Does Exchange Rate Volatility Affect Rice Industry Exports? Evidence From Pakistan

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ABSTRACT

This research work empirically examines the impact of exchange rate volatility on rice industry exports of Pakistan using time series data for the period from 1982 to 2019. The variables considered for analysis in this study are value of rice exports of Pakistan to world, credit to private sector, world GDP and a measure of exchange rate volatility. The exchange rate volatility is measured using the moving average standard deviation formula. For estimation of long run and short run results Autoregressive Distributed Lag (ARDL) Model has been applied. The findings of this study reveal that exchange rate volatility does not have a significant impact on the rice industry exports of Pakistan while world GDP and credit to private sector have a positive and significant impact on the rice industry exports.

Keywords: Exchange Rate Volatility, Exports, Rice Industry, ARDL Model.

Introduction

In the light of export led growth hypothesis it can be stated that exports play a pivotal role in the development process of a country. However, in case of Pakistan exports are highly concentrated in few commodities. One such commodity is rice. According to Food and Agriculture Organization (FAO) report (2015) Pakistan is the fourth largest exporter of rice in the world. Pakistan exports rice to a large number of countries and some of the main export markets of rice for Pakistan are Kenya, U.A.E, Saudi Arabia, and Malaysia. One of the major determinants of exports of any country is the exchange rates. Until early 1970s the world was following a fixed exchange rate system under the Bretton Wood agreement. Under the fixed exchange rate system the exchange rate does not show much variability and therefore there is less risk of incurring losses on account of changes in exchange rates. However, after the collapse of Bretton Wood System in early 1970's a large number of countries switched over to the floating/managed floating exchange rate system. Pakistan adopted the managed floating exchange rate system in 1982. Under the floating or flexible exchange rate regime, the exchange rate becomes quite volatile as it keeps on changing frequently. This volatility of exchange rate makes the international trade transactions more risky and in case of developing countries like Pakistan where the financial sector of the economy is not fully developed the level of risk is heightened.

The empirical research conducted to examine the link between exchange rate volatility and exports is inconclusive. The reason cited for such ambiguous results is the aggregation bias (Mckinsey, 1999 and IMF, 2004). The aggregation bias could arise when research is conducted using aggregated trade data e.g. by looking at the total exports of a country to the rest of the world. Since exports of a country come from different sectors/industries of the economy, these different sectors/industries could respond differently to the changes in exchange rates. Some might respond negatively, some positively and some might remain unaffected depending upon the risk taking behavior of the exporter and the nature of commodities being exported. In order to avoid the aggregation bias, this study is, therefore, going to examine the

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impact of exchange rate volatility on the exports of a specific industry (i.e. rice) instead of total exports of Pakistan.

Literature Review

Since the adoption of the floating/ flexible exchange rate system by the world in the early 1970's, a large number of researchers have examined the impact of exchange rate volatility on the volume of exports. However, there is lack of consensus in the empirical findings. Some researchers found that exchange rate volatility negatively affected the volume of exports while others concluded that the impact of exchange rate volatility on exports was positive. Moreover, there are such empirical findings as well which showed no relationship between exchange rate volatility and exports. Thus the issue is still debatable. A brief review of literature is provided as under.

The first systematic analysis of exchange volatility on trade was done by Hooper and Kohlhagen (1978). They examined the bilateral trade of USA, Germany and some other developed countries for the period from 1965 to 1975. Their results showed that the exchange rate volatility did not have an impact on the volume of trade of the developed countries considered in their research. Following the methodology used by Hooper and Kohlhagen, Cushman (1983) re-examined the issue after extending the sample size for the time period 1965-77. He found that out of 14 bilateral trade flows considered in his study six showed negative relationship with exchange rate volatility. Thus his study partially corroborated that exchange rate volatility adversely affected the trade flows.

