The impact of real effective exchange rate on revealed comparative advantage and trade balance of Pakistan

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Article Info	Abstract
	This study estimates the effects of devaluation and appreciation of real effective exchange rate ($REER$) on revealed comparative advantage (RCA) at Harmonized System 2-digit level of exports in Pakistan. A non-linear Autoregressive Distribute Lag ($ARDL$) technique is applied to test the asymmetric evidence. This study employs two models to explore the export performance. **Findings/Originality:** The results of model 1 estimation confirm the proof of asymmetric $ARDL$ and concludes that devaluation has a positive effect on selected RCA's index value and helps enhance exports of Pakistan. Meanwhile, the appreciation of $REER$ is having an adverse impact. Model-2 estimates the effect of these selected RCA's, $REER$, and world aggregated income (Yw) on the trade balance (TB) of Pakistan. The results estimate that an increase in selected RCA's index values, world aggregated income, and REER depreciation is useful to decrease in deficit TB of Pakistan.

Introduction

In the current era of globalization, a decrease in trade barriers, technological improvement, and exports determine the revealed comparative advantage. Most of the developing countries, including Pakistan, intend to expand their markets by reducing their production costs and achieving economies of scale to compete with their giant competitors in the region (Saeid Mahdavi & Sohrabian, 1993). Moreover, exports are also one of the key channels to transfer technology and skills to the developing economies (Kale, 2001). The exports led-based policies should focus on boosting exports to generate foreign reserves and balance of payment surpluses (Holmes & Panagiotidis, 2009; Onafowora, 2003). There may be numerous factors that can determine the trade performance of any country. As an example, absolute advantage, relative advantage, and differences in product cost, terms of trade (TOT), the concentration of advanced-technology, revealed comparative advantage (RCA), real effective exchange rate (REER), world-aggregated income, etc. (Bahmani-Oskooee, 2001; Bahmani-Oskooee & Fariditavana, 2016; Smith, 1976).

In the presence of giant-exports competitors, developing countries like Pakistan are conscious of boosting their export share in the world. The way to survive for any developing country is to capture more product share in the world markets if she has a comparative advantage in certain products. One of the critical factors like devaluation of the real effective exchange rate may help assess the world markets by reducing export prices. The REER has a significant impact on exports and imports of any economy (Kemal & Qadir, 2005). An appreciation or depreciation in the domestic currency may result in a change in the balance of trade of any county, e.g.,

depreciation causes cheaper exports and more expensive imports, which lead to deterioration in the trade balance in the short-run (Magee, 1973). The *REER* has significant impacts on macroeconomic policies and the country's economic growth (Baharumshah, 2001).

Some scholars used exchange rate and trade balances data and concluded that there is a long-run relationship between the real effective exchange rate (*REER*) and trade balance in their relevant examined data sets. They are Bahmani-Oskooee (1991, 2001), Bahmani-Oskooee and Ratha (2004), Baral et al. (2006), Greenwood (1984), Halicioglu (2008), Hussain and Bashir (2013), Mahdavi (2000), Mohammad and Hussain (2010), Rahman, Mustafa, and Burckel (1997), and Rose and Yellen (1989).

Kamin and Rogers (1997) investigated the positive and long-run rational impact between output and real effective exchange rate (*REER*). They concluded that devaluation leads to contractionary effects on economic growth and the high inflation rate in Mexico. Rahman and Mustafa (1996) examined that devaluation has a healthy and significant impact on India and Nepal's trade balance. They also used the trade balances of six Asian countries, including Pakistan, and examined that the exchange rate devaluation has a long-run effect on Pakistan.

Many researchers like Bahmani-Oskooee and Fariditavana (2015, 2016), Lin and Fu (2015), and Shahid and Afzal (2013) and found the non-linear association between exchange rate and balance of trade. Applied the technique of *NARDL* to check the non-linearity between real exchange rate and trade balance. They concluded an inverse relationship between the exchange rate (*ER*) and trade balances (*TB*) of exporting crude oil.

Pakistan has been facing a trade deficit for the last many decades. Mohammad and Hussain (2010) empirically examined that Pakistan has a trade surplus in 1952-53 due to the Korean War when Pakistan's exports significantly increased. Secondly, in 1972-73, the government devalued the domestic rupee by 131% to give export incentives to the exporters and imposed the tariff on imports. Pakistan adopted a managed floating exchange rate in 1982. According to the State Bank of Pakistan, Pakistan is trading with more than 150 countries. Pakistan's per capita trade is 199 USD. Pakistan's current GDP is 283.7 billion USD. GDP growth rate was 5.3% in 2018 (SBP, 2018). Exports & imports of merchandise share in the world's trade are 0.13% and 0.29%, respectively. The current account deficit is 12.1% of GDP (WTO, 2018). Pakistan is the 5th largest populous country in the world. Pakistan is the 66th largest export economy and ranked as the 87th most complex economy in the world (The Atlas of Economics Complexity Index, 2018). Exports and imports are valued at 21,686 million USD & 48,582 million USD, respectively, Pakistan Bureau of Statistics (PBS, 2018).

