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Nominal vs. Real Effective Exchange Rate Dynamics and Their Asymmetric Impacts on Pakistan's Sectoral and Aggregate Trade

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ABSTRACT

This study investigates the role of nominal and real effective exchange rates as determinants of Pakistan's foreign trade at both aggregate and sectoral levels, covering total, food, textile, petroleum, and other imports and exports over the period July 2009 to June 2025 using monthly data. Employing both ARDL and NARDL frameworks, the study examines symmetrical and asymmetrical effects of exchange rate fluctuations on trade flows, providing a comprehensive analysis of linear and nonlinear dynamics. The results reveal that imports are generally more responsive than exports, with nominal exchange rate exerting stronger influence on aggregate imports, while real effective exchange rate plays a significant role in textile imports. Asymmetric analysis indicates that depreciation and appreciation impact trade differently, with depreciation often reducing imports but failing to stimulate exports proportionally. Among export categories, textile exports are the only sector significantly sensitive to exchange rate changes. Domestic income consistently increases imports across all sectors, highlighting Pakistan's import dependence during periods of economic growth. Furthermore, the Marshall-Lerner condition is not satisfied at the aggregate level, suggesting that currency depreciation alone is insufficient to improve the trade balance, although it may hold at the sectoral level for textiles and food. These findings provide critical insights for exchange rate policy, sectoral trade interventions, and export diversification strategies aimed at enhancing Pakistan's trade competitiveness and macroeconomic stability.

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Introduction

Devaluation or depreciation are expected to reduce the imports and improve the export volume

through increased costs and reduced prices of the two trades respectively. The phenomenon was first explained thoroughly by Alfred Marshall during early 1920s and Aba Lerner in 1940s. They established a necessary condition for the devaluation to be fruitful which is known as Marshall Lerner Condition (MLC). It states that if the sum of the demand elasticities of imports and exports are greater than one, the trade balance would initially deteriorate and finally in the long run would improve the balance of trade also known as the J-Curve theory. Developing countries like Pakistan depend heavily on imports of oil, machinery and medicines which they themselves can't produce. These countries either lack natural resources or the infrastructure and institutional framework to stabilize their economy through utilization of local resources rather than the dependence on foreign nations. Balance of trade is a major component of current account of a country. Balance of trade can play a significant role in bringing the current account in surplus. All countries really have to do a lot of efforts to turn around the deficit into surplus. In efforts to promote Exports and reduce imports counties opt devaluing its currency. This is expected to reduce the imports as the imports become more expensive for domestic users and at the same time the exports become cheaper for foreign buyers as the same commodity costs them less in the foreign currency units (Rehman *et al.* 2012; Stucka, 2004). This will ultimately correct the deficit balance of trade into surplus in the long run. Does the so far discussion support that all the countries who face a deficit balance of trade should devalue their currencies to take a turn around? To rely upon similar strategy in Pakistan, the economic circumstances of Pakistan need to be understood. In 1999, US dollar pegged exchange rate was implemented with a limited band variation called managed float exchanged rate. However, the pegged exchange rate was dismantled and a float exchange rate was put into action in 2000s (Bano et al., 2004). After this exchange rate policy shift, the trade balance has worsened. At the same time when Pakistan is importing more than its exports, Pakistan's currency has been devaluing persistently specially after 2000s. The above discussion shows that the Pakistani economy has been facing consistent higher imports and lower exports. The currency devalue has been advocated by Marshal and Lerner as a means of correcting the trade balance. After considering above discussion, one ponders what has gone wrong.

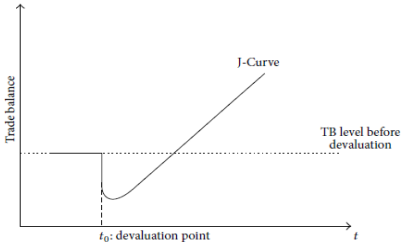
To fully understand the nature of Pakistan Economy, it is very important to analyze Imports and exports in response to exchange rate. Further it is of equal and vital importance if the exchange rate used ought to be real or nominal. This research is an attempt to shed light on the relational aspect between traded commodities and the nature of exchange rate (nominal and real exchange rate) that influences the Pakistani international trade with rest of the world. The previous few studies focus on linear or nonlinear effects of exchange rate on either trade balance or exports and imports, few studies focus on real or nominal exchange rate impact on either trade balance or exports and imports. Besides this, studies focus on commodities at bilateral trade between Pakistan and other nations. However, if the policy makers want answers of all aspects discussed above then a comprehensive study is not readily available at hand. So, there is a need to have a study that uses linear as well as nonlinear impact of nominal as well as real exchange rate on the import, exports and trade balance of Pakistan.

This study aims to achieve following ends:

- To determine the usability of either nominal or real exchange rate as a determinant to Pakistani trade balance.
- To identify if there exists linear or nonlinear association between exchange rate and the imports and exports of Pakistan.
- To test the MLC using imports and exports elasticities.

