2020). Hence, this study prefers ARDL Approach due to its suitability for the estimation variables included in the model.

The main focus of this empirical investigation is to analyze the impact of volatile exchange rates on commodity trade between Pakistan & her major trading partners. Therefore, the ARDL equation for each importing and exporting industry would be:

For each exporting industry:

$$g\Delta \ln VX_t = \alpha + \sum_{k=1}^{n1} b1k\ \Delta\ lnVX_{t\ k} + \sum_{k=0}^{n2} b2k\ \Delta\ lnY_{pk,t-k} + \sum_{k=0}^{ne} b3k\ \Delta\ lnREX_{t-k} + \sum_{k=o}^{n4} b4k\ \Delta lnV_{t-k} + \beta_0\ lnVT_{it-1} + \beta_1\ lnY_{pk,t-1} + \beta_2\ lnREX_{t-1} + \beta_3\ lnV_{t-1} + \varepsilon_t \quad (4)$$

For each importing Industry:

$$g\Delta \ln VM_t = \alpha + \sum_{k=1}^{n1} b1k\ \Delta\ lnVM_{t-k} + \sum_{k=0}^{n2} b2k\ \Delta\ lnY_{pk,t-k} + \sum_{k=0}^{ne} b3k\ \Delta\ lnREX_{t-k} + \sum_{k=o}^{n4} b4k\ \Delta lnV_{t-k} + \gamma_0\ lnVT_{it-1} + \gamma_1\ lnY_{pk,t-1} + \gamma_2\ lnREX_{t-1} + \gamma_3\ lnV_{t-1} + \mu_t \quad (5)$$

The first step is to check co-integration in the ARDL Approach. For the co-integration, this study uses the Bound Testing approach by (Pesaran et al., 2001). Because the F-tabulated values become biased. While Pesaran et al. (2001) develop critical values of the F-test which include upper bound and lower bound values. After checking co-integration, the next purpose is to estimate long-run coefficients in ARDL Approach. After this, this investigation proceeds to estimate the short-run coefficients.

This empirical study makes a series of lagged residuals ($\varepsilon t-1$) to estimate short-run coefficients. While this is the final step of the ARDL Approach and this step is called ECM. Hence, the equation of ECM is presented as:

$$g\Delta(\ln Inds) = a0 + \sum i{=}0\ \lambda 1i\ \Delta Inds_{t-i} + \sum i{=}1\ \lambda 2i\ \Delta Y_{t-i} + \sum i{=}1\ \lambda 3i\ \Delta Exrvol_{t-i} + \sum i{=}1\ \lambda 1i\ \Delta Er_{t-i} + \pi\varepsilon_{t-1} + \varepsilon_t \quad (6)$$

In the above equation, ε_(t-1) (lagged residual) and its (π) coefficient shows the speed of correction of error and convergence to the equilibrium. The important point is that it is necessary to be negative of the error term significantly for error correction.

5. Results

5.1 Outcome of Unit Root Test

We find out, using the ADF test, that the GDP of Saudi Arabia and the Volatility of the Exchange Rate are integrated with order one, and the real Exchange Rate is integrated with I(0). Further, ADF tests confirm that all the selected commodities become stationary on the first difference, hence, the ARDL approach is applicable (See Tables 3 and 4).

Table 2. Unit Root Results of ADF Test

Variables (Pak to china)	At level	At 1st Difference
GDP (Pak)	-2.26 (0.4378)	-3.73 (0.0337)
GDP (S.A)	-2.463213 (0.3430)	-5.06 (0.0014)
Real Bil. Exchange rate	-3.395307 (0.0688)	
EXR Volatility	-2.416304 (0.3652)	-7.10 (0.0000)

Source: Research findings.

Note: P-values are presented in the table.

Table 3. Bilateral Trade between Pakistan and Saudi Arabia (Exports Function)

Codes	F val.	Industries	Level	1st Diff
34	3.92	Fish, fresh (live or dead), chilled o	-5.30 (0.00)	-
36	7.34	Crustaceans and mollusks, fresh, chilled	-0.94 (0.75)	-4.93 (0.00)
42	5.12	Rice	-1.76 (0.38)	-5.63 (0.00)
48	5.04	Cereal prepare. & preps. of flour of	-0.26 (0.91)	-5.90 (0.00)
57	6.08	Fruit & nuts(not included oil nuts),	-0.66 (0.84)	-5.64 (0.00)
61	7.04	Sugar and honey	-1.12 (0.69)	-5.82 (0.00)
66	6.9	Non-metallic mineral manufactures, n	- 1.09 (0.70)	-8.44 (0.00)
75	5.11	Spices	-0.12 (0.93)	-4.61 (0.00)
98	4.94	Edible products and preparations n.	-0.89 (0.77)	-7.72 (0.00)
269	3.59	Old clothing and another old textile	-1.22 (0.65)	-6.30 (0.00)
292	4.86	Crude vegetable materials, n.e.s.	-2.43 (0.13)	-7.51 (0.00)
541	5.42	Medicinal and pharmaceutical product	-1.61 (0.46)	-10.75 (0.00)
553	5.17	Perfumery, cosmetics, and toilet prep	-1.55 (0.49)	-9.29 (0.00)
612	4.63	Manufactures of leather/composite	-2.24 (0.19)	-8.01 (0.00)
651	3.17	Textile yarn	-3.52 (0.01)	-
652	4.1	Cotton fabrics, woven	-2.70 (0.08)	-
653	5.21	Fabrics, woven, of man-made fibers	-4.08 (0.00)	-
655	7.32	Knitted or crocheted fabrics	-3.03 (0.04)	-
657	4.04	Special textile fabrics and related	-3.10 (0.03)	-
658	5.47	Made-up articles, wholly/chiefly of	-2.44 (0.13)	-6.10 (0.00)
659	2.51	Floor coverings, etc.	-1.13 (0.68)	-6.24 (0.00)
663	9.13	Mineral manufactures, n.e.s	-5.47 (0.00)	-
696	3.13	Cutlery	-0.70 (0.83)	-7.10 (0.00)
697	4.68	Household equipment of base metal, n	0.43 (0.98)	-4.45 (0.00)
699	5.67	Manufactures of base metal, n.e.s.	- 1.01 (0.73)	-8.26 (0.00)
728	5.31	Mach.& equipment specialized for pa	- 2.85 (0.06)	-
842	4.13	Outer garments, men's, textile fab	- 1.51 (0.51)	- 4.14 (0.00)
843	6.03	Outer garments, women's, textile f	- 3.99 (0.00)	-
844	3.07	Under garments of textile fabrics	- 4.34 (0.00)	-
845	7.79	Outer garments and other articles, k	- 2.19 (0.21)	-6.26 (0.00)
846	4.3	Under garments, knitted or crocheted	- 1.87 (0.34)	-5.10 (0.00)
847	5.73	Clothing accessories of textile fab	-2.43(0.14)	-2.76 (0.07)
848	6.57	Art. of apparel & clothing accessories	-0.4 (0.72)	-6.54 (0.00)
851	12.46	Footwear	-1.27(0.62)	-5.85 (0.00)
872	6.39	Medical instruments and appliances	-1.6 (0.46)	-6.38 (0.00)
892	3.33	Printed matter	-2.02 (0.27)	-5.44 (0.00)
893	2.35	Articles of materials described in	-1.51 (0.52)	-7.20 (0.00)

