RESEARCH ARTICLE

Empirical Evidence from NARDL Analysis: An Asymmetric Effect of Exchange Rate Volatility on Agricultural Sector in Pakistan

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Abstract: In the literature for Pakistan, the asymmetric effect of the exchange rate on the agricultural sector stands ignored. Current research is designed to investigate the possible asymmetric effect of exchange rate fluctuations on the agricultural sector using a nonlinear autoregressive distributed lag (NARDL) framework. The data set comprises a period of 1970 to 2019, which is taken from the Ministry of Finances and handbook of the State Bank of Pakistan. The variables used in the study are real effective exchange rate, agricultural production, inflation, primary export, government investment, terms of trade, imports, and exports. The ADF unit root test confirmed that the research series is a combination of stationary and non-stationary variables. The study, therefore, uses the ARDL approach, but the focus is to investigate the asymmetric effect; thus, the NARDL technique is also applied. The NARDL results suggest that positive movements have lesser impacts than those of negative movements in the exchange rate on the agriculture sector both in short run and in the long run.

Keywords: asymmetry, agricultural sector, exchange rate fluctuation, Pakistan

Agriculture is a pedestal of food security, a source of raw materials for numerous industries, and a major part of exports. Agriculture, food security, and economic growth connect and support one another in the development process. Pakistan is an agrarian region, and therefore a prerequisite for achieving food security is an increase in agricultural production (Rehman et al., 2015). Agriculture contributes 19.3% to Pakistan's GDP, employs 42% of the labor force, makes up 65% of export earnings, and provides livelihoods for 62% of the country's population (Government of Pakistan , 2019)

Pakistan's exported food includes rice, fruits, vegetables, fish, and unprocessed tobacco. Agriculture contributed about 19.6% of overall export in 2019 (Pakistan Bureau of Statistics, 2019) with rice comprising 44.4% of total food. Among other products, fruits capture the second-highest position with a growth of 8.7% as compare to previous year. Pakistan managed to explore new international markets for fruit export by participating in the Berlin Fair (Trade Development Authority of Pakistan, 2019). Other important components of the food group include oilseeds, nuts and kernels, spices, and wheat.

Over the past decade, Pakistan's agricultural sector has faced several major challenges, including exchange rate fluctuations. As with any other sector, the agricultural sector remains largely affected by fluctuations in exchange rates directly and indirectly (Frieden et al., 2010; Bahmani & Xu, 2012). Directly, this is usually the case regarding the import of raw materials and other modern farm equipment by the sector and the export of their production (Mustafa et al., 2004). Pakistan imports oil, which is used as a raw material in the agriculture sector. With the change in the exchange rate, the oil prices change, which affects the cost of agricultural production by increasing the cost of raw material (Camp, 2019).

The indirect effects of the exchange rate on agriculture can be especially pronounced because many major agricultural commodities are internationally tradable goods. Moreover, as the Pakistan government seeks new revenue sources to ease its budgetary problems, increased explicit taxation of the large agricultural sector has become a serious option. Therefore, shifts in exchange-rate policy have major implications for the relative domestic prices and economic development of a country through their effects on the real exchange rate (Inam & Umobong, 2015). The exchange rate system affects economic growth positively (Aizenman, 2018), and the real rate is a measure of the terms of trade between the economy's traded and non-traded sectors, which sets the signal for resource movements (Nadeem, 2010).

The exchange rate can influence the economy by changing the employment level and affecting production, both in the agricultural and industrial sectors. In this respect, export-led growth can be one possible avenue (Hussain et al., 2019). Pakistan also had an overvalued currency, similar to other emerging economies (Hussain et al., 2019). In recent years, significant shifts in exchange rate policy have occurred. The key objective of the strategy before March 2013 was to stabilize the effective real exchange rate (REER) and to move to nominal exchange rate stability against the U.S. dollars after 2013 (Hamid & Mir, 2017).