Akhtar and Hilton (1984) studied the bilateral trade flows between Germany and USA for the period between 1974 and 1981 using data of quarterly frequency. They estimated the export and the import demand functions for both Germany and USA. In order to incorporate the foreign exchange risk in their trade models they used standard deviation of the nominal effective exchange rate. Their results showed that exchange rate volatility had negative impact on the bilateral trade flows of both USA and Germany. Gotur (1985) re-estimated the model used by Akhtar and Hilton (1984) by extending the data set and including three more countries i.e France, UK and Japan in addition to US and Germany. However, this study could not find any significant relationship between exchange rate uncertainty and trade flows.

Bailey et al (1986) examined the impact of exchange rate volatility on the exports of seven big OECD countries (i.e. Canada, France, Germany , Italy, Japan , UK and US) using aggregate export data for the time period from 1973 to 1984. They found positive relationship between exchange rate volatility and exports both in the short run and long run. Koray and Lastrape (1989) investigated the impact of exchange rate volatility on the bilateral trade flows of United States with its five industrialized trading partners for the period 1959 to 1985. Their results revealed a weak relationship between exchange rate volatility and trade. Asseery and Peel (1991) analyzed the exports of Australia, Japan, Germany, US and UK over the period 1972-87 using the latest techniques being developed at that time (i.e cointegration and error correction). They found that exchange rate volatility had positive effect on the exports of these countries.

Mckenzie and Brooks (1997) investigated the relationship of exchange rate volatility and trade flows between US and Germany for the period from 1973 to 1993. Their results revealed positive link between exchange rate volatility and trade flows. Arize et al (2000) examined the effect of exchange rate uncertainty on the exports from thirteen less developed countries using the Johansen Co-integration technique and the error correction model. In this study exchange rate volatility was found to be inversely related with the exports.

Using the bounds testing approach developed by Pesaran, Shin and Smith (2001), De vita and Abbott (2004) investigated the impact of exchange rate volatility on US exports to Canada, Germany, Japan, Mexico and UK for the time period from 1987 to 2001. They measured volatility as a moving average standard deviation of the real exchange rate. Their study found mixed results. In case of Germany, Mexico and UK the effect of exchange rate volatility was significantly negative while in case of Japan it turned out to be positive. Hence, the effect of exchange rate volatility was indeterminate.

Kasman and Kasman (2005) examined the effect of real exchange rate volatility on the exports of Turkey to its major trading partners over the period 1982-2001. They found that exchange rate volatility had positively affected the volume of exports of Turkey in the long run. Rey (2006) examined the effect of exchange rate uncertainty on the exports of six selected Middle East and North Africa (MENA) countries to 15 EU trading partners over the period 1970-2002 using quarterly data. The study found mixed results. For some countries the effect of exchange rate volatility was negative and for others it was positive.

Using quarterly data over the period 1980 to 2005 Ozturk and Kalyoncu (2009) examined the effect of exchange rate volatility on the trade flows of six countries namely Hungary, Pakistan, Poland, South Africa, South Korea and Turkey. The major findings of the study were that in the long run real exchange rate volatility had significantly negative impact on the trade flows of four out of six countries whereas for the remaining two countries (i.e. Hungary and Turkey) it was found to be positively affecting the exports. Hence the study could not find uniform results for all the countries selected for analysis.

Tandrayen-Ragoobur and Emamdy (2011) evaluated the impact of real exchange rate volatility on the exports of Mauritius for the time period from 1975 to 2007. In this study exchange rate volatility is measured using moving average standard deviation formula and estimations are made using the ARDL methodology. According to the results of this study exchange rate volatility is found to be positively affecting the exports of Mauritius in the short run while in the long run the impact of exchange rate volatility is negative.

Kafle and Kennedy (2013) checked the impact of exchange rate volatility on the agriculture sector trade flows between United States and OECD countries for the period 1970-2010. This study employed gravity model for analysis. The authors found negative impact of exchange rate volatility on the trade flows between United States and the OECD countries. Zakaria (2013) analyzed the effect of exchange rate volatility on the exports of Malaysia to its four major trading partners (i.e. Japan, Singapore, US and UK) using monthly data for the period from January 2000 to August 2012. However, the results obtained by this study were inconclusive. The impact of exchange rate volatility was found to be negative for US and positive for Japan. For the remaining two trading partners no significant relationship between exchange rate volatility and exports could be established.

