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Asymmetric Effects of the Exchange Rate on the Trade Balance of the Textile Industry in Pakistan

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Abstract
This study aims to examine the impact of exchange rate fluctuations on the trade balance of the textile industry in Pakistan. Utilizing data spanning from July 2003 to June 2023, the analysis employs both Linear and Non-Linear Auto-Regressive Distributed Lag (ARDL and NARDL) Bound Testing models to investigate the effects of the real effective exchange rate (REER). Findings reveal a negative relationship between the REER and the trade balance, indicating that an appreciation of the domestic currency relative to a basket of foreign currencies adjusted for inflation results in a deterioration of the trade balance. Moreover, the NARDL model's estimates indicate that while appreciation of the exchange rate does not significantly affect the trade balance, depreciation has a favorable impact. Notably, the long-term effects of exchange rate changes on the trade balance are more pronounced than the short-term impacts.
Keywords: Exchange rate, Trade balance, Textile sector, Linear and Nonlinear ARDL

1. Introduction

The textile sector is fundamental to Pakistan's economic structure, acting as a central pillar of the industrial landscape and a critical source of both employment and revenue generation. This sector makes a considerable contribution to the nation's GDP and constitutes a significant fraction of its export revenues, positioning Pakistan among the global leaders in textile production. In 2023, textile exports reached 12,476.4 million USD, with a slight decrease to 12,443.6 million USD in 2024 (Ministry of Finance, 2024). Textiles contribute about one-fourth to the industrial value added and engage approximately 40 percent of the industrial workforce. Despite facing periodic seasonal and cyclical variations, the textile industry consistently represents around 54.5 percent of the total national exports.

The textile sector not only underpins millions of jobs but also invigorates the agricultural landscape by escalating demand for cotton, Pakistan's principal cash crop. The industry exhibits an extensive production continuum, presenting numerous opportunities for value addition at various stages—from cotton cultivation, ginning, and spinning to weaving, dyeing, finishing, and the assembly of garments. Moreover, the sector's broad-ranging supply chain catalyzes growth in ancillary industries, including chemical production for dyes, packaging, and textile machinery (Ali & Naeem, 2017; Ahmad et al., 2022; Akhuand, 2023). The vitality of the textile industry is crucial for Pakistan's economic stability, influencing a spectrum of economic indicators from rural income levels to the nation's overall export revenue. Consequently, governmental policies frequently focus on bolstering the textile industry, aiming to fortify its global competitiveness and ensure sustained economic growth (Siddiqi et al., 2014; Audi & Ali, 2018).

While Pakistan is a major exporter of textiles, its concurrent role as an importer of textile goods presents a complex set of economic implications. This dual position can sometimes strain the domestic industry, as imported textiles may compete with local products, potentially undercutting prices and market shares of domestic manufacturers (Ahmad et al., 2018; Cizakca, 2024). On the other hand, the import of high-quality textiles, especially specialized fabrics not produced locally, can enhance product offerings and spur innovation within the local industry. However, reliance on imports for certain raw materials or finished goods can expose the economy to global price fluctuations and supply chain disruptions, impacting production costs and market stability. Additionally, this scenario necessitates a delicate balance in trade and tariff policies to protect local industries while maintaining the benefits of global trade partnerships.