Codes	F val.	Industries	Level	1st Diff
894	5.54	Baby carriages, toys, games, and sport	-2.11 (0.24)	-6.86 (0.00)
899	5.2	Other miscellaneous manufactured ar	-5.51 (0.00)	-

Source: Research findings.

Table 4. Bilateral Trade between Pakistan and Saudi Arabia (Exports Function)

Code	Industries	At Level	At 1ST Diff
57	Fruit & nuts(not included oil nuts)	-2.23 (0.19)	-7.47(0.00)
66	Non-metallic mineral manufactures, n	-1.76 (0.39)	-6.02 (0.00)
211	Hides and skins (except fur skins)	-1.88 (0.33)	-6.60 (0.00)
251	Pulp and waste paper	-0.74 (0.82)	-5.05 (0.00)
268	Wool and other animal hair (exclude	-1.26 (0.63)	-5.10 (0.00)
282	Waste and scrap metal of iron or st	-2.01 (0.27)	-6.19 (0.00)
288	Non-ferrous base metal waste and sc	-2.21 (0.20)	-6.64 (0.00)
332	Petroleum products, refined	-1.89 (0.32)	-7.21 (0.00)
333	Petrol. oils, crude, & c.o.obtain. from	-0.28 (0.91)	-6.36 (0.00)
511	Hydrocarbons nes, & their halogen. &	-4.15 (0.00)	-
512	Alcohols, phenols, phenol-alcohols,&	-3.78 (0.00)	-
516	Other organic chemicals	-1.63 (0.45)	-4.88 (0.00)
522	Inorganic chemical elements, oxides	-3.92 (0.00)	-
533	Pigments, paints, varnishes & related	-0.90 (0.77)	-5.50 (0.00)
582	Condensation, polycondensation & pol	-2.08 (0.25)	-4.14 (0.00)
583	Polymerization and copolymerization	-2.08 (2.25)	-8.10 (0.00)
598	Miscellaneous chemical products, n.e	-.4.31 (0.00)	-
641	Paper and paperboard	-0.46 (0.88)	-5.79 (0.00)
642	Paper and paperboard, cut to size or	-1.37 (0.58)	-5.58 (0.00)
659	Floor coverings, etc.	-1.46 (0.53)	-8.12 (0.00)
664	Glass	-2.13 (0.23)	-5.35(0.00)
682	Copper	-2.69 (0.08)	-
723	Civil engineering & contractors plan	-3.76 (0.00)	-
728	Mach.& equipment specialized for pa	-4.69 (0.00)	-
743	Pumps & compressors, fans & blowers	-4.17 (0.00)	-
749	Non-electric parts and accessories	-4.31 (0.00)	-
781	Passenger motor cars, for transport	-3.99 (0.00)	-
892	Printed matter	-2.16 (0.22)	-6.28 (0.00)
893	Articles of materials described in	-1.70 (0.42)	-6.81 (0.00)
899	Other miscellaneous manufactured ar	-4.28 (0.00)	-

Source: Research findings.

5.2 Outcome of Cointegration Test

Exports Function: As Table 5 repots, using the Bound Testing Approach, this study finds out that 32 industries are co- integrated out of selected 39 industries. The industries coded as 36, 57, 61, 66, 655, 663, 699, 843, 845, 847, 848, 851, and 872 are found co-integrated at 1%. While, the following industries coded as 42, 48, 75, 98, 292, 541, 553, 612, 653, 658, 697, 728, 894, and 899 are co-integrated at 5%. Further, the remaining industries coded as 34, 652, 657, 842, and 846 have co-integration at 10%. Moreover, the Bound Testing Approach Shows that only 7 industries are not co-integrated which are coded as 269, 651, 659, 696, 844, 892, 893. So the results of the bound testing approach for the exports function are presented in the following table.