In 2007-08, the rupee depreciated, and the exchange rate increased to 62.55 PKR /USD. As a result, exports increased by 20.427 billion USD. Further depreciation of the rupee took place in 2016-17, and the exchange rate jumped to 104.69 PKR /USD, exports rose to 21.686 billion USD, according to various Economic Survey of Pakistan (ESP, 2018). The share of agriculture, industries, and services & others is 19.53%, 20.88%, and 59.59% of GDP, respectively (ESP, 2018). Significant exports of Pakistan at HS 2-digit level products are textiles, which are worth of 12546 million USD, vegetable products of 2409 million USD, and minerals of 1082 million USD, the leather of 1000 million USD, and food beverages of 802 million USD. The major export destinations are USA, China, UK, Afghanistan, Germany, and the United Arab Emirates, which have a share of 17%, 9%, 8.1%, 6%, 6.3%, and 4% of the total exports of Pakistan respectively (WDI, 2018).

Figure-1: positive and negative shocks of the real effective exchange rate (*REER*) of Pakistan from 1980 to 2018 by taking the year 2010 as a base year. Figure-2 indicates selected comparative advantage (index values) of RCA_1 hides & skins, RCA_2 textiles, clothes, and RCA_3 vegetables. Figure-3 shows a vast dispersion of imports and exports data. Figure-4 indicates the export product share (%), world growth (%), the country's growth (%), and the index value of

RCA_1 hides & skins. Figure-5 elucidates that RCA_2 textiles and clothes contain the highest portion of export commodities at the HS-2-digit level of products of Pakistan (see Annexure-I).

One of the critical purposes of this research study is to explore Pakistan's export competitiveness by using Balassa (1965) revealed comparative advantage index (*RCA*) for selected sectors at HS 2-digit level of products. Primarily, to check whether the impact of fluctuations in *REER* (i.e., positive shock & negative shock) have significant effects on our selected *RCA*'s index values or not. Secondly, to check the impact of *REER*, world aggregated income, and our selected *RCA*'s indexes on Pakistan's trade balance.

This research is novel in some ways. Waliullah, Kakar, Kakar, and Khan (2010), Shahid and Afzal (2013), and Hussain and Bashir (2013) examined the impact of the real effective exchange rate on the trade balance of Pakistan. However, there is no prior research studies have highlighted the importance of selected *RCA*'s in the external sector of Pakistan by taking into account the positive and negative shocks of *REER* by applying a new technique (asymmetric autoregressive distributed lag). Secondly, this research study considers the Balassa (1965) *RCA* index, which helps explain Pakistan's specialization in a particular sector or industry in the world. Thirdly, this research will try to improve Pakistan's trade balance by boosting its untapped export demand in the world through a favorable exchange rate regime.

Methods

Real Effective Exchange Rate: Theoretical Framework

The theoretical background of the real effective exchange rate (*REER*) is a proportion of prices of non-tradable goods (P_{nt}) to tradable goods (P_n). Due to this logic, policymakers and economists often depend upon the *REER* that is occupying by the index ratio of local and foreign consumer rates, to proximate the *REER* (Henry & Longmore, 2003). The *REER* can be expressed as $e = (r/r^*)(p/p^*)$, where r is the local exchange rate depicted in terms of international currency, r^* is a compound of trading partners exchange rate, P is a local rate index, and P^* is an external rate index.

Various Measurement of Revealed Comparative Advantages (RCA's) Indexes

Many studies define the measurement of comparative advantage. For example, *RCA* was empirically studied the first time by Liesner (1958) by the following method:

$$RCA_1 = \frac{X_{pj}}{X_{nj}} \tag{1}$$

where X_{pj} represents the exports of country p for commodity j and X_{nj}; n is the set of countries for j commodities or sectors.

Balassa (1965) introduced the following measure. It has two dimensions, i.e., greater than one and less than one. If the *RCA* is greater than 1, the country has revealed comparative advantage in that commodity or industry. When the value of *RCA* is less than one, the result is reversed, i.e., the comparative disadvantage in that industry or sector. Balassa (1965) *RCA* index is calculated as follow:

$$RCA_2 = RCA_{PL} = (X_{PL}/X_p)/(X_{WL}/W_w) \tag{2}$$

X_{PL}: exports of product L by country P, X_P: total exports from country P. X_{WL}: total exports of product L by the rest of the world, X_W: total exports from the world. Greenaway and Milner (1993) introduced to measure *RCA* is

$$RCA_3 = (X_{pj} - M_{pj})/(X_{pj} + M_{pj}) \tag{3}$$

$X_{pj} - M_{pj}$ = the difference in exports & imports of the country p for j sector. The RCA_3 ranges as $-1 \leq RCA_3 \leq +1$. However, the closer the value to $+1$, the greater the revealed comparative advantage will be according to that RCA index. Vollrath's (1991) RCA in logarithmic form can be written as

$$RCA_4 = RTA = lnRX_A - lnRM_A \tag{4}$$

This index represented the difference between the logarithmic revealed export advantage and revealed import advantage.

In short, some of the researchers, including Hoen and Oosterhaven 2006), Laursen (1998), and Proudman and Redding (2000) tried their best to overcome the shortcomings of the Balassa RCA index and introduced many alternative RCA indices. However, no one could succeed in rule out all these deficiencies. Therefore, Balassa (1965) RCA index is still widely recognized as one of the standard measures to estimate the revealed comparative advantage as a standard measure.