Bahmani-Oskooee, Harvey and Hegerty (2014) investigated the impact of exchange rate volatility on the United States' trade flows (i.e. both exports and imports) with Spain over the time period 1962-2009. In order to avoid the aggregation bias this study used industry level data of US export and import. The findings of the study indicated that out of 74 US export industries only 35 were affected with exchange rate volatility (11 positively and 24 negatively) whereas the remaining appeared to be insensitive to the changes in exchange rate. Thus this study has shown that the impact of exchange rate volatility could vary from industry to industry.

Yousaf and Sabit (2015) analyzed the impact of exchange rate volatility on the bilateral exports of five original ASEAN member countries to China for the period 1992 to 2011. From their research the authors concluded that every one percent increase in the exchange rate volatility would depress exports by about 0.21 percent. Thus exports seemed to be less responsive to the changes in the exchange rates.

Empirical Studies Related to Pakistan

The empirical work on the relationship between exchange rate volatility and exports of Pakistan is very limited. The first study to check the impact of exchange rate volatility on the exports of Pakistan was conducted by Kumar and Dhawan (1991). In this study the authors estimated the effect of exchange rate uncertainty on Pakistan's exports to its major trading partners in the developed world over the period 1974 to 1985. They found that Pakistan's exports were adversely affected due to unpredictable changes in the exchange rates. Subsequently the empirical works of Mustafa and Nishat (2004), Aurangzeb, Stengos and Mohammad (2005) , Aqeel and Nishat (2006) and Alam (2010) also found that exchange rate volatility had negative impact on the exports of Pakistan. However, all these studies used aggregate exports data (i.e. total exports of Pakistan). Since different sectors/ industries could respond differently to the exchange rate risk, therefore the results of these studies contain aggregation bias.

There are only two studies, one by Aftab, Abbas and Kayani (2012) and the other by Haseeb and Rubaniy (2014), which used disaggregated data to examine the impact of exchange rate volatility on the exports from Pakistan. However, the study by Aftab et al (2012) did not include the product rice in their analysis whereas the study by Haseeb and Rubaniy (2014) did consider rice but along with other products and for a shorter time span. As we know that Pakistan is one of the large exporter of rice in the world and fluctuations in exchange rate could affect the volume of rice exports, it is therefore necessary to examine the impact of exchange rate volatility on rice exports in detail. Thus, there exists scope to explore this issue at length

Methodology and Data

In order to examine the impact of exchange rate volatility on the rice export from Pakistan this study uses annual time series data for the period from 1982 to 2019. In line with the study by De Vita and Abbott (2004) this research work specifies the following model for estimation:

$$lnREX_t = \beta 0 + \beta_1 lnCPS + \beta_2 lnWGDP_t + \beta_3 lnVol_t + e_t \qquad (1)$$

In the above equation the dependent variable REX represents the value of rice export from Pakistan. To capture the impact of financial development and income on the rice industry exports of Pakistan the control variables of credit to private sector (CPS) and world GDP (WGDP) have been included in the above model. The variable of prime interest namely exchange rate volatility (Vol) has been constructed from real effective exchange rate (REER) using the following formula of moving average standard deviation:

$$Vol_t = \left[1/2 \sum_{i=1}^{2} \left(LnREER_{t+i-1} - LnREER_{t+i-2} \right)^2 \right]^{1/2} \qquad (2)$$

In the above equation the subscript t shows time dimension and the number 2 above the summation sign shows the order of the moving standard deviation. The data of the variables have been obtained from different sources. The data for the value of rice exports have been obtained from the UNCOMTRADE under the Standard International Trade Classification (SITC) Revision 2 at 3 digit level. The data for the variables world GDP, Credit to Private Sector and Real Effective Exchange Rate have been obtained from the World Development Indicators database. In the equations 1 and 2, ln represents the natural logarithm of variables.