Literature Review

There are instances when the Marshal Lerner Condition is met but still the trade balance failed to



show any improvement after domestic currency devaluation (Bahmani-Oskooee, 1985). To understand and respond to such anomalies, it took about three decades subsequent to the generalization of the ML Condition, J-Curve theory surfaced. As first demonstrated by Magee (1973), the J-Curve phenomenon demonstrates how the devaluation of domestic currency exchange rate would affects the country's trade balance over the time period. Therefore, the J-curve can be called a dynamic version of the ML Condition or, in a broader perspective, that of elasticity approach (Niehans, 1984).The J-Curve phenomenon prophesies improved trade balance in long-run to achieve a higher level than its initial level at the time of currency devaluation (Bacchette & Gerlach, 1994). Laetitia & Hongbing (2019) analyzed and appraised the effect of local currency CFA Franc devaluation on the Cameroon's balance of trade. The results show that the trade and exchange rate variables of Cameroon do not satisfy the Marshal Lerner Condition. Further results reveal that trade balance deterioration in short-run would be corrected in long-run that proves the existence of J-curve effect in case of Cameroon. Hassan (2018) conducted research and observes the existence of nonlinear responsiveness of different industries of Pakistan to the exchange rate. Verheyen (2013) studied the relationship between nominal as well real exchange rate and exports of twelve European Monetary Union countries. The nonlinear response implies that the exports respond differently to the Euro appreciation and yet in a different magnitude to the same level of depreciation. Rehman et al. (2012) provided empirical evidence that it is understandable that the depreciation in exchange rate of Pakistan has not been effective in improving the trade balance. Hence State Bank of Pakistan may not devalue Pak Rupee as a policy variable to improve the trade balance. According to Shahbaz, et al. (2012), the elasticities of exports and imports don't fulfill Marshal Lerner condition that establishes the fact there is no evidence of J-Curve existence for Pakistan.

Kanchana & Ahmed (2010) have shown that the devaluation of Sri Lankan rupee compared to Chinese RMB has a positive effect on Sri Lanka's exports to China whereas the same has a negative impact on Sri Lankan imports from China. In case of Pakistan, as the exports have high import contents, and most of the imports are inelastic, a J-Curve does not seem to exist. It also implies that Pakistan would not benefit from currency devaluation (Rehman, 2007). Rehman & Muhammad (2003) found there exists an evidence of J curve. However, a long-run impact of real devaluation of Pak Rupee appears to be unfavorable. Considering the nature of vast literature already available, it is observed that the most of the literature has emphasized linear relationship between trade balance and exchange rate changes i.e. Laetitia & Hongbing (2019) and Shahbaz et al. (2012). On the other hand, there are very few studies who have studied the trade balance and exchange relationship in a nonlinear assumption i.e. Hassan (2018) and Verheyen (2013) are among the few other researchers.

Data and Methodology

This study utilizes monthly data from July 2009 to June 2025. One model contains exports as dependent variable whereas real GDP of trading partner country or foreign income (Yf_t), and real effective exchange-rate ($REER_t$) as independent variables whereas second model with imports as

dependent variable and real GDP of the domestic country facing currency devaluation (Y_t), and real effective exchange-rate ($REER_t$) as independent variables. Ensuing Bahmani-Oskooee (1985) and Rose & Yellen (1989) the abridged logarithmic model for exports and imports can take the following forms:

$$lnM_t = \alpha_0 + \alpha_1 lnY_t + \alpha_2 lnREER_t + \varepsilon_t \quad (3.1)$$

$$lnX_t = \beta_0 + \beta_1 lnYf_t + \beta_2 lnREER_t + \varepsilon_t \quad (3.2)$$

The equations 3.1 and 3.2 utilized real effective exchange rate as independent variable. Another two models shown in equations 3.3 and 3.4 replace real effective exchange rate with nominal exchange rate. It is mandatory to add relative prices as an independent variable along with nominal exchange rate. It can provide information about whether it is price difference across borders that contributes to changes in real effective exchange rate or nominal changes in currency prices. The models of total Imports and total exports with nominal exchange rate can be written in the following:

$$lnM_t = \tau_0 + \tau_1 lnY_t + \tau_2 lnRP_t + \tau_3 lnNER_t + \varepsilon_t \quad (3.3)$$

$$lnX_t = \pi_0 + \pi_1 lnYf_t + \pi_2 lnRP_t + \pi_3 lnNER_t + \varepsilon_t \quad (3.4)$$

The above four models of total imports and total exports can be extended to the exports or imports of each food, textile, petroleum and all other commodities. For the imports and exports of a specific commodity, independent variables remain same as shown in total imports and total exports models respectively. After finding the separate elasticities the α_2 and β_2, they are summed up to see if equal or exceed one in absolute terms, that is the ML Condition. Technically, if summation of elasticities τ_3 and π_3 is greater than one it would be incorrect to say that Marshall learner condition holds because it describes only valuation effect of trade which may misguide policy makers to target nominal exchange rate instead of real effective exchange rate. Along with this problem, another confusion arises when both kinds of exchange rate can have symmetrical and asymmetrical effects on exports or imports. To capture symmetric effects, Auto-Regressive Distributed Lag (ARDL) model is employed on above four models along with sixteen models representing exports and imports of four commodities suggested by Pesaran et al. (2001). To check asymmetric effects of exchange rate on total exports and total imports. The models for the total exports and total imports with asymmetrical effects of real effective exchange rate are as follows:

$$lnM_t = \gamma_0 + \gamma_1 lnY_t + \gamma_2 lnREER_t^+ + \gamma_3 lnREER_t^- + \varepsilon_t \quad (3.5)$$

$$lnX_t = \delta_0 + \delta_1 lnYf_t + \delta_2 lnREER_t^+ + \delta_3 lnREER_t^- + \varepsilon_t \quad (3.6)$$

The models for the total exports and total imports with asymmetrical effects of nominal exchange rate are as follows:

$$lnM_t = \varphi_0 + \varphi_1 lnY_t + \varphi_2 lnRP_t + \varphi_3 lnNER_t^+ + \varphi_4 lnNER_t^- + \varepsilon_t \quad (3.7)$$

$$lnX_t = \omega_0 + \omega_1 lnYf_t + \omega_2 lnRP_t + \omega_3 lnNER_t^+ + \omega_4 lnNER_t^- + \varepsilon_t \quad (3.8)$$

In equations 3.5 to 3.8, ER_t^+ and ER_t^- represent depreciation and appreciation respectively. To capture the asymmetric effects of exchange rate, non-linear Auto-Regressive Distributed Lag model is employed all these equations suggested by Shin et al. (2011). Finally, time period covered in this study includes a six-month (march-2020 to july-2020) COVID downfall that is captured by a dummy variable in all models. The description of commodity groups of exports and imports is illustrated in table 3.1.