Table 5. Results of Bound Testing Approach (Exports Function)

Codes	Industries	F val.	Codes	Industries	F val.
34	Fish, fresh (live or dead), chilled o	3.92	657	Special textile fabrics and related	4.04
36	Crustaceans and mollusks, fresh, chilled	7.34	658	Made-up articles, wholly/chiefly of	5.47
42	Rice	5.12	663	Mineral manufactures, n.e.s	9.13
48	Cereal prepare. & preps. of flour of	5.04	697	Household equipment of base metal, n	4.68
57	Fruit & nuts (not including oil nuts),	6.08	699	Manufactures of base metal, n.e.s.	5.67
61	Sugar and honey	7.04	728	Mach.& equipment specialized for pa	5.31
66	Non-metallic mineral manufactures, n	6.9	842	Outer garments, men's, textile fab	4.13
75	Spices	5.11	843	Outer garments, women's, textile f	6.03
98	Edible products and preparations n.	4.94	845	Outer garments and other articles, k	7.79
292	Crude vegetable materials, n.e.s.	4.86	846	Under garments, knitted or crocheted	4.3
541	Medicinal and pharmaceutical products	5.42	847	Clothing accessories of textile fab	5.73
553	Perfumery, cosmetics, and toilet prep	5.17	848	Art. of apparel & clothing accessories	6.57
612	Manufactures of leather/composite	4.63	851	Footwear	12.46
652	Cotton fabrics, woven	4.1	872	Medical instruments and appliances	6.39
653	Fabrics, woven, of man-made fibers	5.21	894	Baby carriages, toys, games, and sport	5.54
655	Knitted or crocheted fabrics	7.32	899	Other miscellaneous manufactured ar	5.2

Source: Research findings.

Imports Function: Bound Testing Approach shows in Table 6 that 23 industries are co-integrated out of 30 selected industries. In these 23 industries, these industries coded as 211, 251, 522, 723, 728,749, 781, and 982 are co-integrated at 1%. While, the following industries coded as 57, 268, 512, 516,533, 582, 583, 641, 642, 743 are found co-integrated at 5%. Further, these four industries coded as 282, 288, 659, and 899 are co-integrated at 10%. Moreover, only 7 industries coded as 66, 334, 511, 598, 664, 682, and 893 are not co-integrated. Hence, the results of a co-integration test for the imports function are presented in the following table below.

Table 6. Results of Bound Testing Approach (Imports Function)

Code	Industries	F val.	Code	Industries	F val.
57	Fruit & nuts (not including oil nuts)	5.4	583	Polymerization and copolymerization	4.54
211	Hides and skins (except fur skins)	8.17	641	Paper and paperboard	4.49
251	Pulp and waste paper	8.31	642	Paper and paperboard, cut to size or	5.55
268	Wool and other animal hair (exclude	4.79	659	Floor coverings, etc.	3.82
282	Waste and scrap metal of iron or st	4.32	723	Civil engineering & contractors' plans	6.05
288	Non-ferrous base metal waste and sc	3.97	728	Mach.& equipment specialized for pa	7.15
512	Alcohols, phenols, phenol-alcohols, &	4.54	743	Pumps & compressors, fans & blowers,	5.12
516	Other organic chemicals	4.53	749	Non-electric parts and accessories	5.87
522	Inorganic chemical elements, oxides	7.94	781	Passenger motor cars, for transport	10.9
533	Pigments, paints, varnishes & related	4.72	892	Printed matter	7.79
582	Condensation, polycondensation & pol	4.85	899	Other miscellaneous manufactured ar	4.04
				Petrol. oils, crude, & c.o.obtain. from	6.25

Source: Research findings.

After checking the co-integration of industries, this study estimates the long-run as well as short-run coefficients. Therefore, firstly, this investigation presents the long-run coefficients of the ARDL Model.

5.3 Results Discussion

Exports Function: As Table 7 reports, overall, volatility affects 20 industries, in the long run, such that half of 20 is affected positively and the other half is affected negatively while these industries coded as 36, 42, 48, 61, 66, 75, 612, 655, 842 and 892 are affected positively as well as the following industries coded as 34, 269, 553, 653, 658, 659, 696, 845, 851 and 894 are affected negatively due to the volatility of exchange rate. Further, the remaining 19 industries which are not affected by volatility, in the long-run, are coded as 57, 98, 292, 541, 651, 652, 657, 663, 697, 699, 728, 843, 844, 846, 847, 848, 872, 893 and 899. However, the uncertain exchange rate makes a positive impact on the 3 big industries coded as 42, 66, and 75 have 35%, 7%, and 6% export shares respectively while the volatility affects only 1 industry coded as 685 having 14% exports share negatively. However, GDP responds to volatility positively in most industries.

In short-run, we find that volatility affects 11 industries coded as 42, 48, 66, 292, 612, 658, 699, 843, 845, 848, and 851 positively in which there are 2 big industries coded as 42 and 658 having 35% and 14% exports share respectively. While 12 industries coded as 34, 36, 75, 98, 269, 541, 553, 555, 765, 844, 893, and 894 are affected negatively in the short run. Further, 5 industries react to uncertainty positively as well as negatively and their codes are 57, 652, 847, 872, and 899. What about the remaining 11 industries? These 11 industries which have the following codes as 61, 651, 653, 659, 663, 696, 728, 842, and 846 don't react to the volatility.

Imports Function: As table 8 shows, this empirical study finds out that fluctuations in the exchange rate affect 16 industries positively and affect 6 industries negatively in the long run, while this study selects 30 industries. The positively affected industries are coded as 211, 282, 288, 333, 512, 516, 522, 533, 582, 583, 682, 723, 728, 743, 893, and 899. While the volatility of the exchange rate affects these industries coded as 57, 66, 251, 268, 642, and 659 negatively. Further, the remaining 8 industries don't show a long-run relationship with the volatility, and their codes are 334, 511, 598, 641, 664, 749, 781, and 892. However, two big industries code 333 and 583 which have 33% and 6% imports share are affected negatively. What is the reaction of GDP to the volatility? GDP, in most industries, has a positive response to volatility in the long run.

In the short-run, this study finds out that 10 industries react to the volatility positively and these industries have the following codes 57, 282, 333, 642, 682, 723, 728, 743, 749, and 893. On the other hand, 5 industries coded as, 251, 334, 664, 781, and 899 respond negatively to the variability of the exchange rate. Since 2 industries coded as 288, 892 respond to volatility positively as well as negatively. Error Correction Model explores that 11 industries are not affected due to the volatility and these industries are coded as 66, 211, 268, 512, 516, 522, 533, 582, 583, 641, and 659. However, there is only one big industry coded as 333 having a 33% import share which was affected positively due to the exchange rate volatility.