Pakistan is one of South Asia's developing economies. Its economy is heavily dependent on the international market not only for oil imports but also for imports of technology and inputs for domestic production and consumption. The country faces a continuing trade deficit, which usually results in a reduction of foreign reserves. For almost a decade, Pakistan's exports stagnated at US$ 25 billion, whereas its imports increased to US$ 50 billion, putting enormous pressure on the external balance (Government of Pakistan, 2016).

After its independence, Pakistan has had various exchange rate structures, beginning with a fixed exchange rate system between 1947 and 1982, two significant devaluations (in 1955 and 1972), and one revaluation in 1973. In 1982, Pakistan switched to a controlled floating system that lasted until 1998, during which there were several years of ad hoc exchange rate regimes (Dorosh & Valdes, 1990) and significant depreciation in the nominal exchange rate between 1998 and 2001. Following the nuclear test in May 1998, Pakistan returned to a controlled floating structure in 2001, which it has retained since then (Mahmood et al., 2011).

Pakistan's trade composition depicts that the country exports low-price elastic primary and semi-finished goods and imports both capital goods and crude oil (Hussain et al., 2019). In such a scenario, the intentionally undervalued currency leads to the inefficiency of the exporting sector. Moreover, foreign remittances play a crucial role in the current account position. Pakistan is facing a problem of exchange rate stabilization and easy monetary policy for free mobilization of capital, but diminishing foreign resources deviate from the country to get these objectives (Adil, 2018).

In the past, several researchers debated the effect of the exchange rate on the growth of the agricultural sector, but such empirical literature lacks agreement on the direction and magnitude of the possible impact. In the case of Pakistan, very few studies incorporated the sectoral effect of exchange rate fluctuation. Aftab et al. (2012) studied the effect of exchange rate fluctuation at the sectoral level of the agricultural sector and manufacturing sector and concluded that change in exchange rate had an impact on the sectoral level. Alam et al. (2017) stressed that exchange rate volatility might favor some sectoral exports. They used the food, textile, and manufacturing sectors and found that some sectors are more affected than others. Zia and Mahmood (2013) are of the view that exchange rate depreciation impacts the export of the manufacturing sector. They concluded

concluded that depreciation does not necessarily increase export. They found that the impact on change in the exchange rate is high in the wholesale price index but lower for the consumer price index. The exchange rate affects asymmetrically on exports and imports, and it also impacts on trade balance (Chughtai et al., 2015). Pakistan faces currency deprecation and increased trade deficit most of the time. Abbas and Raza (2013) studied the relationship between the trade deficit and economic growth. The exchange rate had a moderate correlation with the trade deficit. Pakistan exports are greater than its import, and the deficits have increased since its independence. Recent studies (Hamid & Mir, 2017; Javed & Farooq, 2009; Nawaz, 2012; Shahbaz et al., 2012) have shown that devaluation of the currency is boosting the economic growth in Pakistan. All of these studies are based on the assumption that exchange rate has an asymmetric effect; therefore, these studies seem to be missing important insights and do not lay out the asymmetric effect of exchange rate on economic growth. Besides, these empirical studies do not isolate the impact on the economic performance of appreciation from depreciation. Some experiential research (Bahmani-Oskooee & Fariditavana, 2016; Bahmani-Oskooee & Mohammadian, 2017; Bussiere, 2013; Delatte & Lopez-Villavicencio, 2012) proved that the exchange rate changes in inflation, trade, and GDP growth are asymmetrical.

The present study is, therefore, the first attempt to investigate testing for possible exchange rate asymmetric impacts on the agricultural sector in a developing economy like Pakistan. This research demonstrates that the influence of Pakistani currency appreciation on the agricultural sector is distinct from depreciation. The study employs nonlinear autoregressive distributed lag (NARDL) methodology, which was developed by Shin et al. (2014), to test for possible asymmetric effects of exchange rate on agricultural sector changes in the context of a developing economy such as Pakistan. In South Asia, the Pakistani currency has been more volatile concerning its similarly developing counterparts. No research has examined the exchange rate's asymmetric effect to the best of our knowledge. This research, therefore, is pioneering work for providing analysis of the asymmetric effect of exchange rate shifts on Pakistan's agricultural sector.