Model Specification

To examine the degree of trade-specialization of a specific country, Balassa (1965) recommended (RCA) as

$$RCA_{PL} = \left(X_{PL}/X_p\right)/\left(X_{WL}/X_{wp}\right) \tag{5}$$

Model 1 is constructed to check the impact of $REER$ movement on RCA of these commodities, as suggested by Shin et al. (2011), by using the bivariate model:

$$RCA_{it} = \beta_0 + \beta_1 lnREER_t^+ + \beta_2 lnREER_t^- + \mu_t \tag{6}$$

where i; 1, 2, 3 and t; 1980 to 2018, $RCA_1, RCA_2,$ and RCA_2 are Balassa (1965) index value of RCA's, hides & skins, textiles & clothes, and vegetables at HS-2-digit level of products respectively ln $REER^{+,-}$; the natural log of the positive and negative shock of the real effective exchange rate of Pakistan.

Model 2 is constructed to evaluate the impact of the real effective exchange rate, selected revealed comparative advantage indexes and world's aggregated income on the trade balance of Pakistan, use the following, adopted by Rose and Yellen (1989):

$$lnTB_t = \alpha_0 + \alpha RCA_1 + \beta RCA_2 + \gamma RCA_3 + zlnYw_t + \lambda lnREER_t + \varepsilon_t \tag{7}$$

where lnY_w is world aggregated income, and other variables have been explained in model M-1.

Annual data for Pakistan's export commodities are in the U.S. dollar and used to examine the non-linear relationship between each selected RCA and $REER$ at HS 2-digit level products from 1980 to 2018. Data of RCA Balassa index is obtained from United Nations Commodity Trade Statistics Database (UN-COMTRADE), and World Integrated Trade Solution (WITS), data for $REER$ and world aggregated income is taken from World Development Indicator (WDI), and State Bank of Pakistan (SBP).

Table 1 presents a brief description of the variables.

Table 1. Description of Variables

Selected RCA (Index)	Dependent Variable			Independent Variable (ln)	
Variable	RCA_1 Hides & Skins	RCA_2 Textiles & Clothes	RCA_3 Vegetables	$REER$ (PKR)	World Aggregated Income (Yw)
Measurement	Index Value > 1	Index Value > 1	Index Value > 1	Constant base=2010	In Billion USD

Sources: UN-COMTRADE, WITS, and WBDI form 1980-2017

The nature of this research is two-folded. So, we assume the following symmetrical model by adding a REER variable as a determinant of revealed comparative advantage (*RCA*). The proposed model is:

$$RCA_t = \beta_0 + \beta lnREER_t^{+,-} + \mu_t \tag{8}$$

A Non-linear Autoregressive Distributed Lag (*NARDL*) technique developed by Shin et al. (2011) will be followed to observe the impact of positive shock (depreciation) and negative shock (appreciation) of the *REER* on revealed comparative advantage (*RCA*) index value. *NARDL* technique also has the advantage of solving the multi-collinearity problem by taking the appropriate lag order for the variables. Furthermore, Shin, Yu, and Greenwood-Nimmo (2014) suggested a methodology to differentiate one variable into two variables in the following manners:

$$PREER_t = \sum_{j=1}^t REER_j^{+,-} = \sum_{j=1}^t \max(\Delta REER_j, 0) \tag{9}$$

$$NREER_t = \sum_{j=1}^t REER_j^{-} = \sum_{j=1}^t \min(\Delta REER_j, 0) \tag{10}$$

Equations (9) and (10) represent the partial sum of positive and negative movements in the real effective exchange rate (*REER*), respectively. If we put the variables calculated from equations (2) and (10) into equation (1), we can get the non-linear autoregressive distributed lag (*NARDL*), as suggested by Shin et al. (2014). This *NARDL* or asymmetric *ARDL* is the addition of the linear or symmetrical *ARDL* model of Pesaran, Shin, and Smith (2001) and expressed in the following way:

$$\Delta RCA_t = \alpha + \varphi RCA_{t-1} + \gamma^+ PREER_{t-1} + \gamma^- NREER_{t-1} + \sum_{i=1}^p \delta_i \Delta RCA_{t-i} + \sum_{i=0}^q \lambda_i + \sum_{i=0}^r (\theta_i^+ \Delta PREER_{t-i} + \theta_i^- \Delta NREER_{t-i}) + \mu_t \tag{11}$$

First model-1, we have to find that there is a long-run relationship. For that purpose, the null hypothesis (H_0) for no cointegration can be written as H_0: ($\varphi = \beta = \gamma^+ = \gamma^- = 0$). If estimated F-values from the Wald test are greater than the upper critical values calculated by Pesaran et al. (2001), we may reject the null hypothesis (H_0) and conclude the existence of cointegration in equation (10). After confirming the cointegration, we can check the long-run effects of our explanatory variables, i.e., $REER_t$ and $NEER_t$ on RCA_{it} by generating normalized coefficients of $REER_{t-1}$ and $NEER_{t-1}$, standardized by RCA_{t-1}.