Table 7. Short-Run and Long-Run Coefficients Results (Exports Function)

			Short Run Estimates					Long Run Estimates		
code	Industries	Trade Share %	d(lnV)	d(lnV(-1)	d(lnV(-2)	d(lnV(-3)	constant	Y	lnex	lnV
34	Fish, fresh (live or dead), chilled	1.014828973	-0.33 (-3.42)	-0.26 (-2.41)	0.11 (1.11)		37.37 (1.83)	-1.47 (-1.91)	3.14 (1.54)	-0.16 (-4.55)
36	Crustaceans and mollusks, fresh, chilled	1.438505653	-0.43 (-2.47)				-193.94 (-4.70)	7.12 (4.95)	4.03 (1.61)	0.18 (2.59)
42	Rice	35.40509555	0.17 (1.37)	0.30 (1.65)	0.06 (0.50)	-0.30 (-1.63)	-59.69 (-1.94)	3.16 (3.70)	-4.70 (-1.45)	0.10 (2.12)
48	Cereal prepare. & preps. of flour of	0.965164191	0.09 (2.66)				-241.38 (-3.51)	8.55 (3.96)	7.45 (1.47)	0.30 (3.08)
57	Fruit & nuts(not including oil nuts)	3.291688885	-0.10 (-0.80)	-0.28 (-1.99)	0.04 (0.36)	0.30 (2.24)	70.03 (0.54)	-2.71 (-0.54)	5.49 (0.49)	-0.36 (-0.90)
61	Sugar and honey	6.84697214	-0.48 (-0.90)	-0.73 (-1.46)			-335.80 (-2.30)	9.75 (2.27)	29.03 (2.36)	0.42 (1.75)
66	Non-metallic mineral manufactures,n	1.034618729	0.12 (0.89)	0.30 (2.49)			-134.43 (-4.16)	5.16 (5.27)	1.74 (0.66)	0.15 (3.16)
75	Spices	5.555274452	-0.11 (-1.54)	-0.26 (-2.79)	0.11 (1.30)		-119.04 (-3.41)	4.51 (3.77)	2.63 (1.25)	0.14 (2.54)
98	Edible products and preparations n.	0.78562415	-0.13 (-0.87)	-0.90 (-4.04)	0.31 (1.56)		-136.29 (-1.34)	3.26 (1.10)	19.24 (2.03)	0.12 (0.66)
269	Old clothing and another old textile	0.77562415	-0.06 (-1.69)				-16.37 (-0.75)	0.70 (0.91)	1.58 (1.12)	-0.07 (-2.12)
292	Crude vegetable materials, n.e.s.	0.325877662	0.40 (3.46)				-16.31 (-0.76)	1.20 (1.71)	-3.06 (-1.74)	0.02 (0.05)
541	Medicinal and pharmaceutical products	0.845083778	-0.02 (-0.10)	-0.36 (-1.96)			-31.22 (-0.89)	1.92 (1.63)	-4.69 (-1.74)	-0.01 (-0.19)
553	Perfumery, cosmetics, and toilet prep	0.662000378	-0.08 (-2.97)				2.85 (0.21)	0.36 (0.78)	-1.91 (-1.97)	-0.08 (-3.79)
612	Manufactures of leather/ composite	0.062895403	0.74 (3.05)	0.36 (1.55)			-1.88 (-0.56)	0.29 (0.25)	0.28 (0.11)	0.13 (2.16)
651	Textile yarn	0.447632241	-0.02 (-0.58)				19.25 (0.48)	-0.71 (-0.52)	2.39 (0.84)	-0.03 (-0.60)
652	Cotton fabrics, woven	3.971765636	0.21 (2.10)	-0.25 (-1.72)	0.16 (1.47)		2.80 (0.07)	0.07 (0.06)	2.45 (0.79)	0.03 (0.50)
653	Fabrics, woven, of man-made fibers	2.927238117	-0.08 (-1.59)				79.27 (1.99)	-2.49 (-1.83)	-1.14 (-0.39)	-0.11 (-1.78)
655	Knitted or crocheted fabrics	0.47064658	-0.59 (-1.74)	-0.40 (-1.19)			-307.50 (-2.79)	8.67 (2.62)	28.60 (3.16)	0.45 (2.59)
657	Special textile fabrics and related	0.440868539	0.01 (0.08)	-0.44 (-2.38)			-33.69 (-0.52)	1.28 (0.59)	2.12 (-0.54)	-0.08 (-0.07)
658	Made-up articles, wholly/chiefly of	14.23400777	0.03 (0.26)	0.27 (1.72)	0.19 (1.78)		31.72 (1.35)	-1.07 (-1.47)	2.97 (1.61)	-0.08 (-2.24)
659	Floor coverings, etc.	0.174811148	0.11 (0.66)	0.16 (0.68)	0.04 (0.22)	0.11 (0.51)	138.81 (2.57)	-4.79 (-2.99)	-1.11 (-0.23)	-0.16 (-1.97)
663	Mineral manufactures,n.e.s	0.083021423	0.01 (0.43)				-11.92 (-0.59)	0.69 (1.01)	-0.19 (-0.13)	0.01 (0.43)
696	Cutlery	1.325870213	-0.03 (-1.51)				-21.48 (-0.88)	1.18 (1.42)	-0.80 (-0.42)	-0.06 (-1.72)
697	Household equipment of base metal,n	3.025834205	0.15 (1.02)				143.29 (0.88)	-2.56 (-0.55)	-23.07 (-1.59)	-0.34 (-1.29)
699	Manufactures of base metal,n.e.s.	0.453212792	0.74 (2.22)	0.47 (1.69)			-50.69 (-0.98)	2.32 (1.42)	-1.12 (-0.28)	-0.05 (-0.66)
728	Mach.& equipment specialized for pa	0.177191494	0.14 (1.50)				-144.47 (-1.18)	4.70 (1.22)	8.85 (1.09)	0.28 (1.22)
842	Outer garments, men's, textile fab	1.822842101	0.20 (0.89)	0.02 (0.12)			-123.94 (-2.33)	4.48 (2.74)	4.59 (1.06)	0.17 (2.05)
843	Outer garments, women's, textile f	0.45283731	0.08 (0.34)	-0.13 (-0.65)	0.65 (2.91)		15.31 (0.39)	-0.77 (-0.60)	5.52 (1.37)	0.05 (0.78)
844	Under garments of textile fabrics	0.174103642	-0.63 (-2.07)				-25.75 (-0.36)	0.49 (0.21)	6.21 (1.13)	0.03 (0.29)