Table 3.1
Exports and Imports Groups

Imports	Exports
Food (FM_t)	Food (FX_t)
Textile (TM_t)	Textile (TX_t)
Petroleum (PM_t)	Petroleum (PX_t)
All Others (OM_t)	All Others (OX_t)
Total Imports (M_t)	Total Export (M_t)

The sources of dataset and variable description are illustrated in table 3.2

Table 3.2
Description of Variables and Sources

Variables		Measure	Source
Exports (all group)	X_t	Million US$	State Bank of Pakistan
Imports (all group)	M_t	Million US$	State Bank of Pakistan
Real Effective Exchange Rate	$REER_t$	Nominal Exchange Rate times Relative Price	International Financial Statistics and State Bank of Pakistan
Nominal Exchange Rate	NER_t	Pakistan rupees per US$	State Bank of Pakistan
Domestic Real GDP	Y_t	Industrial Production Index of Pakistan	International Financial Statistics
Foreign Real GDP	Yf_t	Industrial Production Index of USA	International Financial Statistics
Relative Price	RP_t	Ratio of Domestic Prices to Foreign Prices	International Financial Statistics

Results and Discussion

Unit root tests are among those tests. To check if the variables are stationary at level or at first difference, Augmented Dickey–Fuller test (ADF) is used, and the results are as follows:

Table 4.1
Augmented Dickey Fuller Test

Variables	Level (ADF Statistic)	First Difference (ADF Statistic)	Order of Integration
Independent Variables			
$lnREER_t$	-1.920	-13.995***	I (1)
$lnNER_t$	-1.470	-10.812***	I (1)
$lnRP_t$	-2.875*	-11.976***	I (0)
lnY_t	-2.853*	-6.022***	I (0)
$lnYf_t$	-3.125**	-12.011***	I (0)
Total Imports and Commodity-wise Imports (Dependent Variables)			
lnM_t	-2.99**	-19.63***	I (0)
$lnFM_t$	-2.04	-11.05***	I (1)
$lnTM_t$	-3.07**	-9.656***	I (0)
$lnPM_t$	-3.41**	-20.96 ***	I (0)
$lnOM_t$	-1.72	-11.41***	I (1)
Total Exports and Commodity-wise Exports (Dependent Variables)			
lnX_t	-2.08	-3.84***	I (1)
$lnFX_t$	-2.28	-5.29***	I (1)
$lnTX_t$	-1.84	-23.18***	I (1)
$lnPX_t$	-4.27***	-17.63 ***	I (0)
$lnOX_t$	-2.17	-17.48***	I (1)

Note: * represents 10%, ** represents 5% and *** represents 1% level of significance.

The above results in table 4.1 show that all the independent variables appeared in each model are integrated of order one except Pakistan Industrial Production Index which is level stationary. Pakistan Industrial Production index is a common independent variable of all models. The ADF test shows that most of the variables of all models are stationary at first difference but being level stationary of a common independent variable confirms the suitability of Auto-Regressive Distributed Lag Model by Pesaran et al. (2001). To check the long run symmetric and asymmetric effects of exchange rate either real effective exchange rate or nominal exchange rate, bound testing approaches of linear and non-linear ARDL are utilized. Table 4.2 below shows the summary of bound testing.

Table 4.2

Bound Testing Summary

		Models of Imports					Models of Exports				
		lnM_t	$lnFM_t$	$lnTM_t$	$lnPM_t$	$lnOM_t$	lnX_t	$lnFM_t$	$lnTX_t$	$lnPX_t$	$lnOX_t$
$lnREER_t$	ARDL	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	NARDL	☑	☑	☑	☒	☑	☑	☑	☑	☑	☑
$lnNER_t$	ARDL	☑	☑	☑	☒	☑	☑	☑	☑	☑	☑
	NARDL	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