ECM model can be expressed by adding the lag of error term generated from the equation (4). This may have the following expression:

$$\Delta RCA_t = \sum_{i=1}^p \delta_i \Delta RCA_{t-i} + \sum_{i=0}^r (\theta_i^+ \Delta PREER_{t-i} + \theta_i^- \Delta NREER_{t-i}) + \tau_t ECM_{t-1} + \psi_t \tag{12}$$

From equation (11), a negative sign of the coefficient of Error Correction Model (ECM) is the proof for the short-run association in the model. It can also be an alternative confirmation for long-run relationships or cointegration in the model, as Pesaran et al. (2001) suggested. The maximum lag lengths are measured by the Schwarz Information Criterion (SIC).

Results and Discussions

As autoregressive distributed lag (*ARDL*) technique is useful in the presence of mixed order of integration, i.e., integration of order zero I (0) or one I (1). Our series is stationary at level zero or first difference, and found none of our series is required to check at their second difference.

Table 2 shows the results obtained from Augmented Dickey-Fuller (ADF-test) for unit root (at 5% and 10% level of significance) at the level and first difference (Dickey & Fuller, 1979). It is clear that the RCA_1 index value, real effective exchange rate (*REER*), and world aggregated income are stationary at level, and RCA_2 and RCA_3 are stationary at first difference.

Table 2. ADF Unit Root Test

Stationary	Dependent Variable			Independent Variable (ln)	
	RCA_1 Hides & Skins	RCA_2 Textiles & Clothes	RCA_3 Vegetables	REER	World Aggregated Income (Yw)
At Level	-2.135*** (0.001)	-1.512 (0.516)	-2.514 (0.121)	-2.020*** (0.001)	-2.004 (0.334)
At First Difference	----	-6.538*** (0.000)	-5.831*** (0.010)	----	-3.013*** (0.004)

***, **, * indicate rejection of the null hypothesis at the 1%, 5% and 10%, respectively

From Table 2, we can see that RCA_1, RCA_2, and RCA_3 are stationary at the first difference. Non-linear Auto Regressive Distributed Lag (NARDL) Wald-test is used to check the existence of long-run relationship among the endogenous and exogenous variables in Model 1. The projected models of revealed comparative advantage (RCA's) are in Table 3.

Table 3. Wald-Test and Diagnostics-Tests

Diagnostic-Tests	Dependent Variable: Selected RCA'S		
	RCA_1 Hides & Skins	RCA_2 Textiles & Clothes	RCA_3 Vegetables
F-Value (Wald Test)	5.039	7.121	5.718
Serial Correlation	1.182 (0.375)	1.549 (0.242)	1.092 (0.513)
Heteroscedasticity	1.086 (0.369)	1.392 (0.381)	2.434 (0.290)
J-B Normality	1.433 (0.322)	0.487 (0.782)	1.344 (0.193)
Ramsey Reset	0.747 (0.802)	1.288 (0.300)	0.664 (0.513)
CUSUM	Stable	Stable	Stable
CUSUMsq	Stable	Stable	Stable

(Brackets indicate p-values of relevant tests and upper bound critical values are 3.2 at 10%, 4.08 at 5%, and 4.66 at 1%, respectively, and S shows the stability of projected models through CUSUM & CUSUMsq test)

From Table 3, it is clear that long-run relationship exists in our examined model as calculated F-values are larger than the critical F-values, i.e., (upper bound critical values 3.2, 4.08, and 4.66 at 10%, 5%, and 1% respectively). Our models are free from autocorrelation, non-normality, and heteroskedasticity problems. The Ramsey RESET test is also predicting the normality of the export models. Most significantly, the estimated NARDL parameters are stable in estimating CUSUM and CUSUM sq. Therefore, we can calculate the short-run and long-run effects of the projected models.

Table 4. Non-Linear Autoregressive Distributive Lags (NARDL) Long Run Results

Independent Variable	Dependent Variable: Selected RCA'S		
	RCA_1 Hides & Skins	RCA_2 Textiles & Clothes	RCA_3 Vegetables
$PREER_t^+$	0.099*** (0.007)	0.013*** (0.007)	0.025*** (0.004)
$NREER_t^-$	-0.043*** (0.002)	-0.095*** (0.000)	-0.012** (0.011)

***, **, * indicate rejection of the null hypothesis at the 1%, 5% and 10%, respectively

From Table 4, we can see that the coefficients of positive real significant exchange rate shock (*PREER*) for RCA_1 Hides & skins, RCA_2 Textiles and Clothes, and RCA_3 Vegetables. These coefficients represent the positive movement of *REER*, i.e., depreciation of the domestic currency. The PREER coefficient for RCA_1 Hides & skins, 0.099, means that a 1% increase in *REER* brings a 0.0987% increase in revealed comparative index value (RCA_1) Hides & skins. Similarly, the coefficient of negative real effective exchange rate movement (N*REER*) depicts the appreciation of *PKR*. The coefficient for RCA_1 Hides & skins is -0.0433, which elaborates that a 1% decrease in *REER* will decrease the 0.043% index value of revealed comparative advantage for RCA_1 Hides & skins. Furthermore, the coefficients of *PREER* for RCA_2 Textiles and Clothes and RCA_3 Vegetables are 0.1233 and 0.025, respectively. 1% increase in real effective exchange rate brings 0.1233% and 0.025% increase in *RCA* index value for Textiles & Clothes, and Vegetables. However, coefficients of N*REER* -0.0951 and -0.0122 depict appreciation of PKR that elucidates a 1% decrease in *REER* may decrease 0.09% and 0.012% index value of revealed comparative advantage for RCA_2 Textiles & Clothes, and RCA_3 Vegetables respectively.