			Short Run Estimates					Long Run Estimates		
code	Industries	Trade Share %	d(lnV)	d(lnV(-1)	d(lnV(-2)	d(lnV(-3)	constant	Y	lnex	lnV
845	Outer garments and other articles,k	1.753263286	0.13 (0.74)	-0.05 (-0.26)	-0.08 (-0.42)	0.40 (1.97)	0.22 (0.01)	-0.51 (-0.48)	7.90 (2.17)	-0.10 (-1.69)
846	Under garments, knitted or crocheted	0.222168454	-0.08 (-0.22)				48.15 (0.95)	-2.33 (-1.32)	6.89 (2.14)	-0.02 (-0.22)
847	Clothing accessories of textile fab	0.385228912	0.01 (0.05)	0.19 (0.83)	-0.38 (-1.70)	0.49 (2.10)	82.26 (0.90)	-5.39 (-1.98)	24.96 (2.48)	-0.11 (-0.74)
848	Art of apparel & clothing accessories	3.629079016	0.15 (1.41)	0.02 (0.18)	0.19 (1.69)		-50.970 (-1.76)	2.95 (1.26)	14.99 (1.67)	0.10 (0.72)
851	Footwear	1.991567904	0.23 (2.17)	0.26 (2.07)	0.30 (2.47)		173.91 (3.07)	-4.84 (-2.55)	-11.99 (-4.43)	-0.39 (-4.08)
872	Medical instruments and appliances	0.567761676	0.08 (0.59)	-0.04 (-0.25)	-0.49 (-2.87)	0.38 (2.16)	-26.49 (-0.95)	1.18 (1.35)	0.78 (0.32)	0.01 (0.02)
892	Printed matter	0.294860823	-0.07 (-0.54)				-132.49 (-2.06)	4.40 (2.10)	7.61 (1.76)	0.26 (2.49)
893	Articles of materials described in	0.318257269	-0.19 (-2.15)				22.66 (0.60)	-6.09 (-0.94)	-2.44 (-0.51)	-0.48 (-1.25)
894	Baby carriages, toys, games, and sport	0.221549187	-0.11 (-2.21)				149.54 (2.11)	-5.44 (-2.03)	1.01 (0.22)	-0.27 (-2.12)
899	Other miscellaneous manufactured ar	0.205484568	-0.27 (-2.90)	-0.08 (-0.57)	0.26 (2.34)	-0.39 (-3.30)	-184.51 (-1.10)	4.18 (0.84)	26.92 (2.12)	0.33 (1.24)

Source: Research findings.

Table 8. Short Run and Long Run Coefficients Results (Imports Function)