Methods

Empirical Model, Data, and Estimation Procedure

The study uses time-series data from 1970 to 2019. The variables used in this research are agricultural production (Agri), inflation (WPI), trade (tot), imports (IMP), government investment (INVES), primary export (prim), total export (ex), and real effective exchange rate (RER). For asymmetric effects, exchange rate series are separated into positive change, which indicates an appreciation of domestic currency (RER_POS), and negative change, which shows depreciation of domestic currency (RER_NEG). All data for this research was obtained from the Ministry of Finance and the handbook of the State Bank of Pakistan.

To analyze the long-run relationship between agricultural production and the mentioned variables, we devise the following linear equation. The simple equation of variables are as follows:

$$AGRI = \alpha + \beta_1 WPI + \beta_2 TOT + \beta_3 RER + \beta_4 INVES + \beta_5 PRIM + \beta_6 EX + \beta_7 IM + u \tag{1}$$

The variables are mixed of stationary at level and non-stationary, which is integrated with order one. In this situation, we apply the ARDL methodology. We use a nonlinear framework for this study as nonlinear impacts may exist in time series. The nonlinear model is as follow

$$AGRI = f\left(REF^{+}, RER^{-}\ EX, IM, PRIM, INVES, TOT, WPI\right) \tag{2}$$

Based on the asymmetric relationship between exchange rate and agriculture production, the model takes the shape of:

$$\begin{aligned} AGRI = {} & \eta_0 + \eta_1 \left(RER\right)_t^{+} + \eta_2 \left(RER\right)_t^{-} + \eta_3 \left(WPI\right)_t + \eta_4 \left(TOT\right)_t + \eta_5 \left(INVES\right)_t + \\ & \eta_6 \left(PRIM\right)_t + \eta_7 \left(EX\right)_t + \eta_8 \left(IM\right)_t + \varepsilon_t \end{aligned} \tag{3}$$

Where:

- η_i is concerned with long-run parameters.
- Asymmetric impacts of policy rate are incorporated by positive changes RER^+ and negative changes RER^- respectively.

Equation (1) depicts the long-term effects. To estimate short–term co-efficient, we re-specify Equation (1)

$$\begin{aligned}\ln AGRI &= \eta_0 + \sum_{i=1}^{q}\eta_1 \ln AGRI_{(t-i)} + \sum_{i=1}^{q}\eta_2 (WPI)_{(t-i)} + \sum_{i=1}^{q}\eta_3 (TOT)_{(t-i)} + \sum_{i=1}^{q}\eta_4 (RER)_{(t-i)} + \\ &\sum_{i=1}^{q}\eta_5 (INVES)_{(t-i)} + \sum_{i=1}^{q}\eta_6 (PRIM)_{(t-i)} + \sum_{i=1}^{q}\eta_7 (EX)_{(t-i)} + \sum_{i=1}^{q}\eta_8 (IM)_{(t-i)} + \lambda_1 \ln AGRI_{(t-i)} + \\ &\lambda_2 (WPI)_t + \lambda_3 (TOT)_t + \lambda_4 (RER)_t + \lambda_5 (INVES)_t + \lambda_6 (PRIM)_t + \lambda_7 (EX)_t + \lambda_8 (IM)_t + \varepsilon_t\end{aligned} \tag{4}$$

Equation (4) is an error–correction specification which gives both the long-run and short-run coefficients; λ represents long-run coefficients, whereas differenced variables depict short-run coefficients. However, Equation 4 depicts the symmetric relationship among variables, whereas the interest of this research is to check the asymmetric and nonlinearities of the exchange rate present in time series. The aspect of nonlinearity is crucial for the reason that if components of the series are co-integrated (both positive and negative), then there can exist hidden co-integration asymmetries in the time series (Granger & Yoon, 2002). So, we used NARDL approach presented by Shin et al. (2014) to explore if there are a long-term cointegration and an asymmetrical relationship among variables. The NARDL model is a modified version of the autoregressive distributed lag (ARDL) following Delatte and Lòpez-Villavicencio (2012); Brun-Aguerre et al. (2016); and Bahmani-Oskooee and Mohammadian (2017). Thus, concerning the asymmetric impact, we formalize the nonlinear co-integrating equation. The nonlinear ARDL methodology of decomposition as RER_POS and RER_NEG denote the partial sum of exchange rate processes that accumulate positive and negative changes, respectively.