Table 5 elaborates on the results of the short-run and Error Correction Model (*ECM*). The parameters of ECM_{t-1} are negative and significant in the short run. This is evidence that all the models have a short-run association. It may be the alternative verification of cointegration. Furthermore, due to depreciation, export performance improves in all the categories of export commodities, and appreciation has an adverse effect on all selected *RCA*'s at the HS-2-digit level of products. The speed of convergence from the short run to the long run for selected RCA_1, RCA_2, and RCA_3 are 1/0.2676*12=44 months, 23 months, and 29 months, respectively.

Table 5. *NARDL*: Short Run Results

Independent Variable	Dependent Variable: Selected *RCA*'S		
	RCA_1 Hides & Skins	RCA_2 Textiles & Clothes	RCA_3 Vegetables
ΔRCA_{t-1}	0.454**	3.454***	0.981***
	(0.032)	(0.006)	(0.008)
$\Delta PREER_{t-1}$	-1.221	-1.432	-2.332
	(0.123)	(0.122)	(0.045)**
$\Delta NREER_t$	-2.129***	-3.111	-1.999
	(0.010)	(0.001)***	(0.000)***
ECM_{t-1}	-0.2686***	-0.512	-0.390
	(0.000)	(0.003)***	(0.009)***

***, **, * indicate rejection of the null hypothesis at the 1%, 5% and 10%, respectively

In overall estimation, we examined that positive and negative shocks of *REER* have expected impacts on selected *RCA* at HS-2-digit level of exports of Pakistan. Furthermore, all the models are predicting the non-linear effects in the long and short-run analysis as *PREER* and *NREER* are showing different signs of their parameters. Our research findings contrast the following papers, such as Ahmad and Kalim (2014), Ahmad and Kalim (2013), and Karamelikli (2016).

Model 2 applies a bound test to check the presence of a long-run relationship between the dependent and independent variables, and the outcomes are as follows. Table 7 indicates a long-run relationship between the variables as Ftestis greater than the upper bound value both at 5% and 10% significance levels.

After estimating the bound test *ARDL* technique, to calculate the cointegration form, an appropriate lag length is selected based on the Akaike Information Criterion (*AIC*); the results are shown in the following table. Moreover, the increase in ln (*X/M*) represents an improvement in the trade balance, while the decline shows an increase in the deficit trade balance of Pakistan.

Table 6. Bound Test for BOT Equation

Significance Level	Critical Values Bound		F-Calculated
	Lower-Bound I(0)	Upper-Bound I(1)	
10%	2.45	3.52	
05%	2.86	4.01	$F_C = 6.7566$
01%	3.75	5.06	

Table 7. Estimation of *LR* Coefficients by *ARDL* Technique on *BOT* of Pakistan

Dependent Variable ln $(TB)_t$ = ln$(X/M)_t$		
Variable	Coefficient	Probability
RCA_1 Hides & skins	-0.065***	0.002
RCA_2 Textiles & Clothes	-1.002*	0.060
RCA_3 Vegetables	-0.046**	0.045
ln($REER$)	-0.003*	0.056
ln(Y_w)	-0.020*	0.087
C	0.407	0.798

***, **, * indicate rejection of the null hypothesis at the 1%, 5% and 10%, respectively

Table 7 shows that coefficients of RCA_1 Hides & skins, RCA_2 Textiles and Clothes, and RCA_3 Vegetables are negative and significant. The coefficient of RCA_1 Hides & skins is -0.06544, which indicates that 1% increase in revealed comparative advantage index value will reduce the deficit in the balance of trade of Pakistan by 0.06%. Similarly, coefficients of RCA_2 Textiles and Clothes and RCA_3 Vegetables are -1.0077 and -0.04587 that represent 1% increase in revealed comparative advantage index value will lead to a decline by 1% and 0.045% in the deficit trade balance of Pakistan at HS 2-digit level products. Further, the real effective exchange rate ($REER$) has a significant impact on the balance of trade of Pakistan. Ln ($REER$) is -0.00332, which indicates that a 1% increase in real effective exchange rate brings a 0.0033% decrease in the deficit balance of trade of Pakistan. Moreover, the coefficient of world aggregated income (Y_w) is 0.020, which indicates that a 1% increase in world aggregated income may decrease in deficit BOT of Pakistan by 0.020%. Hence, it can be concluded that RCA indexes, Y_w, and $REER$ are helpful in reducing the deficit trade balance of Pakistan. A similar relationship has been observed by many researchers such as Chinn (1991, 2006), Duasa (2007), and Moffett (1989).

Table 8, *ECM* for the balance of trade equation represents the speed of adjustment in the short run to the long run (*ECM* speed of convergence is 1/0.3890*12 months=31 months).