			Short Run Estimates					Long Run Estimates		
Code	**Industries**	**Trade Share %**	**d(lnV)**	**d(lnV(-1)**	**d(lnV(-2)**	**d(lnV(-3)**	**constant**	**Y**	**lnex**	**lnV**
57	Fruit & nuts (not including oil nuts),	0.004984845	1.25 (1.98)	-0.17 (-0.28)	-0.69 (-2.78)	0.42 (2.06)	-11.56 (2.40)	1.30 (2.83)	9.38 (1.56)	0.69 (2.54)
66	Non-metallic mineral manufactures, n	0.009902258	0.09 (0.49)				103.01 (1.91)	-7.97 (-2.00)	-3.26 (-0.56)	-0.50 (-2.28)
211	Hides and skins (except fur skins),	0.028969528	0.36 (0.70)	-0.28 (-0.40)	-0.95 (-1.62)	0.64 (0.89)	-1285.89 (-4.58)	53.21 (3.09)	58.88 (3.41)	2.71 (2.88)
251	Pulp and waste paper	0.017598575	-0.19 (-2.28)				-2.17 (-0.05)	-1.09 (-0.82)	-1.11 (-0.75)	-0.19 (-2.55)
268	Wool and other animal hair (excluding	0.052940475	-0.12 (-0.34)				-0.62 (-4.29)	-16.91 (-2.68)	-8.19 (-1.30)	-1.22 (-3.45)
282	Waste and scrap metal of iron or st	0.025205108	0.62 (2.41)				-198.85 (-1.52)	16.92 (2.85)	-9.31 (-1.18)	0.81 (2.45)
288	Non-ferrous base metal waste and sc	0.051051729	0.03 (0.21)	-0.16 (-0.78)	-0.59 (-2.88)	0.42 (2.06)	-171.56 (2.40)	12.30 (2.93)	9.28 (1.56)	0.59 (2.64)
332	Petroleum products, refined	4.18665533	0.46 (0.51)	-1.65 (-1.75)	1.02 (0.98)		-88.11 (-0.26)	8.66 (0.37)	-5.69 (-0.15)	0.29 (0.23)
333	Petrol. oils, crude,& c.o.obtain.from	33.25305021	0.10 (0.90)	0.02 (0.12)	-0.01 (-0.1)	0.31 (2.00)	188.58 (3.01)	-10.21 (-3.58)	-10.98 (-3.28)	-0.68 (-4.48)
511	Hydrocarbons nes, & their halogen.&	1.420218019	0.43 (0.34)	-0.56 (-1.94)	0.87 (1.07)		-212.63 (-1.99)	4.98 (2.95)	3.68 (0.07)	1.53 (2.30)
512	Alcohols, phenols, phenol-alcohols,&	2.248457349	0.24 (0.88)				-250.92 (-2.34)	26.05 (3.13)	20.13 (1.75)	1.27 (2.73)
516	Other organic chemicals	0.066373469	0.30 (1.34)	-0.20 (-0.89)	-0.35 (-1.33)		-424.93 (-2.95)	21.85 (4.99)	7.13 (1.24)	1.16 (4.97)
522	Inorganic chemical elements, oxides	0.000731543	0.53 (1.01)	-0.63 (-0.34)	-0.23 (-1.13)	0.80 (1.18)	-899.48 (-3.59)	35.31 (3.64)	53.64 (3.90)	1.88 (3.64)
533	Pigments, paints, varnishes & related	0.067451008	0.27 (0.82)	0.14 (0.31)	-0.59 (-1.53)	0.03 (0.07)	-734.67 (-4.09)	53.50 (3.40)	76.86 (3.94)	2.46 (2.97)
582	Condensation, polycondensation & pol	0.029197463	-0.07 (-0.28)				-207.86 (-2.56)	15.13 (2.51)	-1.27 (-0.16)	0.63 (1.90)
583	Polymerization and copolymerization	6.410262592	0.13 (0.24)	-0.76 (-1.34)	0.77 (1.17)		-412.63 (-1.69)	24.98 (2.25)	13.68 (0.87)	1.23 (2.10)
598	Miscellaneous chemical products, n.e	0.391154517	0.10 (0.14)	-0.36 (-0.34)	0.88 (1.77)		-612.63 (-1.09)	2.90 (2.85)	11.68 (0.07)	1.03 (2.40)
641	Paper and paperboard	0.012250559	-0.04 (-0.16)				-109.84 (-0.82)	7.99 (0.52)	27.25 (1.09)	-0.13 (-0.16)
642	Paper and paperboard, cut to size or	0.172421733	0.10 (0.33)	0.47 (1.75)			161.56 (1.18)	-6.66 (-1.33)	5.65 (0.97)	-0.82 (-2.93)
659	Floor coverings, etc.	0.014610893	0.59 (1.52)				80.42 (0.83)	-7.16 (-1.22)	-7.89 (-1.47)	-0.71 (-2.14)
664	Glass	0.006021573	0.05 (0.18)	-0.43 (-1.69)			104.54 (0.87)	-15.69 (-0.70)	-6.60 (-0.31)	-0.86 (-0.76)
682	Copper	0.002478278	0.54 (2.01)				-136.20 (-0.99)	15.00 (2.17)	9.29 (1.04)	0.92 (2.40)
723	Civil engineering & contractors plans	0.047836346	0.64 (1.91)				-373.06 (-2.03)	15.26 (2.24)	-4.00 (-0.54)	0.82 (2.11)
728	Mach.& equipment specialized for pa	0.00112116	0.64 (2.00)				-246.40 (-1.68)	12.73 (2.20)	1.44 (0.26)	0.68 (2.07)
743	Pumps & compressors,fans & blowers,	0.009598402	0.74 (2.27)				-239.37 (-1.61)	15.03 (2.27)	5.81 (0.94)	0.78 (2.12)
749	Non-electric parts and accessories	0.00067997	-0.11 (-0.32)	0.76 (2.09)			-0.96 (-0.01)	1.00 (0.28)	-.7.11 (-2.15)	-0.01 (-0.03)
781	Passenger motor cars, for transport	0.000695373	-0.71 (-2.48)				31.87 (0.37)	-1.29 (-0.41)	1.38 (0.39)	-0.05 (-0.33)
892	Printed matter	0.010112493	-0.41 (-0.84)	1.05 (1.80)	-0.85 (-1.53)	-1.44 (-2.64)	-87.61 (-0.52)	3.09 (0.47)	4.09 (0.48)	-0.21 (-0.60)
893	Articles of materials described in	0.009399921	0.68 (1.84)				-156.97 (-2.84)	35.89 (2.78)	52.89 (3.20)	1.90 (2.29)
899	Other miscellaneous manufactured ar	0.001560847	-1.32 (-2.00)	-0.71 (-0.79)	0.11 (0.15)	-1.26 (-1.39)	-570.07 (-1.76)	19.49 (1.68)	27.17 (1.95)	1.16 (1.80)

Source: Research findings.

Table 9. Diagnostic Statistics (Exports Function)