$$POS_t = \sum_{j=}^{t} \Delta LnRER_j^{+} = \sum_{j=}^{t} \max\left(\Delta LnRER_j, 0\right) \tag{5}$$

$$NEG_t = \sum_{j=}^{t} \Delta LnRER_j^{-} = \sum_{j=}^{t} \min\left(\Delta LnRER_j, 0\right) \tag{6}$$

Summarizing these equations, we obtain the asymmetric error correction equation, which is as follows:

$$\begin{aligned}\Delta \ln AGRI_t &= \eta_0 + \sum_{i=1}^{q}\eta_1 \ln AGRI_{(t-i)} + \sum_{i=1}^{q}\eta_2 (WPI)_{(t-i)} + \sum_{i=1}^{q}\eta_3 (TOT)_{(t-i)} + \sum_{i=1}^{q}\eta_4 (RER\_\mathrm{POS})_{(t-i)} + \\ &\sum_{i=1}^{q}\eta_5 (RER\_NEG)_{(t-i)} + \sum_{i=1}^{q}\eta_6 (INVES)_{(t-i)} + \sum_{i=1}^{q}\eta_7 (PRIM)_{(t-i)} + \sum_{i=1}^{q}\eta_8 (EX)_{(t-i)} + \sum_{i=1}^{q}\eta_9 (IM)_{(t-i)} + \\ &\lambda_1 \ln AGRI_{(t-i)} + \lambda_2 (WPI)_t + \lambda_3 (TOT)_t + \lambda_4 (RER\_POS)_t + \lambda_5 (RER\_NEG)_t + \lambda_6 (INVES)_t + \\ &\lambda_7 (PRIM)_t + \lambda_8 (EX)_t + \lambda_9 (IM)_t + \varepsilon_t\end{aligned} \tag{7}$$

Results

Unit Root Tests

To test the presence of stationary in data augmented Dicky-Fuller (ADF) test was applied. The results of the ADF test were presented in Table 1, which confirms that all variables are stationary at 1(1) and 1(0), but no variable was found to be stationary at 1(2). This is evident from results that series were integrated at different levels; therefore, the NARDL bound test approach proposed by Shin et al. (2014) is considered an appropriate model for long-run relationship analysis between series.

Lag Length Criteria

The optimal lag length was determined in the unrestricted error correction models (NARDL model) using the Schwarz information criterion (SIC) and Akaike information criterion (AIC). AIC and SIC results were presented in Table 2 that depicts that the maximum lag length is chosen as four for the lagged levels of variables.

Table 1

Results of Unit Root Test

	At Level				At First Difference		
	t-Statistic	**Prob.**			**t-Statistic**	**Prob.**	
AGRI	-0.91	0.776	n0	d(AGRI)	-6.63	0.000	***
WPI	-4.88	0.000	***	d(WPI)	-7.61	0.000	***
TOT	-2.98	0.045	**	d(TOT)	-10.91	0.000	***
RER	-0.89	0.783	n0	d(RER)	-4.17	0.002	***
INVES	-2.08	0.254	n0	d(INVES)	-4.52	0.001	***
PRIM	-2.26	0.190	n0	d(PRIM)	-5.95	0.000	***
EX	-2.16	0.222	n0	d(EX)	-4.63	0.001	***
IM	-3.43	0.015	**	d(IM)	-4.70	0.000	***