Table 8.: ECM for Selected *ARDL* Model BOT Equation

Variable(ln)	Coefficient	Prob.
D(RCA_1 Hides & Skins)	0.615*	0.084
D(RCA_1 Hides & Skins (-2))	-2.787***	0.000
D(RCA_2 Textiles & Clothes)	-0.156**	0.039
D(RCA_2Textiles & Clothes(-1))	0.261*	0.069
D(RCA_3 Vegetables)	-0.128	0.242
D(RCA_3 Vegetables (-1))	0.137**	0.042
D($REER$(-1))	-0.278***	0.001
D($REER$(-3))	-0.096	0.151
D(Y_w)	-0.951***	0.005
Coint-Eq(-1)	-0.389***	0.004

***, **, * indicate rejection of the null hypothesis at the 1%, 5% and 10%, respectively

Table 9 shows that the value of R-squared (0.8870) indicates that 88.70% variation in the *TB* equation is due to independent variables *REER*, selected *RCA* index values, and world aggregated income.

Table 9. R^2, adj-R^2 and Diagnostic Tests

Value of R^2	Value of Adjusted R^2
0.8870	0.8601
Diagnostic Tests For Trade Balance Equation	
Serial Correlation	1.0023
Normality	0.7945
Heteroscedasticity	1.2322

The lower part of table 9 represents the different diagnostic-tests to examine the rationality of the *ARDL* model of *the TB* equation. The results confirm the absence of heteroscedasticity, serial correlation, and conclude that the error term is not generally distributed in the model. The value of the *LM* version is > 0.05, which indicates rejecting the null hypothesis and accept the alternative hypothesis.

The *CUSUM* (cumulative summations) and *CUSUMsq* (cumulative sum of the square of residuals across time trend) are used to validate the stability of the *ARDL* model. These tests were developed by Brown, Durbin, and Evans (1975) and also suggested by Pesaran and Shin (1998) in the previous literature.
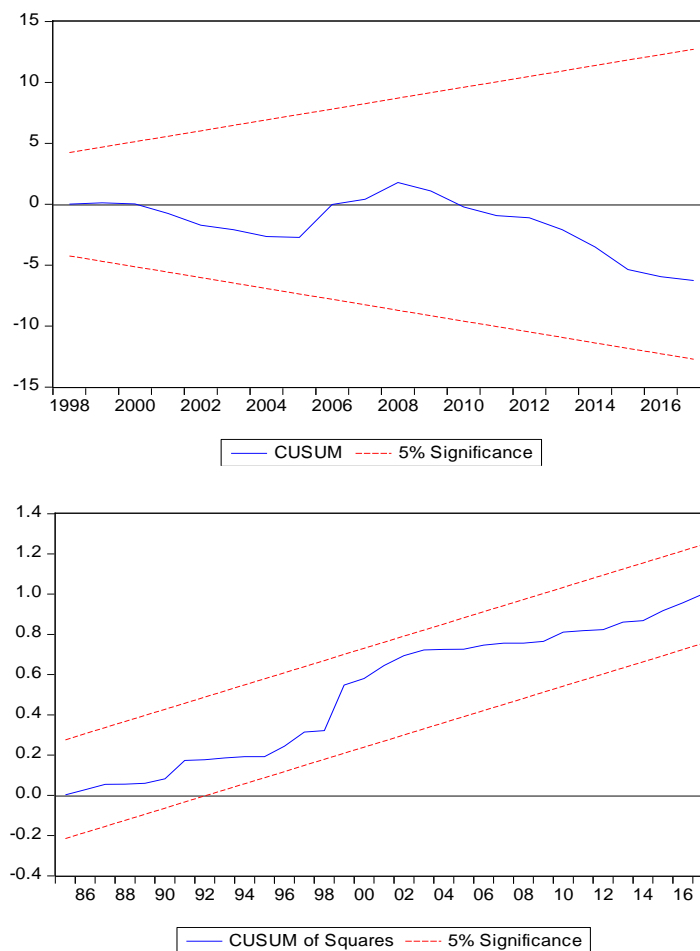
Figure 1. Diagnostic Graph for Stability of the BOT Model

Conclusions

This study estimates the effects of devaluation and appreciation of the *REER* on *RCA* at the HS-2-digit level of exports of Pakistan. Using annual data from 1980 to 2018, this study found the long run and short run cointegration for the products in which Pakistan has revealed comparative advantage. From the results of model-1, appreciation of *REER* has adverse effects on all selected *RCA* models, i.e., RCA_1 hides & skins, RCA_2 textiles & clothes, and RCA_3 vegetables; likewise, devaluation has positive effects on these selected *RCA* models. Therefore, depreciation helps boost exports of commodities at the HS-2-digit level of the industry.

From model-2, the outcomes reveal that the real effective exchange rate (*REER*) depreciation of domestic currency (PKR) has a significant impact on the trade balance (TB) of Pakistan. The world aggregated income (Yw; is assumed to assess the export demand of Pakistan) selected *RCA*'s indexes at HS 2-digit level of products can help reduce deficit balance of trade by seeking potential market so that the demand for Pakistani exports may enhance in the world market. Moreover, this paper suggests that the government should adopt such an exchange rate policy that leads to increase exports and may cause a reduction in the deficit trade balance of Pakistan. Furthermore, this paper also suggests that policymakers should make effective monetary and fiscal policies to enhance the trade potential of Pakistan to capture the export share in world markets.