☒ represents inconclusive results through bound testing

Table 4.3

Long run Estimates of Imports Models with Nominal Exchange Rate

Variables	Total Imports		Food Imports		Textile Imports		Petroleum Import		Other Imports	
	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL
lnY_t	1.44* (7.25)	1.61*** (9.35)	0.96*** (3.43)	1.05*** (3.58)	0.89** (2.48)	0.75** (2.04)		1.97*** (4.87)	1.78*** (7.75)	1.72*** (6.80)
$lnRP_t$	-0.89*** (-3.07)	-1.20*** (-4.39)	-1.60*** (-3.83)	-1.44*** (-3.29)	-1.31*** (-2.94)	-1.15** (-2.54)		-2.85*** (-5.20)	0.003 (0.01)	0.03 (0.09)
$lnNER_t$	-1.00*** (-3.48)	-	-1.61*** (-3.99)	-	-0.52 (-1.00)	-		-	0.26 (0.85)	-
$lnNER_t^+$	-	-0.85*** (-3.37)	-	-1.20*** (-3.24)	-	-0.57 (-1.14)		-1.19* (-1.71)	-	0.18 (0.54)
$lnNER_t^-$	-	0.50 (0.93)	-	-0.88 (-0.94)	-	-1.56 (-1.45)		5.36*** (3.89)	-	-0.22 (-0.28)
D_t	0.15** (2.04)	0.05 (0.64)	0.24** (2.21)	0.20 (0.14)					-	-
Constant	12.47*** (7.25)	7.83*** (9.57)	15.07*** (6.19)	8.05*** (5.85)	10.15*** (3.52)	8.60*** (5.02)		5.66*** (2.97)	2.97* (1.68)	4.27*** (3.64)
Diagnostic Tests										
LM-1 lag	1.09 [0.30]	1.17 [0.28]	0.52 [0.47]	1.33 [0.25]	0.70 [0.40]	0.69 [0.41]	2.28 [0.13]	0.11 [0.74]	3.05 [0.08]	2.80 [0.09]
LM-12 lag	17.36 [0.14]	14.99 [0.24]	15.22 [0.23]	20.86 [0.05]	19.29 [0.08]	18.51 [0.10]	14.42 [0.27]	9.43 [0.67]	18.36 [0.10]	17.96 [0.12]
ARCH-1 lag	0.00 [0.96]	0.00 [0.95]	6.54 [0.01]	1.59 [0.21]	6.46 [0.01]	6.23 [0.01]	9.38 [0.00]	4.93 [0.03]	0.68 [0.41]	0.76 [0.38]
ARCH-12 lag	15.38 [0.22]	13.67 [0.32]	32.05 [0.00]	39.99 [0.00]	11.66 [0.47]	11.23 [0.51]	16.50 [0.17]	14.37 [0.28]	14.65 [0.26]	13.46 [0.34]
Jarque Bera	5.20 [0.07]	4.50 [0.10]	2.44 [0.30]	3.62 [0.16]	23.98 (0.00)	24.51 [0.00]	4.49 (0.11)	0.98 [0.61]	12.45 [0.00]	11.94 [0.00]
ECM (-1)	-0.43*** (-6.65)	-0.52*** (-7.25)	0.57*** (-8.76)	-0.56*** (-8.58)	-0.41*** (-6.36)	-0.43*** (-6.45)	-	-0.45*** (-6.57)	-0.85*** (-11.68)	-0.84*** (-11.61)
Wald	-	0.87 [0.35]	-	5.17 [0.02]	-	1.18 [0.29]	-	0.70 [0.40]	-	2.21 [0.14]
CUSUM	S	S	S	S	S	US	S	S	S	S
RESET	1.66 [0.20]	0.14 [0.70]	0.88 [0.34]	0.11 [0.74]	2.16 [0.14]	0.96 [0.33]	0.30 [0.58]	0.04 [0.85]	2.78 [0.10]	3.12 [0.08]

Note: *** represents 1%, ** represents 5%, and * represents 10% level of significance. Values in parenthesis and square brackets are t-statistics and p-values respectively. "S" and "US" represent Stable and Unstable.

Table 4.3 illustrates the ARDL and NARDL results. In case of total imports, nominal exchange rate

has negative and significant relationship with total imports by following ARDL (Rashid & Razzaq, 2010). It shows one percent increase in nominal exchange rate is associated with a decrease of total imports by one percent (Afzal, 2006). The relative prices have negative and domestic income has positive and significant effects on total imports (Rashid & Razzaq, 2010; Afzal, 2006). The results of NARDL illustrate that only depreciation matters and one percent depreciation declines total imports by 0.85 percent (Batool, 2011; Fiaz et al., 2021). Relative prices and domestic income have same effects as shown in ARDL but with a slightly higher magnitude (Rashid & Razzaq, 2010). The nominal exchange rate has a negative significant impact on the import of food items (Batool, 2011). In the long run, if there is 1 percent depreciation of the Pak rupee with respect to USD, there would be 1.61% reduction in the import of food items into Pakistan (Batool, 2011). Relative prices also have a significant negative whereas domestic income has positive significant impact on the food imports (Afzal, 2006; Rashid & Razzaq, 2010). The long run estimates also have a significant effect of COVID. The results of NARDL for food imports illustrate that only depreciation of exchange rate has negative and significant effects showing, one percent depreciation of nominal exchange rate results in 1.20 % decrease in food imports (Fiaz et al., 2021). In case of textile imports, nominal exchange rate does not affect textile imports either in ARDL or NARDL. In case of Petroleum imports, the results of NARDL demonstrate that one percent depreciation of nominal exchange rate leads to decrease in Petroleum imports by 1.19 percent whereas one percent appreciation of exchange rate leads to increase in Petroleum imports by 5.36 percent (Batool, 2011; Fiaz et al., 2021). In case of other imports, nominal exchange rate has no effects on other imports either in ARDL or in NARDL.