(*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

Table 2

Results of Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-153.2	NA	3.59E-07	7.864	8.198	7.985
1	148.6	471.122	3.49E-12	-3.737	-0.728	-2.641
2	229.0	94.102	2.26E-12	-4.536	1.148	-2.466
3	330.9	79.570	1.13E-12	-6.387	1.972	-3.343
4	700.9	144.367*	1.05e-17*	-21.311*	-10.277*	-17.293*

Bound Test

The F-statistics of the bound test were presented in Table 3. The calculated value for f-stat is 5.29, which exceeds the upper bound critical value of 3.77 at a 1% level of significance, thereby indicating the cointegration relationship. Pesaran et al. (2001) focused on a significant F-statistic for the confirmation of the long-run equilibrium relationship.

Empirical Results

The results of short- and long-run estimates of the effects of exchange rate fluctuations on agricultural sectors were presented in Table 4 and Table 5, respectively. The short-run results (see Table 4) reflected that lag of agricultural production had a highly significant impact on current year production. Inflation and trade openness had a positive and significant impact on agricultural production. The exchange rate had an asymmetric and significant effect on agricultural production. From the results, it is evident that appreciation of domestic currency had positive but significant effects on agricultural production, but depreciation impacts negatively in the case of Pakistan. Similarly, investment and imports affect agricultural production positively and significantly, whereas primary exports and exports affect agricultural production negatively. All variables' growth rate, except trade openness, significantly impacts agriculture production in the short run. The results are highly significant at one percent.

From Table 5, long-run results show that a unit increase in inflation and trade openness is likely to increase agricultural production by 0.0024 and 0.0015, respectively. High inflation is related to price fluctuations, which then leads to the profitability of farmers. As a result, investment in the agricultural sector will increase, as Mallik and Chowdhury (2001) explained the positive relationship between inflation and growth. Trade openness enhances competition and improves efficiency in resource allocation, which leads to the enhancement of agricultural productivity in the economy (Kahnamoui, 2013). With trade openness, access to the world market increases, which allows economies to achieve economies of scale. An increase in trade openness leads to an increase in productivity gains through international diffusion and adoption of new technologies, which enhance the benefits of foreigners, ultimately increasing agricultural production. It can, therefore, be argued that trade openness has a positive and favorable impact on agricultural production in the case of Pakistan, with more economies of scale and an increase in productivity. The results are aligned with the findings of Din et al. (2004). The effect of the exchange rate on production is inconclusive in literature, as explained by different researchers.

Similarly, appreciation is likely to increase production by 0.183 units. On the contrary, depreciation is expected to decrease production by 0.378 units. Appreciation in domestic currency leads to an increase in imports of machinery and raw materials used in the agricultural sector at cheaper rates, which motivates the farmers to use improved technology to increase production and hence profit. In the case of depreciation, vice versa situations will occur (Gotur, 1985; Medhora, 1990). Government investment and total exports pose a positive link with agricultural production, as Mahmood et al. (2011) explained. They show that the exchange rate positively affects export, which leads to an increase in demand for exported goods. As the results confirm, one unit increase in investment and total export will increase production by 0.141 and 0.029 units, respectively. Evensom (2001) and Alston et al. (2010) found that returns to agricultural

Table 3

Results of Bound Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
F-statistic	5.295581	10%	1.85	2.85
k	8	5%	2.11	3.15
		2.50%	2.33	3.42
		1%	2.62	3.77