Results and Discussion

Unit Root Test

The first step in the time series analysis is the stationarity test. Therefore, this study has applied the Augmented Dickey-Fuller (ADF) unit root test for checking the stationarity of variables. In this test the null hypothesis is that the time series variable under consideration contains unit root. The testing criterion is that the test statistic obtained in ADF test is compared with the critical values at different levels of significance, the most common being 5% level of significance. If the value of the test statistic turns out to be smaller in real terms than the critical value, then we reject the null hypothesis and conclude that the time series variable is stationary. In case we could not reject the null hypothesis then the variable is considered to be non-stationary. The results of ADF unit root test are presented in the table 1.

Table 1: Unit Root Test (ADF)

Variables	At Level		At First Difference		Level of Integration
	ADF test statistic	Critical Value at 5%	ADF test statistic	Critical Value at 5%	
LnREX	-2.71	-3.54	-8.22*	-3.54	I(1)
LnCPS	-2.21	-3.54	-4.81*	-3.54	I(1)
LnWGDP	-2.21	-3.54	-4.48*	-3.54	I(1)
LnVOL	-4.02*	-2.95			I(0)

*indicates stationarity at 5% level of significance.

From the results given in table 1 above it is evident that the first three variables namely LnREX, LnCPS and LnWGDP are non-stationary at level but they become stationary at first difference. As regards the fourth variable i.e. LnVOL it has proven to be stationary at level because its ADF test statistic is smaller in real terms than the critical value at 5% level of significance. Since this variable is stationary at level there is no need to check its stationarity at first difference. According to the last column of table 1 three variables are integrated of order one and one variable is integrated of order zero.

After establishing the order of integration, the next step is to check for long run and short run relationship among the variables. For this purpose co-integration and error correction models are estimated. In a situation when some variables are integrated of order one and some are integrated of order zero the appropriate econometric model to apply is the Autoregressive Distributed Lag (ARDL) Model.

ARDL Approach of Cointegration

The ARDL approach of cointegration was introduced by Pesaran and Shin (1999) and further developed by Pesaran et al (2001). This approach of testing for cointegration has certain advantages over other approaches. First of all, the ARDL model does not require that all the variables be integrated of the same order. This model can be applied when some of the variables under consideration are integrated of order one and some of order zero. Another advantage of ARDL model is that it is more efficient in case when the sample size is relatively small. The third advantage of this technique is that it provides unbiased estimates of the long run model even in the presence of endogenous regressors (Harris and Sollis, 2003). As the variables under investigation in the present study are integrated of different orders, therefore the ARDL model has been selected for estimation of the results. The equations for the ARDL model of this study are presented below.

$$D(\ln(REX_t) = a_{01} + b_{11}\ln(REX_{t-1}) + b_{21}\ln(WGDP_{t-1}) + b_{31}\ln(CPS_{t-1}) + b_{41}\ln(VOL_{t-1}) + \sum_{i=1}^{p} a_{1i} D(\ln(REX_{t-i})) + \sum_{i=1}^{q} a_{2i} D(\ln(WGDP_{t-i})) + \sum_{i=1}^{q} a_{3i} D(\ln(CPS_{t-i})) + \sum_{i=1}^{q} a_{4i} D(\ln(Vol_{t-i})) + \varepsilon_{1t} \quad (3)$$

$$D(\ln(WGDP_t) = a_{02} + b_{12}\ln(REX_{t-1}) + b_{22}\ln(WGDP_{t-1}) + b_{32}\ln(CPS_{t-1}) + b_{42}\ln(VOL_{t-1}) + \sum_{i=1}^{p} a_{1i} D(\ln(WGDP_{t-i})) + \sum_{i=1}^{q} a_{2i} D(\ln(REX_{t-i})) + + \sum_{i=1}^{q} a_{3i} D(\ln(CPS_{t-i})) + \sum_{i=1}^{q} a_{4i} D(\ln(Vol_{t-i})) + \varepsilon_{2t} \quad (4)$$