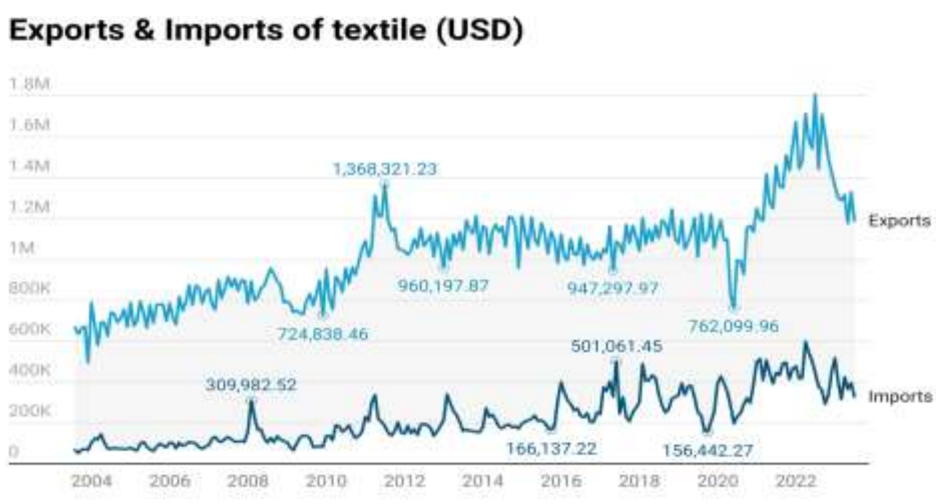

Figure 1: Dynamic pattern of textile imports and export of Pakistan

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The dynamic pattern of the monthly exports and imports of textile presented in the Figure 1. It depicts the trend of textile exports and imports for Pakistan in USD from 2004 to 2022. Exports show a generally increasing trend over the years, with a significant peak in the months of 2021 at approximately 1.37 million USD. This peak suggests a high demand or successful export strategy during that period. Following 2021, there is a sharp decline in export values in the months of 2022. Imports, on the other hand, remain relatively low and stable compared to exports, indicating that the domestic production of textiles may sufficiently meet local demand, or that the import of raw materials is not heavily reliant on foreign markets. The import values peaked around the months of 2010 and have been on a gentle decline since, with a minor uptick around the months of 2018. The substantial gap between the values of exports and imports highlights Pakistan's strength as a net exporter in the textile sector.
The fluctuations in Pakistan's textile imports and exports can be attributed to a various factors, such as economic policies, global demand, competition, supply chain issues, and raw material costs. Crucially, the exchange rate of the Pakistani Rupee against major currencies like the US Dollar significantly influences the competitiveness of Pakistani textiles in international markets. A depreciating rupee may render exports more economically attractive but can simultaneously raise the expenses associated with importing raw materials. This research aims to assess the influence of the exchange rate on Pakistan's textile trade balance. The study enhances existing academic discussions by exploring not only the linear relationships but also the nonlinear effects of exchange rate fluctuations on the trade balance, offering a more nuanced understanding of how currency valuation impacts Pakistan's textile sector.