Table 4
Short-Run Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.031	1.033	4.871	0.000
AGRI(-1)*	-1.064	0.207	-5.142	0.000
WPI(-1)	0.003	0.001	2.738	0.017
TOT(-1)	0.002	0.001	3.168	0.007
RER_POS(-1)	0.195	0.050	3.930	0.002
RER_NEG(-1)	-0.403	0.170	-2.376	0.034
INVES(-1)	0.151	0.038	3.982	0.002
PRIM(-1)	-0.084	0.024	-3.530	0.004
EX(-1)	-0.040	0.038	-1.051	0.312
IM(-1)	0.031	0.036	0.861	0.405
D(WPI)	-0.001	0.000	-2.480	0.028
D(WPI(-1))	-0.003	0.001	-4.135	0.001
D(WPI(-2))	-0.001	0.000	-2.638	0.021
D(TOT)	0.0001	0.0024	0.0624	0.9512
D(TOT(-1))	-0.001	0.000	-1.912	0.078
D(RER_POS)	-0.098	0.057	-1.706	0.112
D(RER_POS(-1))	-0.231	0.069	-3.338	0.005
D(RER_POS(-2))	-0.082	0.056	-1.452	0.170
D(RER_NEG)	0.024	0.115	0.204	0.841
D(RER_NEG(-1))	0.226	0.161	1.406	0.183
D(RER_NEG(-2))	0.227	0.145	1.572	0.140
D(INVES)	-0.022	0.042	-0.531	0.605
D(INVES(-1))	-0.109	0.043	-2.556	0.024
D(PRIM)	-0.020	0.012	-1.648	0.123
D(PRIM(-1))	0.030	0.016	1.810	0.093
D(PRIM(-2))	0.037	0.012	3.048	0.009
D(EX)	0.053	0.037	1.439	0.174
D(IM)	0.003	0.034	0.098	0.924
D(IM(-1))	0.009	0.036	0.245	0.810
D(IM(-2))	-0.044	0.027	-1.612	0.131
CointEq(-1)*	-0.860	0.11	-9.47	0.00

research and development and government investment positively impact agricultural production. Similarly, our results of total exports are in line with the results of Mahmood and Munir (2018). In the same manner, one unit increase in primary export and imports will lead to 0.078 and 0.037 units decrease in agricultural production, respectively. An increase in export provides employment opportunities, which lead to an increase in output. Increase export widen the markets that enable farmers to lower the cost by attaining economies of scale (Balassa, 1978). An increase in exports leads to an increase in the efficiency of resource allocation by an increase in international competition, which leads to the utilization of new technology and production of quality goods (Olowofeso & Olorunfemi, 2006).

The dynamics of the short-run are very crucial due to ECM co-efficient. The lagged error correction co-efficient, ECM (-1), is visible in the last row of Table 4, where it is appropriately negative and significant, showing cointegration between variables. The *ECM* t-$_1$ co-efficient exhibits the adjustment pace of the long-run equilibrium after experiencing a short-term shock. *ECM* t-$_1$ co-efficient – 0.860 indicates that the last year shocks disequilibria revert to long-run equilibrium in the present year.

Asymmetric Test

The asymmetry in the relationship can be observed from the size of the coefficients. However, to confirm the asymmetric association between variables, the Wald test is employed. The results of the Wald tests in Table 6 indicate the existence of asymmetric effects of the exchange rate to positive and negative change. The result of the NARDL model and Wald test supports the results in which negative and positive change of exchange rate had a different effect.

Dynamic Stability

We then proceed to evaluate the adequacy of the specification and dynamic stability of the model by running diagnostic tests. Firstly, we check the normality of data through the Jarque Bera test result (Table 7),

Table 5

Long Run Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WPI	0.0024	0.0008	2.8893	0.0127
TOT	0.0015	0.0005	3.3058	0.0057
RER_POS	0.1835	0.0419	4.3800	0.0007
RER_NEG	-0.3784	0.1372	-2.7584	0.0163
INVES	0.1419	0.0344	4.1203	0.0012
PRIM	-0.0787	0.0173	-4.5581	0.0005
IM	-0.0378	0.0345	-1.0939	0.2939
EX	0.0293	0.0311	0.9430	0.3629
C	4.7265	0.2038	23.1894	0.0000

Table 6

Asymmetric Test

Wald Test:			
Test Statistic	**Value**	**Df**	**Probability**
t-statistic	2.844382	13	0.0138
F-statistic	8.090508	(1, 13)	0.0138

which shows that data is normally distributed. Secondly, we check for serially independent errors. This step is essential as the requirement of ARDL methodology is "Gaussian error," so it is crucial to establish that the error is serially independent, otherwise it may affect the choice of optional lag length. Thus, we test autocorrelation, heteroscedasticity, and functional form to ensure the presence of Gaussian error. All the diagnostic test statistics show that data is not serially correlated, and no heteroscedasticity was correctly specified. The results are given in Table 7.