A clear limitation of this study is that it takes only three index values of selected *RCA*'s in which Pakistan has a comparative advantage in the world. Other *RCA*'s may be included to predict better impacts on the trade of potential of Pakistan, but unluckily, Pakistan has no revealed comparative advantage in those commodities at HS 2-digit level of products.

Conflict of Interest

Authors do not have any conflict of interest.

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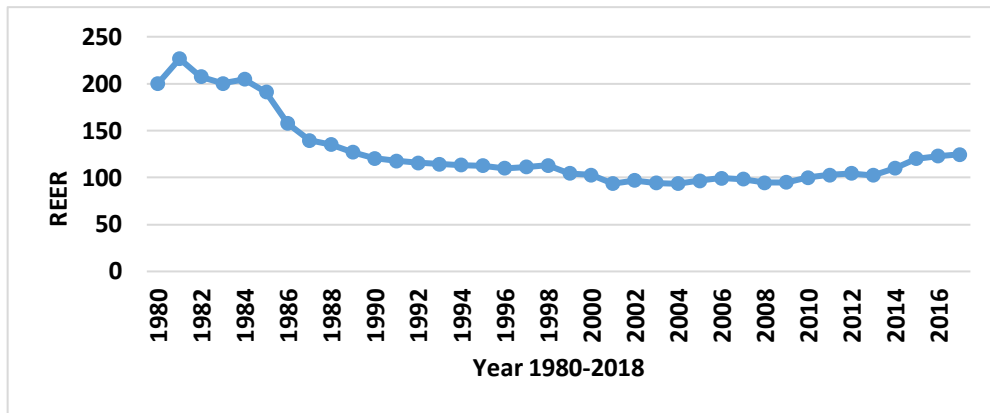
Annexure-I

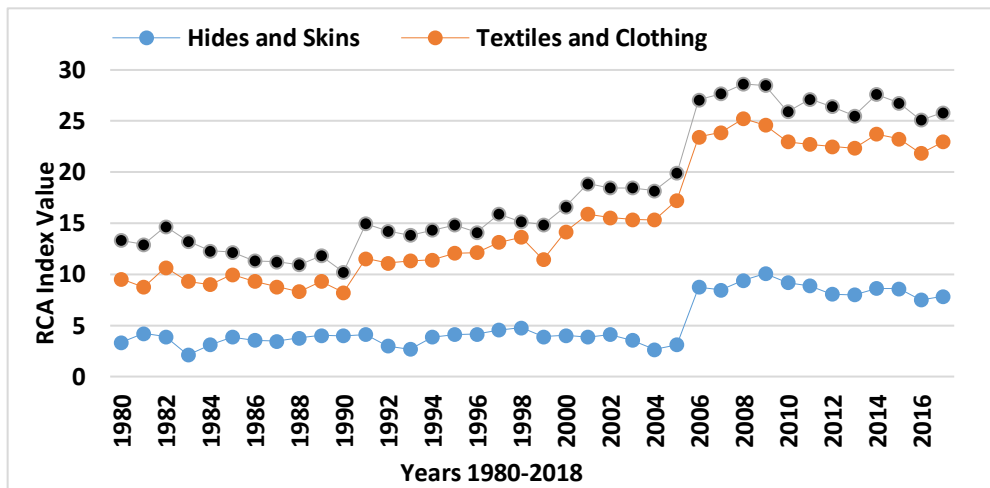**Figure 1.** *REER* of Pakistan (base year 2010)

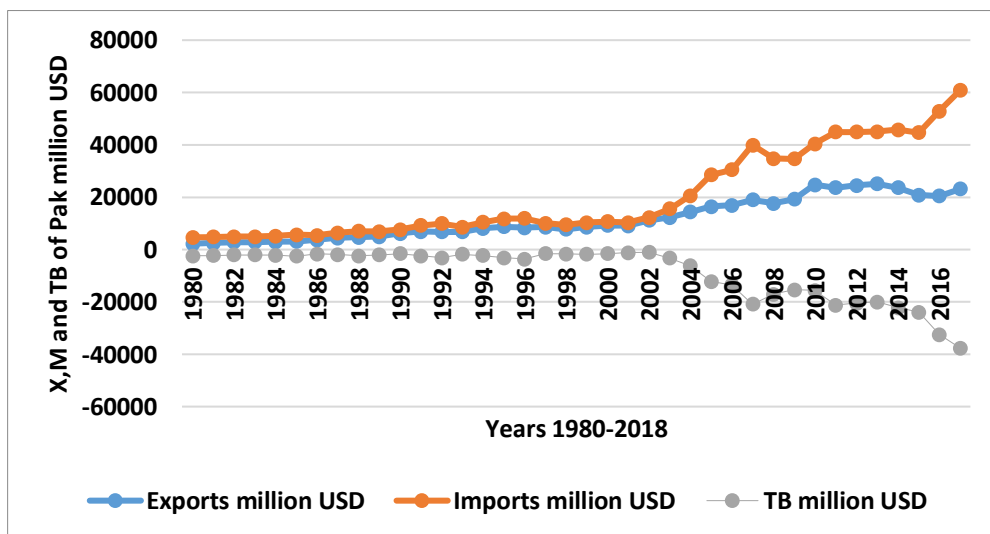**Figure 2.** Selected *RCA* Index Value (1980-2018)