$$D(\ln(CPS_t) = a_{03} + b_{13}\ln(REX_{t-1}) + b_{23}\ln(WGDP_{t-1}) + b_{33}\ln(CPS_{t-1}) + b_{43}\ln(VOL_{t-1}) + \sum_{i=1}^{p} a_{1i} D(\ln(CPS_{t-i}) + \sum_{i=1}^{q} a_{2i} D(\ln(WGDP_{t-i}))+) + \sum_{i=1}^{q} a_{3i} D(\ln(REX_{t-i})) + \sum_{i=1}^{q} a_{4i} D(\ln(Vol_{t-i})) + \varepsilon_{3t} \quad (5)$$

$$D(\ln(VOL_t) = a_{04} + b_{11}\ln(REX_{t-1}) + b_{24}\ln(WGDP_{t-1}) + b_{34}\ln(CPS_{t-1}) + b_{44}\ln(VOL_{t-1}) + \sum_{i=1}^{p} a_{1i} D(\ln(Vol_{t-i})) + \sum_{i=1}^{q} a_{2i} D(\ln(WGDP_{t-i})) + \sum_{i=1}^{q} a_{3i} D(\ln(CPS_{t-i})) + \sum_{i=1}^{q} a_{4i} D(\ln(REX_{t-i})) + \varepsilon_{4t} \quad (6)$$

In the above equations 3 to 6 all the variables are as previously defined. In these equations ln(.) represents natural logarithm, D stands for the first difference and ε_t are the error terms. In the ARDL approach the long run relationship among variables is tested through bounds F-test. The first step of ARDL bounds testing procedure is the estimation of equations 3 to 6 by ordinary least squares. Then F test is applied to check the joint significance of the coefficients of the lagged level variables under the null hypothesis of H_0: $b_{1i} = b_{2i} = b_{3i} = b_{4i} = 0$ against the alternate hypothesis that H_1: $b_{1i} = b_{2i} = b_{3i} = b_{4i} \neq 0$. The critical values for conducting this test were constructed by Pesaran et al (2001) at two different levels i.e. lower level and upper level. If the calculated F statistic exceeds the upper critical value then the null hypothesis of no cointegration is rejected. If the F statistic value is below the lower critical bound then we cannot reject the null hypothesis and if the value of F statistic falls between the lower and upper bounds then the test becomes inconclusive. The results of the bounds test are presented in the following table 2. The calculated F statistics are shown in the 3rd column of the above table. These values have been obtained by considering each variable of this study as a dependent variable turn by turn. According to the results given in the table 2 there is cointegration (i.e. long run relationship) among the variables of this study because in all the cases the values of calculated F statistics are greater than the upper critical value at 5% level of significance.

Table 2: ARDL Bounds Tests Results

Dependent Variable		F-statistic	Outcome
F_{REX} (REX\WGDP, CPS,VOL)		10.02	Cointegration
F_{WGDP} (WGDP\ REX, CPS,VOL)		14.19	Cointegration
F_{CPS} (CPS\ REX, WGDP ,VOL)		20.82	Cointegration
F_{VOL} (VOL\ REX, WGDP , CPS)		6.38	Cointegration
Lower Critical Value at 5%	3.23		
Upper Critical Value at 5%	4.35		

Source: Author's Calculation.

After confirming the existence of cointegration among the variables, the next step is to estimate the long run coefficients under the ARDL approach. The conditional ARDL model is specified in the equation below for long run estimates.

$$\text{Ln}(REX_t) = a_0 + \sum_{i=1}^{p} a_{1i} \ln(REX_{t-i}) + \sum_{i=0}^{q_1} a_{2i} \ln(CPS_{t-i}) + \sum_{i=0}^{q_2} a_{3i} \ln(WGDP_{t-i}) + \sum_{i=0}^{q_3} a_{4i} \ln(Vol_{t-i}) + \varepsilon_t \quad (7)$$

The lag length in the above ARDL model has been selected on the basis of Akaike Information Criterion (AIC). The optimal lag length of the ARDL model as specified by AIC is (3, 0, 1, 3). The estimated long run coefficients are reported in table 3 below.