Structural Stability Test

Furthermore, ensuring the dynamic stability of the model is essential as the autoregressive model is highly sensitive to lag length, sample point, and number variables. Brown et al. (1975) suggested the Cusum and Cusum square test, which are employed to know the parameter stability of the model in case of OLS. Figure 1 (a, b) exhibits the graphs of CUSUMSQ and CUSUM. We apply these tests on the lines of Brown et al. (1975), which clearly suggest that the model does not depict any serial correlation and heteroscedasticity and residuals are distributed normally. The results show that the NARDL model is stable. The blue line is within boundary of a 5% level of significance. Thus, the model is stable.

Figure 1

Table 7

Dynamic Stability

Diagnostic test: NARDL model			
Issue	**Diagnostic**	**Probability**	**Result**
Autocorrelation	Breusch-Godfrey LM=1.138899	0.3552	No serial correlation
Specification	Ramsey Reset =0.933918	03529	Correctly specified
Heteroskedasticity	Breusch-Pagan-Godfrey=1.374906	0.2771	No heteroskedasticity
Normality	Jarque _ Bera =0.4155	0.8123	Normality exist

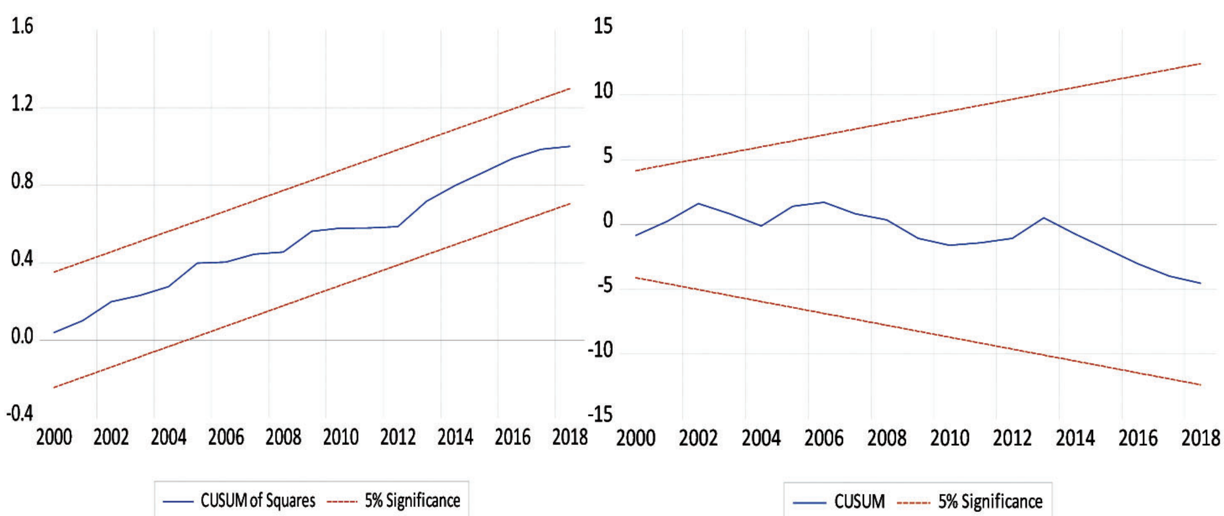

Figure 1. The Figure of CUSUMQ and CUSUM

Discussion

The debate relating to the impact of the exchange rate is not new. Atkinson et al. (1976) found that the exchange rate plays an important role in the growth of the agricultural sector. Moreover, some researchers argued that the effect of the exchange rate is negligible or small in the agriculture sector (Chambers & Just, 1979). Exchange rate volatility affects economic growth by affecting trade and domestic prices (Schwartz, 1986). The question is whether the exchange rate affects the agricultural sector in the case of Pakistan. The focus of the current study is to analyze the effect of the exchange rate whether its impact on the agriculture sector is large or small.