2. Literature Review

Katseli (1983) and Ghosh (1990) highlight the unclear relationship between nominal and real exchange rates, suggesting potential flaws in studies that rely solely on these measures. This ambiguity is reflected in numerous investigations that utilize various forms of exchange rates, such as Nominal Exchange Rate (NER), Nominal Effective Exchange Rate (NEER), Real Exchange Rate (RER), Real Effective Exchange Rate (REER), and Bilateral Exchange Rate (BER). Several studies, including those by Hassan (2018) and Shahzad et al. (2017), emphasize the extensive use of both nominal and real rates. There exists a critical need to focus on the impact of currency devaluation in nominal terms on the specific volumes of imports and exports, aiming to ascertain their net effects in both the short and long term.
The impact of exchange rate on Pakistan's textile industry reveal mixed outcomes concerning the relationship. Rehman & Muhammad (2003), Rehman et al. (2012), Sun & Chang (2020), Andreou (2021), Mealli (2021), Mordecai & Akinsola (2021), and Irfan & Sohail (2021) found insignificant short-term or long-term relationship between exchange rate devaluation and the trade balance. Similarly, Kang (2016) discovered that devaluation did not significantly enhance export growth compared to countries where the currency frequently appreciated. Hassan (2018) noted differential responses across various industries to exchange rate depreciation, with some industries being responsive while others remained unaffected. These findings indicate that the effects of devaluation are not uniform across different sectors and commodities, leading to inconclusive results overall.
Nam (1995) analyzed South Korea's export-led growth from 1962-91, emphasizing how strategic exchange rate policies and heavy industry development fueled domestic and export markets, highlighting that effective currency devaluation necessitates supportive economic frameworks like export subsidies and investment in infrastructure. In contrast, Kamal & Dharmendra (1997) explored currency devaluation effects in eight diverse countries, finding that devaluation generally does not improve the trade balance in the long run, with mixed results across countries, suggesting that standard economic theories might not fully explain these outcomes. Abeysinghe & Yeok (1998) studied the impact of currency appreciation in Singapore and concluded that it positively affected export competitiveness due to high import content in exports, indicating that the effects of currency valuation changes can vary greatly depending on the structure of a country's economy and its export composition. Collectively, these studies underscore the complexity of exchange rate management and its differential impact on national trade balances and export competitiveness.
Studies like Rehman & Muhammad (2003) and Shahbaz et al. (2012) focus specifically on Pakistan, exploring the complex dynamics between the Pakistani Rupee's depreciation and the country's Balance of Trade (BoT). These studies consistently highlight that despite short-term gains in competitiveness from currency depreciation, the long-term effects are often detrimental, contradicting the anticipated J-curve effect. Kanchana & Ahmed (2010) broaden the scope by examining Sri Lanka and China, noting that devaluation can differently affect exports and imports depending on sectoral considerations, suggesting a nuanced approach to policy-making.
Similarly, Verheyen (2013) introduces a non-linear perspective with his analysis of the European Monetary Union's exports to the USA, emphasizing the asymmetric responses to currency appreciations and depreciations. Bahmani-Oskooee & Ratha (2004) and Hassan (2018) further enrich the discussion by introducing non-linear econometric models to assess the real and complex effects of exchange rate volatility on trade flows and industry-level trade balances. This body of work collectively underscores the critical need for sector-specific insights and cautious policy formulation in managing the implications of exchange rate adjustments on national trade outcomes.
The existing research has predominantly explored either the linear or nonlinear impacts of the exchange rate on trade balance, exports, and imports. These studies have focused on commodities in bilateral trade between Pakistan and its trading partners (Laetitia & Hongbing, 2019; Shahbaz et al., 2012). Conversely, only a limited number of studies have examined this relationship under a nonlinear assumption (Hassan, 2018; Verheyen, 2013). The literature is unable to examine the impact of exchange rate on a specific commodity like textile, given the importance of this sector for the Pakistan. Moreover, the asymmetric impact of exchange rate on trade balance of the textile sector is also lack in the existing literature. There is a pressing need for a study that addresses both linear and nonlinear impacts of the real effective exchange rate on the textile trade, using monthly data.

3. Theoretical Framework

3.1. Theories of exchange rate and balance of trade

The theories surrounding the relationship between exchange rates and trade balances delve into the intricate dynamics of international trade and economic policy. Initially, Mercantilism posited that a nation's wealth was measured by its stock of precious metals, advocating for a surplus in trade balance through heightened exports and reduced imports (Peukert, 2012). However, the limitations of Mercantilism, including its inability to sustain economic stability, paved the way for the Standard Theory of International Trade. This theory, propelled by the seminal works of Adam Smith (1776) and David Ricardo (1817), advocated for free trade and highlighted the benefits of trade based on comparative advantages, thereby promoting industrial prosperity as evidenced by England's success (Sen, 2010).

Building on these foundational ideas, the Standard Theory linked commodity flows and exchange rate fluctuations. It posited that a depreciation in the home currency would reduce the import volume due to higher local costs, while simultaneously boosting exports by making them cheaper on the international market (Zhang, 2008). This direct relationship between real exchange rates and trade balances, however, was later challenged by the Elasticity Approach, which introduced the concept of price elasticity of demand for imports and exports as critical factors. This approach, also known as the Bickerdike-Robinson-Metzler Condition, emphasized that the effectiveness of currency devaluation depends significantly on the responsiveness of trade volumes to price changes (Hooy & Chan, 2008).