Table 4.4

Long run Estimates of Imports Models with Real Effective Exchange Rate

Variables	Total Imports		Food Imports		Textile Imports		Petroleum Import		Other Imports	
	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL
lnY_t	1.31*** (8.29)	1.60*** (7.27)	1.15*** (5.64)	1.45*** (4.53)	1.71*** (3.34)	0.50 (1.46)	1.20 (1.39)		1.99*** (10.64)	1.72*** (6.93)
$lnREER_t$	-0.80*** (-2.85)	-	-1.01*** (-2.97)	-	-2.09** (-2.37)	-	-1.45 (-1.06)		0.31 (0.95)	-
$lnREER_t^+$	-	-0.96*** (-3.13)	-	-1.13*** (-3.21)	-	-0.41 (-0.93)	-		-	0.62** (2.25)
$lnREER_t^-$	-	-0.70** (-2.40)	-	-0.87** (-2.46)	-	-1.52*** (-3.97)	-		-	0.30 (1.07)
D_t	0.15** (2.53)	0.19*** (3.16)	0.30*** (3.91)	0.34*** (4.08)	13.32** (2.33)	9.00*** (5.88)	14.48 (1.53)		0.14** (0.03)	0.09 (1.36)
Constant	12.21*** (7.07)	7.23*** (7.46)	11.52*** (5.62)	5.51*** (3.90)	1.71*** (3.34)	0.50 (1.46)	1.20 (1.39)		1.69 (0.81)	4.34*** (3.95)
Diagnostic Tests										
LM-1 lag	0.11 [0.74]	0.21 [0.64]	0.03 [0.87]	0.01 [0.92]	0.83 [0.36]	0.37 [0.54]	2.90 [0.09]	0.03 [0.87]	0.57 [0.45]	0.08 [0.78]
LM-12 lag	16.03 [0.19]	15.53 [0.21]	13.94 [0.30]	13.35 [0.34]	18.79 [0.09]	17.89 [0.12]	14.06 [0.30]	12.49 [0.41]	14.43 [0.27]	13.23 [0.35]
ARCH-1 lag	0.00 [95]	0.50 [0.48]	6.2 [0.01]	6.63 [0.01]	3.89 [0.05]	5.65 [0.02]	1.96 [0.16]	9.00 [0.00]	0.10 [0.76]	0.41 [0.52]
ARCH-12 lag	12.07 [0.44]	8.11 [0.78]	29.11 [0.00]	32.68 [0.00]	11.00 [0.53]	10.35 [0.59]	7.91 [0.79]	12.71 [0.39]	18.26 [0.11]	20.52 [0.06]
Jarque Bera	5.00 [0.08]	4.96 [0.08]	3.56 [0.17]	1.48 [0.48]	17.22 [0.00]	23.42 [0.00]	1.30 [0.52]	3.26 [0.20]	18.70 [0.00]	14.74 [0.00]
ECM (-	-	-	-	-	-	-	-	-	-	-

1)	0.40*** (-6.37)	0.42*** (-6.56)	0.58*** [-8.65]	0.58*** (-8.72)	0.22*** (-3.91)	0.48*** (-6.79)	0.18*** (-4.13)		0.87*** (-12.09)	0.90*** (-12.62)
Wald	-	1.19 [0.28]	-	1.43 [0.23]	-	14.73 [0.00]	-	0.01 [0.93]	-	5.89 [0.01]
CS (CS-SQ)	S(S)	S(S)	US(US)	S(US)	S(US)	S(US)	US(US)	US(S)	S(US)	S(US)
RESET	3.43 [0.07]	0.94 [0.33]	0.91 [0.34]	0.13 [0.72]	0.84 [0.36]	0.51 [0.48]	0.00 [0.96]	3.41 [0.07]	3.97 [0.05]	2.37 [0.13]

Note: *** represents 1%, ** represents 5%, and * represents 10% level of significance. Values in parenthesis and square brackets are t-statistics and p-values respectively. "S" and "US" represent Stable and Unstable.

Table 4.4 shows the results of ARDL and NARDL for the total imports and sectoral imports of Pakistan. Domestic income has positive and significant effects in all models of imports except petroleum imports where it is insignificant (Afzal, 2006; Rashid & Razzaq, 2010). The real exchange rate in all ARDL models of imports has negative and significant coefficient, showing depreciation of real effective exchange rate leads to decrease in total imports, food imports, and textile imports (Batool, 2011; Rashid & Razzaq, 2010). Textile imports are more sensitive to real effective exchange rate with elasticity -2.09 than food imports with elasticity -1.01 followed by total imports with elasticity 0.8 (Batool, 2011; Shair et al.). The NARDL models certify the presence of asymmetric effects of real effective exchange rate in all models except petroleum imports on which NARDL couldn't be applied due to inconclusive results of NARDL bound testing (Fiaz et al., 2021; Batool, 2011). In NARDL models, one percent depreciation in real effective exchange rate results in 0.96 percent decline in total imports, 1.13 percent decline in food imports, and 0.62 increase in other imports (Fiaz et al., 2021; Batool, 2011). As for as appreciation of real effective exchange rate is concerned, one percent appreciation in real effective exchange rate decreases total imports by 0.7 percent, food imports by 0.87 percent, and textile imports by 1.52 percent (Fiaz et al., 2021; Shair et al.).