code	Industries	F val.	ECM	LM	RESET	CUSUM	CUSUMSQ	Adj. R2	Normality
34	Fish, fresh (live or dead), chilled	3.92	-0.61 (-3.33)	0.05	0.02	S	S	0.94	0.76
36	Crustaceans and mollusks, fresh, chilled	7.34	-0.67 (-5.49)	0.57	0.06	S	S	0.89	0.99
42	Rice	5.12	-0.97 (-2.97)	0.76	2.63	S	S	0.86	6.93
48	Cereal prepare & preps. of flour of	5.04	-0.31 (-3.27)	1.17	1.1	S	S	0.91	0.68
57	Fruit & nuts (not including oil nuts)	6.08	-0.21 (-1.16)	2.13	3.44	S	S	0.88	1.97
61	Sugar and honey	7.04	-0.94 (-4.31)	0.94	0.21	S	S	0.69	0.08
66	Non-metallic mineral manufactures, n	6.9	-0.90 (-4.81)	1.36	0.06	S	S	0.85	2.16
75	Spices	5.11	-0.37 (-3.68)	1.1	2.82	S	UNS	0.91	5.92
98	Edible products and preparations n.	4.94	-0.36 (-2.38)	1.87	2.65	S	S	0.87	0.04
269	Old clothing and another old textile	3.59	-0.56 (-3.01)	1.27	2.31	S	S	0.76	1.33
292	Crude vegetable materials, n.e.s.	4.86	-0.83 (-3.87)	2.47	1.86	S	S	0.58	1.16
541	Medicinal and pharmaceutical products	5.42	-0.69 (-4.67)	0.28	0.23	S	S	0.78	5.43
553	Perfumery, cosmetics and toilet prep	5.17	-0.81 (-4.26)	1.04	3.1	S	UNS	0.88	1.02
612	Manufactures of leather/of composite	4.63	-0.95 (-5.11)	2.54	0.21	S	UNS	0.64	3.81
651	Textile yarn	3.17	0.89 (-4.12)	2.31	1.73	S	S	0.31	2.71
652	Cotton fabrics, woven	4.1	-0.94 (-3.56)	2.15	0.01	S	S	0.56	2.26
653	Fabrics, woven, of man-made fibers	5.21	-0.65 (-3.58)	1	3.11	S	S	0.15	1.07
655	Knitted or crocheted fabrics	7.32	-0.44 (-2.96)	0.95	2.28	UNS	UNS	0.52	0.89
657	Special textile fabrics and related	4.04	-0.72 (-4.28)	1.68	1.42	UNS	UNS	0.15	1.19
658	Made-up articles, wholly/chiefly of	5.47	-0.74 (-4.72)	0.74	0.63	S	S	0.73	4.84
659	Floor coverings, etc.	2.51	-0.56 (-3.22)	2.44	1.23	S	S	0.35	2.33
663	Mineral manufactures,n.e.s	9.13	-0.48 (-3.08)	0.81	1.41	S	S	-0.02	0.57
696	Cutlery	3.13	-0.59 (-4.11)	1.11	1.67	S	S	0.67	0.91
697	Household equipment of base metal,n	4.68	-1.04 (-3.77)	1.86	3.11	S	S	0.92	1.55
699	Manufactures of base metal,n.e.s.	5.67	-0.75 (-3.08)	0.81	1.6	S	S	0.71	3.25
728	Mach.& equipment specialized for pa	5.31	-1.07 (-5.71)	1.14	1.97	S	UNS	0.82	0.95
842	Outer garments, men's, textile fab	4.13	-0.55 (-3.15)	0.41	2.19	S	S	0.87	1.51
843	Outer garments, women's, textile f	6.03	-0.43 (-2.20)	0.04	0.09	S	S	0.64	1.88
844	Under garments of textile fabrics	3.07	-0.55 (-3.11)	1.88	0.23	S	S	0.56	1.77
845	Outer garments and other articles,k	7.79	-0.94 (-4.52)	0.81	0.24	S	S	0.93	2.07
846	Under garments, knitted or crocheted	4.3	-0.50 (-2.49)	1.07	0.22	S	UNS	0.85	0.8

code	Industries	F val.	ECM	LM	RESET	CUSUM	CUSUMSQ	Adj. R2	Normality
847	Clothing accessories of textile fab	5.73	-0.78 (-3.80)	0.75	0.08	S	S	0.85	1.88
848	Art of apparel & clothing accessories	6.57	-0.70 (-3.86)	0.08	0.5	S	S	0.95	1.21
851	Footwear	12.46	-053 (-3.32)	0.05	0.01	S	S	0.96	0.31
872	Medical instruments and appliances	6.39	-0.97 (-4.31)	0.74	0.63	S	S	0.73	4.84
892	Printed matter	3.33	-0.67 (-3.11)	1.23	1.22	S	S	0.23	2.33
893	Articles of materials described in	2.35	-0.45 (2.43)	2.22	0.56	S	S	0.88	1.56
894	Baby carriages, toys, games, and sport	5.54	-0.36 (-3.03)	3.39	0.51	S	S	0.56	3.35
899	Other miscellaneous manufactured ar	5.2	-0.36 (-2.97)	0.81	0.24	S	S	0.93	2.07

Source: Research findings.

Table 10. Diagnostic Statistics (Imports Function)

Code	Industries	F val.	ECM	LM	RESET	CUSUM	CUSUMSQ	Adj. R2	Normality
57	Fruit & nuts(not including oil nuts),	5.4	0.30 (1.47)	1.66	2.11	S	S	0.55	1.43
66	Non-metallic mineral manufactures,n	3.35	-0.46 (-2.76)	1.85	1.14	S	S	0.25	0.48
211	Hides and skins (except fur skins),	8.17	-0.84 (-3.50)	1.35	3.67	S	S	0.52	4.11
251	Pulp and waste paper	8.31	-0.98 (-5.69)	0.17	0.8	S	S	0.49	1.42
268	Wool and other animal hair (excluding	4.79	-0.62 (-4.29)	0.45	1.52	S	S	0.27	3.09
282	Waste and scrap metal of iron or st	4.32	-0.76 (-4.27)	1.43	0.75	S	S	0.54	0.18
288	Non-ferrous base metal waste and sc	3.97	-0.51 (-3.40)	0.44	1.07	S	UNS	0.56	0.32
333	Petrol. oils, crude,& c.o.obtain.from	6.25	-1.00 (-2.72)	1.07	0.6	S	UNS	0.46	1.69
334	Petroleum products, refined	1.47	-0.47 (-2.04)	1.13	5.65	S	S	0.19	0.76
511	Hydrocarbons nes,& their halogen.&	5.81	-0.61 (-4.71)	0.45	2.01	S	S	0.11	1.16
512	Alcohols, phenols,phenol-alcohols,&	4.54	-0.33 (-3.21)	0.6	3.91	S	S	0.4	2.1
516	Other organic chemicals	4.53	-0.35 (-3.17)	0.27	0.97	S	S	0.51	0.25
522	Inorganic chemical elements, oxides	7.94	-0.74 (-3.26)	0.6	2.46	S	S	0.55	0.84
533	Pigments, paints, varnishes & related	4.72	-0.86 (-4.75)	1.07	2.58	S	UNS	0.32	0.42
582	Condensation,polycondensation & pol	4.85	-0.46 (-3.16)	0.009	1.56	S	S	0.35	0.98
583	Polymerization and copolymerization	4.54	-0.47 (-3.09)	1.64	18.44	UNS	S	0.46	0.39
598	Miscellaneous chemical products,n.e	3.87	-0.62 (-3.31)	1.66	2.67	S	S	0.44	0.87
641	Paper and paperboard	4.49	-0.38 (-2.55)	0.3	0.76	S	UNS	0.4	0.34
642	Paper and paperboard, cut to size or	5.55	-0.33 (-2.36)	0.1	3.48	S	S	0.41	5.93
659	Floor coverings, etc.	3.82	-0.64 (-4.82)	0.14	0.78	S	S	0.28	5.26
664	Glass	4.04	-0.65 (-4.07)	1.39	2.11	S	S	0.33	4.11