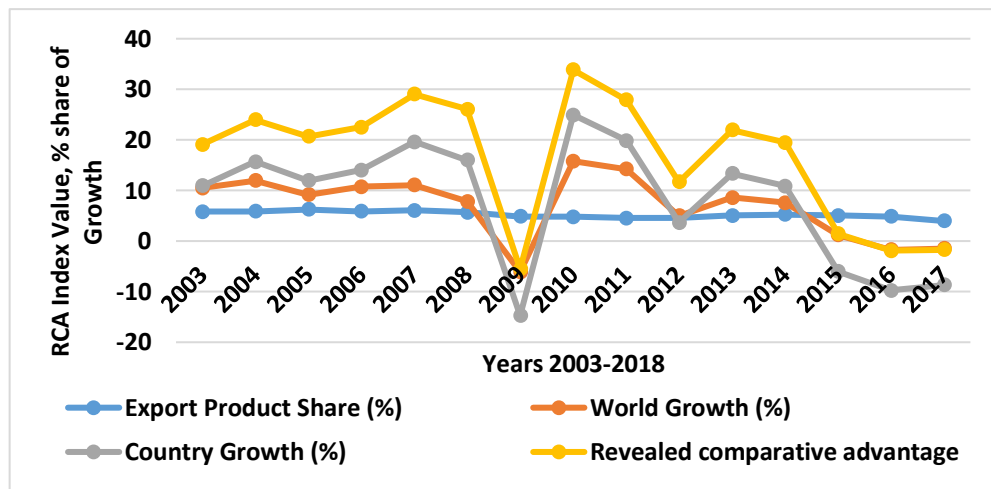**Figure 3.** X, M & *TB* of Pakistan (1980-2018) mil USD

Figure 4. *RCA₁* Hides & Skins (2003-2018)
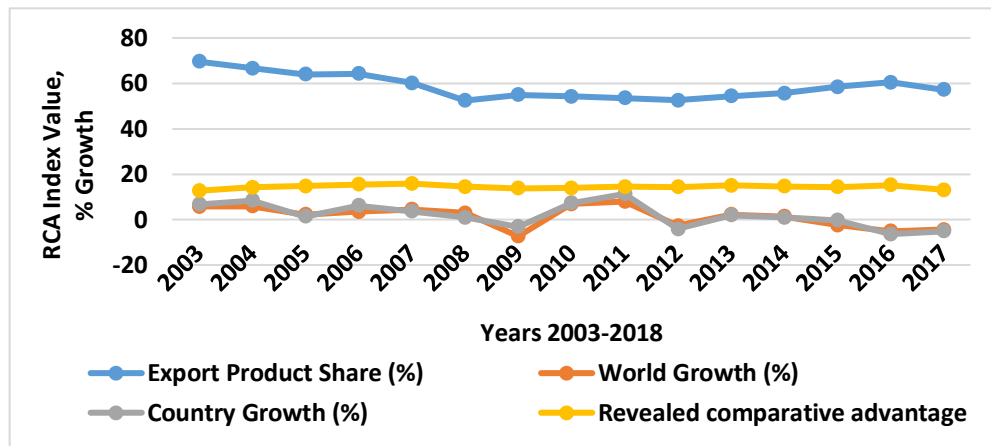

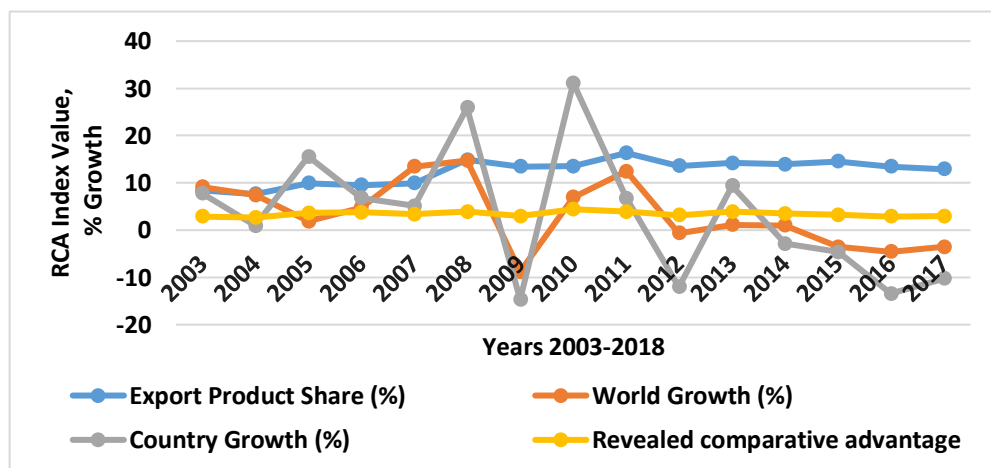**Figure 5.** *RCA₂* Textiles & Clothing (2003-2018)

Figure 6. *RCA₃* Vegetables (2003-2018)

Sources: WITS, WBDI, SBP from 1980-2018