Further complicating the discourse, the J-Curve Theory proposed by Magee (1973) suggests that while devaluation initially worsens the trade balance due to inelastic short-term responses, it eventually leads to improvement as market adjustments take place. This theory implies that a successful adjustment requires a sufficiently elastic demand to counterbalance the initial fall in trade values.

Incorporating a broader macroeconomic perspective, the Keynesian Absorption Approach argues that an improvement in trade balance through devaluation depends not just on price and volume adjustments but also on the domestic economy's ability to substitute imports with local production (Kim, 2009; Naik, 2020; Alzahrani & Salah, 2020). This approach highlights the necessity for a country's economy to operate below full capacity for devaluation to enhance the trade balance effectively.

Lastly, the Monetary Approach to the trade balance, initiated during the early 1970s by Jacob Frenkel and Harry Johnson, considers the influence of monetary policy on trade balances. This theory posits that devaluation impacts the balance of payments through its effect on the real money supply, suggesting that the broader monetary conditions in a country can significantly affect the outcomes of currency devaluation (Edwards & Wilcox, 2003; Hwang & Lee, 2019).

Together, these theories provide a rich tapestry of perspectives that underscore the complex and varied impacts of exchange rate changes on a nation's trade balance, pointing to the necessity of tailoring economic policies to the specific structural characteristics of each economy.

3.2. Theoretical core

The interplay between exchange rates and trade balance is pivotal in economic theory and policy. Theoretical frameworks often posit that fluctuations in a country's exchange rate directly affect its trade balance by altering the price competitiveness of domestic goods abroad. Depreciation of the national currency typically makes exports cheaper and imports more expensive, potentially improving the trade balance if the country's products are competitively priced and not overly reliant on imported inputs. Conversely, currency appreciation can make exports more expensive and imports cheaper, which might deteriorate the trade balance unless offset by other economic advantages such as increased export quality or demand (Katseli, 1983).

This theoretical linkage, however, is contingent upon several structural aspects of the economy. For instance, the impact of depreciation on exports' cost competitiveness depends crucially on the import content of the exported goods. High import content in exports means that any devaluation might increase production costs, thereby negating the benefits of improved price competitiveness abroad. Thus, the effectiveness of exchange rate adjustments in correcting trade imbalances hinges on the specific economic structure and the origin of inputs into export commodities, underscoring the need for tailored exchange rate policies that consider these nuances (Abeysinghe & Yeok, 1998; Arshad & Myukhtar, 2019).

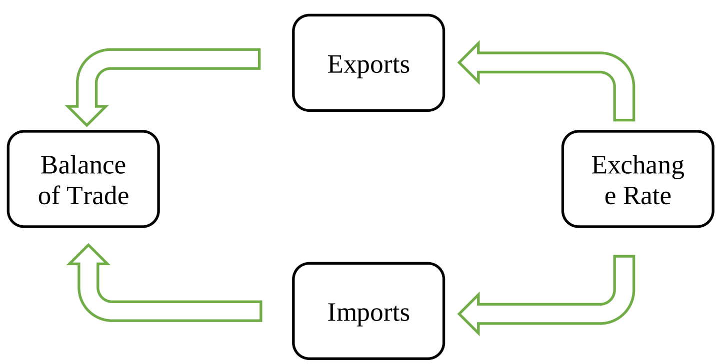

Figure 2. Conceptual Frame Work

The Figure 2 depicts a conceptual framework illustrating the dynamic relationships among the exchange rate, exports, imports, and the balance of trade. A weaker currency enhances export competitiveness but makes imports costlier, impacting the volume of both. These changes in trade volumes affect the balance of trade, which in turn can influence the exchange rate based on whether there is a trade surplus or deficit. This cycle demonstrates how the exchange rate is both influenced by and impacts trade flows.