Table 4.5

Long run Estimates of Exports Models with Nominal Exchange Rate

Variables	Total Exports		Food Exports		Textile Exports		Petroleum Export		Other Exports	
	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL
$lnYf_t$	-0.06 (-0.09)	0.61 (1.20)	1.38 (1.19)	1.48 (1.40)	-0.25 (-0.61)	1.14*** (4.08)	-1.60 (-0.59)	1.20 (0.47)	-0.24 (-0.28)	0.79 (1.62)
$lnRP_t$	0.23 (0.54)	-0.27 (-0.63)	0.50 (0.68)	0.08 (0.08)	-0.76*** (-3.94)	-1.06*** (-7.32)	0.62 (0.33)	-0.82 (-0.50)	-0.48 (-1.02)	-1.62*** (-4.90)
$lnNER_t$	-0.11 (-0.33)	-	0.11 (0.20)	-	-0.40* (-1.68)	-	-0.08 (-0.03)	-	-0.26 (-0.56)	-
$lnNER_t^+$	-	-0.06 (-0.26)	-	0.08 (0.16)	-	-0.34** (-2.13)	-	0.28 (0.14)	-	-0.27 (-1.02)
$lnNER_t^-$	-	1.168* (1.89)	-	0.78 (0.56)	-	1.13*** (2.91)	-	6.53 (1.58)	-	2.84*** (4.28)
D_t	0.58*** (3.26)	0.43*** (2.78)	1.00*** (3.07)	0.86** (2.29)	-	-	18.98 (1.19)	6.23 (0.52)	0.66*** (3.82)	0.40*** (3.63)
Constant	14.73*** (4.60)	11.43*** (4.90)	4.85 (0.81)	5.05 (1.02)	16.70*** (8.11)	8.77*** (6.84)	-1.60 (-0.59)	1.20 (0.47)	13.14*** (2.95)	7.85*** (3.43)
Diagnostic Tests										
LM-1 lag	3.11 [0.07]	3.32 [0.07]	0.09 [0.76]	0.12 [0.73]	0.00 [0.95]	0.16 [0.69]	0.92 [0.34]	0.84 [0.36]	0.00 [0.98]	0.03 [0.86]
LM-12 lag	10.45 [0.58]	10.49 [0.57]	14.32 [0.28]	14.25 [0.29]	13.64 [0.32]	13.01 [0.37]	6.75 [0.87]	6.15 [0.91]	18.94 [0.09]	18.17 [0.11]
ARCH-1 lag	1.10 [0.30]	1.25 [0.26]	3.38 [0.07]	3.28 [0.07]	0.12 [0.73]	1.55 [0.21]	0.000 [0.99]	0.13 [0.72]	0.57 [0.45]	0.14 [0.71]
ARCH-12 lag	8.72 [0.73]	10.67 [0.56]	10.53 [0.57]	10.36 [0.58]	6.79 [0.87]	9.84 [0.63]	19.24 [0.08]	22.43 [0.03]	3.65 [0.99]	2.81 [1.00]

Jarque Bera	0.71 [0.70]	0.99 [0.61]	3.01 [0.22]	3.25 [0.20]	15.30 [0.00]	15.87 [0.00]	19.26 [0.00]	21.51 [0.00]	79.85 [0.00]	118.36 [0.00]
ECM (-1)	-0.23*** (-3.44)	-0.33*** (-3.38)	-0.25*** (-2.86)	-0.29** (-2.52)	-0.30*** (-3.97]	-0.43*** (-4.40)	-0.18*** (-3.93)	-0.22*** (-4.04)	-0.39*** (-4.73)	-0.68*** (-6.15)
Wald	-	2.32 [0.13]	-	0.21 [0.65]	-	10.46 [0.00]	-	0.55 [0.46]	-	14.27 [0.00]
CUSUM	S	S	S	S	S	S	S	S	US	US
RESET	0.22 [0.64]	0.04 [0.84]	0.64 [0.43]	0.57 [0.45}	2.13 [0.15]	0.53 [0.47]	3.21 [0.07]	2.97 [0.09]	0.82 [0.37]	3.12 [0.08]

Note: *** represents 1%, ** represents 5%, and * represents 10% level of significance. Values in parenthesis and square brackets are t-statistics and p-values respectively. "S" and "US" represent Stable and Unstable.

Table 4.5 illustrates the results of ARDL and NARDL illustrating that nominal exchange rate affects only textile exports significantly showing percent depreciation in nominal exchange rate declines textile exports by 0.4 percent (Shair et al.; Batool, 2011). Nominal exchange rate remained insignificant in all other ARDL models (Batool, 2011). Relative prices that is an important factor affecting exports of a country also remained insignificant in all ARDL models except in textile exports where one percent increase in relative prices leads to 0.76 percent decrease in textile exports (Shair et al.; Batool, 2011). In NARDL models of exports, depreciation in nominal exchange rate again only affects textile exports showing one percent depreciation in nominal exchange rate declines textile exports by 0.34 percent (Fiaz et al., 2021; Batool, 2011). It remained insignificant in all other NARDL models (Fiaz et al., 2021). The appreciation variable has significant effects in total exports, textile exports, and other imports by following NARDL models (Fiaz et al., 2021). One percent appreciation in nominal exchange rate has positive effect on total exports by 1.16 percents, on textile exports by 1.13 percent, and on other exports by 2.84 percent (Fiaz et al., 2021).