Table 3: Estimated Long Run Coefficients of ARDL (3,0,1,3) Model

Variable	Coefficient	t-Statistic	Probability
Ln(CPS)	2.007	2.339	0.028
Ln(WGDP)	1.969	7.613	0.000
Ln(VOL)	0.023	0.249	0.805
C	-47.394	-4.498	0.000

Source: Author's Computations.

In the light of the results given in table 3 the estimated long run coefficients of the credit to private sector (CPS) and world GDP (WGDP) are statistically significant. As expected the impact of credit to private sector and world GDP on Pakistan's rice exports is positive. One percent increase in credit to private sector could boost rice exports by 2.007% and one percent increase in world GDP leads to 1.969% increase in exports of rice from Pakistan. As regards the impact of exchange rate volatility (Vol) it has turned out to be insignificant. The reason for its insignificance could be attributed to the fact that rice is a staple food whose price elasticity is quite low. Therefore, rice is found to be insensitive to exchange rate fluctuations.

After discussing the long run relationship among the variables, the next step is to look at the short run dynamics through the estimation of an error correction term of the ARDL model. For a model to be convergent towards long run equilibrium the error correction term should have a negative sign and be statistically significant. According to our results the coefficient of the error correction term is -0.479 with p-value of 0.0047 indicating level of significance at 1%. The magnitude of the error correction coefficient indicates that about half of the adjustment towards the long run equilibrium takes place within a time span of one year.

Next in order to check the validity of the estimated model of this research work some diagnostic tests have been conducted and their results are given in the following table 4.

Table 4: Diagnostic Tests Results

Test	Chi Square Statistic	Probability
Jarque Bera Test	0.68	0.71
White Heteroskedasticity Test	11.28	0.34
Breusch-Godfrey Serial Correlation Test	1.03	0.59

Source: Author's Computation

According to the results reported in the above table our model passes all the diagnostic tests. This can be confirmed from the probability values shown in the last column of table 4 which indicates that the null hypothesis in all the tests could not be rejected. The null hypotheses of these tests are as under:

Jarque Bera Test → Ho= The error term is normally distributed

Heteroskedasticity Test → Ho= The error term has constant variance

Serial Correlation Test → Ho= The error term is free of autocorrelation

Thus it can be concluded that the model employed for estimation purpose in this study is a good one. The next step is to check for parameter stability. In order to examine the stability of the long run and short run coefficients of the model CUSUM (Cumulative Sum of Recursive Residuals) and CUSUMSQ (Cumulative Sum of Squares of Recursive Residuals) tests are applied. These tests are of graphical nature. In these tests we look at the graphs of CUSUM and CUSUMSQ to determine parameter stability. The CUSUM and CUSUMSQ plots of this study are shown in figures 1 and 2 below.