Code	Industries	F val.	ECM	LM	RESET	CUSUM	CUSUMSQ	Adj. R2	Normality
682	Copper	2.75	-0.24 (1.98)	1.19	1.24	S	S	0.26	1.31
723	Civil engineering & contractors' plans	6.05	-0.59 (-3.48)	0.53	0.24	S	S	0.42	3.16
728	Mach.& equipment specialized for pa	7.15	-0.78 (-4.44)	0.55	0.8	S	S	0.42	0.07
743	Pumps & compressors,fans & blowers,	5.12	-0.93 (-5.28)	1.63	1.13	UNS	UNS	0.37	2.15
749	Non-electric parts and accessories	5.87	-0.94 (-4.38)	0.47	1.86	S	S	0.57	0.61
781	Passenger motor cars, for transport	10.88	-1.07 (-5.61)	0.16	0.75	S	S	0.57	0.59
892	Printed matter	7.79	-0.99 (6.30)	0.2	0.4	S	S	0.53	0.53
893	Articles of materials described in	3.07	-0.94 (-4.47)	3.36	1.73	S	S	0.41	2.43
899	Other miscellaneous manufactured ar	4.04	-0.93 (-2.82)	0.12	0.34	S	UNS	0.71	0.56

Source: Research findings.

Additionally, the Error term is found significantly negative in the ECM, in almost every industry which shows the speed of convergence of the model. While the speed of adjustment in most of the industries is reasonable, such as an industry (coded:831) of exports function of bilateral trade between Pakistan and USA has an error term value of -0.45 (-3.57) which shows that there is 45% annually speed of convergence to the equilibrium in that industry. Similarly, considering another industry (coded:48) of exports function, its error term value is -1.20 (-8.55) which shows that there is a 60% (in every six months) speed of convergence to the equilibrium in that industry (Bahmani-Oskooee and Satawatananon, 2011). All the detailed results of ECM and Error terms are presented in Appendix 2A.

5.4 Diagnostics Tests

Firstly, in the exports function, the model of only one industry coded as 894 suffers from autocorrelation. While the regression models of the following industries coded as 42, 57, 75, 98, 553, 653, and 697 indicate miss specifications. Further, the industries' models coded as 42, 75, 541, 658, and 872 are not normal. Moreover, the CUSUM and CUSUMQ tests declare that the regression models of industries coded as 75, 553, 612, 652, 657, 728, and 846 have instable coefficients.

Lastly, keeping in mind the import function, the LM test shows that the models of the following industries coded as 598, 664, and 893 suffer from the problems of autocorrelation. While the Ramsey Reset test points out that models of industries no 211, 334, 512, 583, and 642 are miss specified. Further, the models of the industries coded as 642 and 659 are not normal showed by the Normality test. Moreover, the coefficients of the following industries' models coded as 288, 533, 641, 743, 893, and 899 are instable according to the CUSUM and CUSUMQ tests. Therefore, the results of most of the industries' models are good.

6. Conclusion

The current study endeavors to investigate the short-run and long-run impacts of uncertain exchange rates on commodity trade between Pakistan and its main trading partner Saudi Arabia. For empirical analysis, this study employs the annual data from 1981 to 2018. To compute the volatility of the exchange rate, monthly data of the exchange rate from 1981:01 to 2018:12 are employed. To estimate the volatility, this empirical study uses the average moving exchange rate's standard deviation. In to short-run as well as the long-run, this study employs the ARDL approach model.

Considering the short-run coefficients of the exports function, we find that the uncertainty in the exchange rate affects 11 industries positively while it affects 12 industries negatively. Further, 5 industries exhibit mix (i.e., positive and negative) response to the volatility. Moreover, 11 industries remain unaffected by the effects of the volatility in the short run. Hence, most exporting industries are found to have been negatively affected by the volatility of the exchange rate. In the long run, the findings demonstrate that 10 industries have to face the loss, while the other 10 industries enjoy the benefits due to the uncertainty of the exchange rate. Ironically, 19 exporting industries do not show any response to the volatility.

Whereas the short-run coefficients of imports function are concerned, the exchange rate volatility demonstrates its deleterious repercussions on 6 industries, however, 9 other industries enjoy the benefits during the volatility. Only 2 industries show a mixed (positive as well as negative) response to the volatility. Further, 13 industries have no relationship with the EXVOL in the short run. In the long-run, the imports function exhibits that EXVOL has positive effects on the import flows of 15 industries. On the other hand, the results show that uncertainty of exchange rate affects 7 industries negatively. Further, the exchange rate volatility has no impact on the 8 importing industries. Summing up, the results divulge that most industries in the current case of bilateral trade are sensitive to the volatility of the exchange rate but the predominant influence of the volatility remains positive on the commodity-wise trade.

Unlike the previous literature, the study shows that the industries having a big share of imports and exports are sensitive to the EXVOL in the short run as well as in the long run. However, the focused industries which have importance for an economy are the exporting industries. Concerning the exporting industries, the current findings are just different from the previous studies done regarding Pakistan's economy due to employing the disaggregated data.

Focusing on the policy recommendations, the results reveal that two exporting industries coded as 61 (with a share of 6.84%) and 75 (with a share of 5.55%) get the benefits due to the volatility. As these industries are getting benefits, nothing to do with them. However, one big exporting industry coded as 658 (with a share of 14.23%) has to confront significant losses due to uncertainty in the exchange rate. Hence, the main focus should be on the portion of the exports that are negatively affected by the volatility. Here are some suggestions. First, it is in the interest of the owner of those firms who are exporting, to hedge their contracts to avoid the possible loss. Second, according to Bahmani (2013), even risk lovers can minimize their risk too through hedging. Third, Govt. should adopt a focused subsidized policy for negatively affected industries.

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