Table 4.6

Long run Estimates of Exports Models with Real Effective Exchange Rate

Variables	Total Exports		Food Exports		Textile Exports		Petroleum Export		Other Exports	
	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL	ARDL	NARDL
$lnYf_t$	0.18 (0.31)	0.66 (0.85)	0.77 (1.10)	1.42 (1.19)	0.44 (0.88)	-0.12 (-0.20)	-2.35 (-0.88)	-2.35 (-0.78)	0.17 (0.25)	-0.05 (-0.05)
$lnREER_t$	-0.44** (-2.25)	-	0.14 (0.31)	-	-0.57* (-1.96)	-	1.57 (0.98)	-	-0.35 (-0.74)	-
$lnREER_t^+$	-	-0.54 (-1.39)	-	0.06 (0.12)	-	-0.21 (-0.81)	-	1.57 (0.59)	-	-0.30 (-0.60)
$lnREER_t^-$	-	-0.33 (-0.84)	-	0.35 (0.58)	-	-0.45* (-1.78)	-	15.09*** (3.09)	-	-0.39 (0.43)
D_t	0.30*** (4.07)	0.39*** (3.04)	0.77*** (8.41)	0.90*** (4.28)	0.21*** (3.41)	0.15* (1.88)	15.09 (0.95)	14.89 (1.09)	0.78*** (7.93)	0.74*** (4.74)
Constant	15.26*** (4.63)	10.98*** (3.01)	7.71* (1.97)	5.40 (0.98)	14.09*** (4.89)	14.07*** (5.08)	-2.35 (-0.88)	-2.35 (-0.78)	11.53*** (2.78)	10.92 (0.02)
Diagnostic Tests										
LM-1 lag	3.11 [0.07]	3.32 [0.07]	0.18 [0.67]	0.12 [0.73]	1.62 [0.20]	0.04 [0.84]	0.96 [0.33]	0.80 [0.37]	0.02 {0.89]	0.01 [0.93]
LM-12 lag	10.45 [0.58]	10.49 [0.57]	13.23 [0.35]	13.74 [0.32]	14.06 [0.30]	13.94 [0.30]	5.71 [0.93]	5.46 [0.94]	19.23 [0.08]	19.72 [0.07]
ARCH-1 lag	1.10 [0.30]	1.25 [0.26]	3.52 [0.06]	3.34 [0.07]	0.43 [0.51]	0.08 [0.77]	0.03 [0.86]	0.143 [0.71]	0.49 [0.48]	0.51 [0.47]
ARCH-12 lag	8.72 [0.73]	10.67 [0.56]	9.79 [0.63]	10.18 [0.60]	6.40 [0.89]	5.09 [0.95]	16.79 [0.16]	18.64 [0.10]	3.46 [0.99]	3.52 [0.99]
Jarque Bera	0.71 [0.70]	0.99 [0.61]	2.87 [0.24]	3.18 [0.20]	12.84 [0.00]	13.23 [0.00]	26.03 [0.00]	22.90 [0.00]	81.36 [0.00]	80.87 [0.00]

ECM (-1)	-0.23*** (-3.44)	-0.33*** (-3.38)	-0.30*** (-4.60)	-0.27*** (-3.51)	-0.23*** (-3.54)	-0.26*** (-3.80)	-0.17*** (-4.06)	-0.17*** (-3.86)	-0.38*** (-4.66)	-0.38*** (-4.66)
Wald	-	2.32 [0.13]	-	0.59 [0.44]	-	4.35 [0.04]	-	1.34 [0.25]	-	0.09 [0.76]
CUSUM	S	S	S	S	S	S	S	S	S	US
RESET	0.22 [0.64]	0.04 [0.84]	0.99 [0.32]	0.69 [0.41]	0.85 [0.36]	1.66 [0.20]	3.19 [0.08]	2.92 [0.09]	0.47 [0.50]	0.59 [0.44]

Note: *** represents 1%, ** represents 5%, and * represents 10% level of significance. Values in parenthesis and square brackets are t-statistics and p-values respectively. "S" and "US" represent Stable and Unstable.

Table 4.6 demonstrates long run estimates of ARDL and NARDL showing that foreign income has no effect on any exports' variable either in ARDL or NARDL (Batool, 2011; Shahbaz et al.). In all ARDL models of exports, the real effective exchange rate has only significant effect on total exports and textile exports, depicting one percent change in real effective exchange rate leads to 0.44 percent decline in total exports, and 0.57 percent change in textile exports (Batool, 2011; Shair et al.). Whereas it has no role in determining total exports, food exports, petroleum exports and other exports (Batool, 2011). As far as results of NARDL are concerned, the depreciation of real effective exchange rate has insignificant effects on all variables of exports while appreciation of real effective exchange rate has significant effects on only textile exports and petroleum exports (Fiaz et al., 2021). The diagnostic tests of all models demonstrate that there is long run convergence in all models as coefficients of error correction term of all models are negative and significant. Similarly, outcomes of autocorrelation, model specification and stability tests showed that results of all models are robust and can be utilized for conclusion and policy recommendation.

Table 4.7
Summary for the Exchange Rate Elasticity of Exports and Imports

		Nominal Exchange Rate			**Real Exchange Rate**		
		ARDL	NARDL		ARDL	NARDL	
	Dependent Variables	NER_t	NER_t^+	NER_t^-	$REER_t$	$REER_t^+$	$REER_t^-$
Imports	Total Imports	-1.00	-0.85	0.00	-0.80	-0.96	-0.70
	Food Imports	-1.61	-1.20	0.00	-1.01	-1.13	-0.87
	Textile Imports	0.00	0.00	0.00	-2.09	0.00	-1.52
	Petroleum Imports	-	-1.19	5.36	0.00	-	-
	Other Imports	0.00	0.00	0.00	0.00	0.62	0
Exports	Total Exports	0.00	0.00	1.16	0.00	0.00	0.00
	Food Exports	0.00	0.00	0.00	0.00	0.00	0.00
	Textile Exports	-0.40	-0.34	1.13	-0.57	0.00	-0.45
	Petroleum Exports	0.00	0.00	0.00	0.00	0.00	15.09
	Other Exports	0.00	0.00	2.84	0.00	0.00	0.00

To respond to the specific objective, the effect of nominal and real effective exchange rate on the imports and exports of Pakistan are compared in table 4.7 (Rashid & Razzaq, 2010; Batool, 2011). Total imports of Pakistan are affected by nominal and real effective exchange rate symmetrically as well as asymmetrically (Fiaz et al., 2021; Bahmani-Oskooee & Aftab, 2017). Symmetrically, nominal exchange rate affects total imports more than the real effective exchange rate as absolute nominal exchange rate elasticity is 1 as compared to real effective exchange rate elasticity which is 0.8 (Rashid & Razzaq, 2010). Therefore, nominal exchange rate matters more while formulating trade policies (Bahmani-Oskooee & Fariditavana, 2016). Asymmetrically, depreciation of real effective exchange rate has more effect on total imports as depreciation of real effective exchange rate whereas appreciation of nominal exchange rate is insignificant and appreciation of real effective exchange rate is significant but has less effects than depreciation (Fiaz et al., 2021). It could be concluded that total imports are more sensitive to nominal exchange rate as compared to real exchange rate in Pakistan (Rashid & Razzaq, 2010). For food imports, again absolute elasticity