Efficient agricultural production not only optimizes the economy but also helps to achieve the food safety goal. The path towards effective agricultural production was dotted with volatility in the exchange rates. The present study examined the asymmetric effect of real exchange rate dynamics on Pakistan's agricultural sector from 1981 to 2019. The variables used in this study were agricultural production, real exchange rate, inflation, government investment, primary export, import, and total export. By using the nonlinear ARDL approach proposed by Shin et al. (2014), the study estimated the existence of the asymmetric effect of the exchange rate on agricultural production. In the current research, exchange rate appreciation and depreciation have asymmetrically affected the agricultural sector. Study findings showed that real appreciation has a negative impact, whereas real depreciation in the case of Pakistan has a positive effect on the agricultural sector. A 1% decrease in currency value leads to an increase in production by 0.378 units. Adekunle and Ndukwe (2018), Gotur (1985), and Medhora (1990) also found similar results of depreciation on total agricultural output. In the case of a 1% increase in currency value, agricultural production increases by 0.183. The reason could be that appreciation usually results in cheaper imports, particularly imports related to agricultural inputs like machinery and raw material. The availability of cheaper raw material provides the farmer incentive to increase agricultural production. These results are in line with that of Johnson et al. (2012).

Inflation and trade openness have a significant positive impact on agricultural production, whereas government investment and total export prove to be positive drivers of agricultural productivity. Literature showed that high inflation is related to price fluctuations which then lead to the profitability of farmers. As a result, investment in the agricultural sector will increase. Mallik and Chowdhury (2001) explained the positive relationship between inflation and growth, but Van Zyl (1986) found the opposite results that high inflation declines the profitability by reducing the purchasing power.

Current research results of trade openness matched with that of Kahnamoui (2013), who said that trade openness enhances competition and improves efficiency in resource allocation, which leads towards the enhancement of agricultural productivity in the economy. Besides, attractive export and import opportunities between countries have led to standards of quality and stable production being sustained (De Silva, 2013).

Results further showed that import and export positively affect the agricultural sector in the short run. In the long run, imports have a negative association, but export has a positive association with the agricultural sector. Similar results were reported by Ali et al. (2020). Export had a negative effect on growth, as found by Edeme et al. (2016). Another study by Anowor et al. (2013) found that imports negatively affect growth as imports are greater than export. Export is the tool to boost the economic growth of the economy because as export grows, the employment opportunities increase as a result, which leads towards sustainable growth (Ram, 1987). Similarly, Dorosh et al. (2010) found that diversification in export plays a significant role in the growth of or enhancement of the agricultural sector.

The country's macroeconomic variables like inflation, government investment, import, and export are heavily affected by the exchange rate. These macroeconomic variables play a very significant role in agricultural production.

Based on the findings of current research, the following recommendations are put forward:

- Because of the asymmetric impact of the exchange rate on agricultural production, efforts need to be made by the government to boost the competitiveness of the agricultural sector.
- An increase in local raw material sources can be instrumental in spilling over the exchange rate asymmetric effect.
- The government should enhance agriculture productivity and incomes simultaneously by

providing subsidies on imported goods and special relief for exported goods. More research and development on seed varieties, improving resource use efficiency, and promoting modern technologies. Transfer of technology in agricultural production can play a significant role in increasing agricultural production and hence economic growth.

Limitations of the Study

Growth in the agricultural sector is vital for economic development (Iqbal et al.,2003), the economist should pay considerable attention to this sector. The agricultural sector is a combination of crops, livestock, forestry, and fishing. In the current research, total agricultural production is taken, but further research should be conducted to check the effect of exchange rate fluctuations in each sector. Proper data availability is the main concern to hurdle in this regard. The data is not available for deeper analysis.

Declaration of ownership:

This report is our original work.

Conflict of interest:

None.

Ethical clearance:

This study was approved by our institutions.

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