4. Research Methodology

4.1. Econometric Model

In the academic literature, Rose & Yellen (1989) developed a model for the trade balance, defining it as a function of the real GDP of the domestic country undergoing currency devaluation, the real GDP of the trading partner country, and the real effective exchange rate (REER). This relationship can be expressed as follows:

$$TB_t = f\,(y_t^d, y_t^f\ , REER_t) \qquad (1)$$

Ensuing Bahmani-Oskooee (1985) and Rose & Yellen (1989) the abridged bilateral commodity level model for trade balance can take the following form (Vural, 2016).

$$\ln TB = \alpha_o + \alpha_1^{lg} y_t^d + \alpha_2^{lg} y_t^f + \alpha_3^{ln} REER_t \qquad (2)$$

Here, all the terms are in log form. The variables used in the equation are as follows:

$$\ln TB = \alpha_o + \alpha_1^{lg} y_t^d + \alpha_2^{lg} y_t^f + \alpha_3^{ln} REER_t + \varepsilon_t \qquad (3)$$

TB	Trade balance (Export / Imports) is a ratio of domestic exports value to that of imports
Y^d	Home country's Gross Domestic Product
Y^f	trading partner country's Gross Domestic Product
REER	Real Effective Exchange Rate
t	Time subscript
e	Error term
ln	Natural logarithm

So far models discussed believe that the relationship between the real effective exchange rate and trade balance is linear, however that may not be the situation. The above equation shows long run relationship of exports and the real effective exchange rate. To analyze short run effects of real effective exchange rate on export and imports, the error correction models for each long run model is as follows

$$\Delta \ln TB_t = \alpha + \sum_{k=1}^{l} \beta_k \Delta lnTB_{t-k} + \sum_{k=0}^{l} \gamma_k \Delta lnY_{f,t-k} + \sum_{k=0}^{l} \delta_k \Delta lnREER_{t-k} + \varepsilon_{k0} ECT_{t-1} + \mu_{t,m,r} \qquad (4)$$

The equation 4 represents the linear ARDL error correction model for the imports and real exchange rate.

The linearity assumption may be too restrictive (Verheyen, 2013). In order to study the impact of nonlinearity, the above models need to be applied by nonlinear ARDL framework recommended by Shin et al. (2011) that splits the exchange rate changes into depreciation and appreciations. When the exchange rate is measured as domestic currency per unit foreign currency, the appreciation is when the exchange rate decreases whereas it is depreciation when the exchange rate increases. If appreciation is denoted by $R^-$and depreciation by R^+, then $R_t = R_0 + R^+ + R^-$. As a result, the above economic models are transformed into the following long run econometric models.

$$lnTB_t = \alpha_o + \alpha_1 lny_t^d + \alpha_2 lnREER_t^+ + \alpha_3 lnREER_t^- + \varepsilon_t \qquad (5)$$

The above equation is specification Nonlinear ARDL for imports and Real effective Exchange Rate. The above models (5) will provide the long run estimates for nonlinear ARDL model based on real exchange rate appreciation and depreciation. Furthermore, the error correction mechanisms for the above nonlinear ARDL models are as follows.

$$\Delta \ln TB_t = \rho + \sum_{k=1}^{l} \sigma_k \Delta lnTB_{t-k} + \sum_{k=0}^{l} \tau_k \Delta lnY_{d\ ,t-k} + \sum_{k=0}^{l} \varphi_k \Delta lnREER^+{}_{t-k} + \sum_{k=0}^{l} \omega_k \Delta lnREER^-{}_{t-k} + \theta_{k2} ECT_{t-1} + \mu_{t,x,r,nl} \qquad (6)$$

The equation 6 is used to estimate the Nonlinear ARDL Error Correction Model for the trade balance and real exchange rate.

4.2. Data source and variable construction

This study uses monthly data from 2003M7 (data is being maintained since July 2003) through 2023M06 obtained from State Bank of Pakistan (SBP), Pakistan Bureau of Statistics (PBS) and International Financial Statistics (IFS). The historic determination of Pakistani foreign exchange rate has been strongly linked to the United States Dollar (USD), and it still continues to be so. Therefore, it is safe to use PKR-USD exchange rate as a measure of overall Pakistani exchange rate bench mark for this study. Further, the United States of America is being used as proxy for rest of the world statistics. The variables are used as real and log forms.