of nominal exchange rate is greater than real effective exchange rate following symmetrical and asymmetrical relationships (Batool, 2011). In case of textile imports, only real effective exchange rate matters either symmetrically or asymmetrically (Shair et al.; Batool, 2011). In case of petroleum imports, only nominal exchange rate matters asymmetrically (Batool, 2011). For other imports, only depreciation has nonlinear effects (Fiaz et al., 2021). In case of exports models, it has been observed that except textile exports all kinds of exports taken in the study are symmetrically or asymmetrically insensitive to either nominal or real effective exchange rates (Bahmani-Oskooee & Aftab, 2017). In case of textile exports, real effective exchange rate has more symmetrical effects than nominal exchange rate whereas nominal exchange rate has more asymmetrical effects on textile exports (Shair et al.; Batool, 2011). It can be concluded that Pakistan exports decrease because of depreciation in nominal exchange rate or real effective exchange rate instead of increasing (Bahmani-Oskooee & Fariditavana, 2016). In some cases, appreciation has positive asymmetrical effects on exports (Fiaz et al., 2021).

Table 4.8
Summary for the Sum of Elasticities

	Absolute Elasticities with Nominal Exchange Rate			Absolute Elasticities with Real Effective Exchange Rate		
	Exports	Imports	**Sum of Elasticities**	Exports	Imports	**Sum of Elasticities**
Total Trade	0.00	1.00	**1.00**	0.00	0.80	**0.80**
Food Trade	0.00	1.61	**1.61**	0.00	1.01	**1.01**
Textile Trade	0.40	0.00	**0.40**	0.57	2.09	**2.66**
Petroleum Trade	0.00	-	**0.00**	0.00	0.00	**0.00**
Others Trade	0,00	0.00	**0.00**	0.00	0.00	**0.00**

Table 4.8 demonstrates the absolute elasticities of exports and imports with respect to nominal exchange rate and real effective exchange rate. The results in the table describe that sum of elasticities of total exports and total imports with respect to nominal exchange rate is exactly equal to one whereas with respect to real effective exchange rate is 0.8. These sum of elasticities in case of both kinds of exchange rates show Marshall learner condition is not met in case of Pakistan (Bahmani-Oskooee & Niroomand, 1998; Bahmani-Oskooee & Aftab, 2017). Therefore, devaluation or depreciation in Pakistan will not improve trade balance but worsen it (Bahmani-Oskooee & Fariditavana, 2016). Furthermore, sum of elasticities of exports and imports in textile and food items with respect to real effective exchange rate remained greater than one hence Marshall learner condition is met at sectoral level but not at aggregate level (Batool, 2011; Bahmani-Oskooee & Aftab, 2017).

Table 4.9
Summary of Marshall Learner Conditions

	Sum of Elasticities with Nominal Exchange Rate	Meet MLC	Sum of Elasticities with Real Effective Exchange Rate	Meet MLC
Total Trade	1.00	No	0.80	No
Food Trade	1.61	**Yes**	1.01	**Yes**
Textile Trade	0.40	No	2.66	**Yes**
Petroleum Trade	0.00	No	0.00	No
Others Trade	0.00	No	0.00	No

Finally, the empirical results in table 4.9 indicate that Pakistan's imports are generally more responsive to exchange rate movements than exports, particularly in the case of total, food, and textile imports where depreciation tends to reduce import demand. Nominal exchange rate plays a relatively stronger role in determining aggregate imports, whereas the real effective exchange rate appears more influential in certain sectors such as textile imports. The findings also confirm the

presence of asymmetric effects, suggesting that depreciation and appreciation of exchange rates affect trade flows differently, with depreciation mostly reducing imports but not consistently promoting exports. Among export categories, textile exports emerge as the only sector significantly sensitive to exchange rate variations, while food, petroleum, and other exports remain largely insensitive. Overall, the Marshall Lerner condition is not satisfied at the aggregate level.

Conclusion and Policy Recommendations

The results indicate that imports are more sensitive to exchange rate fluctuations than exports, with total, food, and textile imports responding significantly to both nominal and real effective exchange rate changes. Nominal exchange rate has a stronger influence on aggregate imports, while real effective exchange rate appears more important in specific sectors such as textiles. The analysis confirms asymmetric effects in many cases, where depreciation generally reduces imports, but appreciation and depreciation do not have equivalent impacts on trade flows. Among exports, only textile exports show significant responsiveness to exchange rate movements, whereas food, petroleum, and other exports remain largely insensitive. Finally, the Marshall–Lerner condition is not satisfied at the aggregate level, implying that currency depreciation is unlikely to improve the overall trade balance, though it may hold at the sectoral level for textiles and food, suggesting limited potential for targeted policy measures. Based on the findings, policymakers in Pakistan should prioritize stabilizing the nominal exchange rate, as it has a stronger impact on aggregate imports compared to the real effective exchange rate. Sector-specific interventions are also necessary, particularly for textiles and food, where exchange rate movements significantly influence trade flows; these may include export incentives, targeted subsidies, and tariff adjustments to support competitiveness. Given the presence of asymmetric effects, sudden or large fluctuations in the exchange rate should be avoided, as depreciation generally reduces imports without substantially boosting exports. Since the Marshall Lerner condition is not satisfied therefore, policies should also focus on export diversification and import substitution, especially in non-textile and non-food sectors.

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