Figure 1: Plot of CUSUM

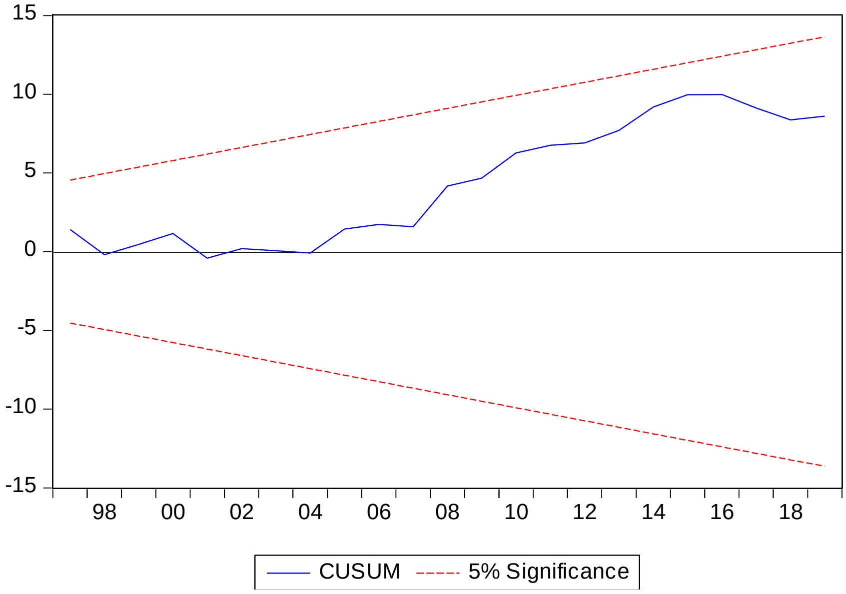
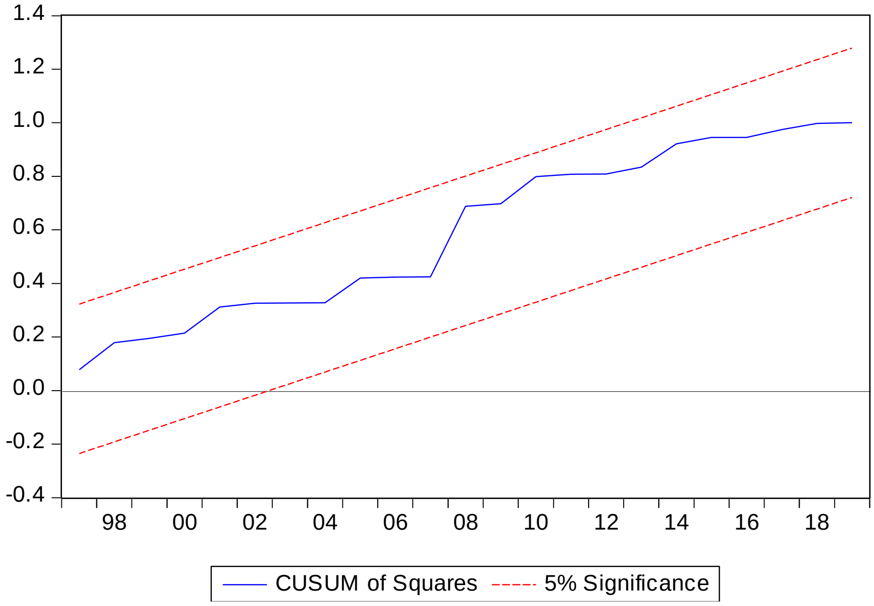


Figure 2: Plot of CUSUMSQ



From the figures 1 and 2 it is evident that the plots of both CUSUM and CUSUMSQ stay within the 5 percent level of significance lines. Hence it is concluded that the estimated parameters of the ARDL model remain stable over the entire sample period.

Conclusion

This study has analyzed the impact of exchange rate volatility on the rice industry exports from Pakistan over the period 1982 to 2019. The exchange rate volatility in this research work has been measured using the moving average standard deviation formula. The result of this study indicates that exchange rate volatility does not have a significant impact on the rice industry exports. This result is in conformity with the findings of Bahmani-Oskooee et al (2014) who reported that almost half of the American industries considered in their study were found to be insensitive to exchange rate volatility (ERV). Although the impact of ERV on rice industry export of Pakistan is not found to be statistically significant, yet it is not advisable to let the exchange rate move up and down erratically. Basically exchange rate is a key policy variable in an open economy and unpredictable changes in it could affect the economy adversely and even could render the policies of Govt. ineffective. In fact exchange rate stability generates macroeconomic stability and macroeconomic stability in turn could boost the export performance of the economy and thus pave the path for economic development. Therefore it is recommended that Government should take effective steps to maintain exchange rate stability in order to make Pakistan's exports more competitive in the international market.

Moreover, the results of this study showed that credit to private sector has positive and significant impact on the rice industry exports. Therefore, it is recommended that more credit facilities should be made available for rice exporters to stimulate exports from this industry.

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