Table 1: Data and Variable construction

Variable	Symbolic Sign	Measures	Data Source
Trade Balance	TB	Exports volume divided by imports volume	SBP Statistics
Industrial Production Pakistan	Yd	Proxy for monthly Gross Domestic Product	IFS
Industrial Production USA	Yf	Proxy for monthly World Gross Domestic Product	IFS
Real Effective Exchange Rate	REER	NEER x CPI/CPI f	IFS

4.3. Estimation Specification

4.3.1. ARDL and NARDL

Based on the Shin et al. (2011) framework, this study is to use Nonlinear Auto-Regressive Distributed Lag (NARDL) econometric technique to study the linear as well as nonlinear behavior of the exports and imports influenced by exchange rate of Pakistan. For the sake of comparison, the study also uses Auto-Regressive Distributed Lag (ARDL). These techniques are also sued by the Verheyen (2013) to study the impact of exchange rate on the European exports to USA. We also estimate the linear ARDL model and the non-linear ARDL model in the case of Pakistan with rest of the world. The study uses the time series monthly data from Jul

2003 to Dec 2019. The sample of Pakistan's and trading partners based on the availability of data. To see if J-curve phenomena exist or not, also whether the effects of changes in exchange rate are symmetric or asymmetric.

4.3.2. Bounds test

As recommended by Pesaran et al. (2001) ARDL bound test can be run and a long run relation can be established through bound ARDL bound testing given that the variables are I(0) and or I(1). Further the ARDL is also tested for if there exists an asymmetry in the effect of exchange rate as suggested by Shin et al. (2011). In this approach, the exchange rate is split in the partial sum of the Pak rupee appreciations (ER_POS) and that of depreciation (ER_NEG). Also, Wald linear restriction test is used to test the hypothesis of ER_POS and ER_NEG being equal, in which case there will not be an asymmetry of the exchange rate impact.

So, if the null hypothesis of the Wald test i.e., the linear restriction of ER_POS being equal to ER_NEG is rejected, there would be an asymmetry, otherwise there will be a symmetry. If there is an asymmetry that means the appreciation and depreciation of the exchange rate impact the variable differently and not the same way.

4.3.3. Validity of Data

The problem of Multicollinearity arises when two or more regressors in the model highly correlate with each other. If we estimate the model in the existence of Multicollinearity, even trivial changes in data will unwittingly alter the results of estimates. Multicollinearity restricts the estimates result to be outline (Wooldridge, 2013). Estimation in the presence of Multicollinearity will result in a larger standard error, which signify that the coefficient may not be estimated with adroit perfection (Gujrati, 2009).

4.3.4. Heteroscedasticity Test

To check if the variance of residual is persistent or not, we apply the test of heteroscedasticity. As when there is heteroscedasticity and we run the regression, the results will be inefficient as the assumption of minimum variance is exploited. The erosion of efficiency gives on the prejudice S.E and as a result, the conclusion from the estimates becomes infirm. (Baltagi, 2005). Analysis of F.E. regression assumes that residuals are separately and equitably dispersed. This problem exists because the variance of residuals changes over time.

$$\partial^2 i = \hat{\partial}^2$$

Here

i=1, and n represents the number of cross-sections

Suppose

$$\partial^2 i = \tau^{-1} \sum_{\tau=1} \hat{\mu}_{it}^2$$

Here, estimator of ith unit residual variance formed on tie it attainable for this entity. Hence the above equation can by written as

$$wi = T^{-1}(T_{i-1}^{-1}) \sum_{t=1} (\hat{\mu}_{it}^2 -)$$

Here

Wi= Calculated variance

And in this case the modified Wald test would be of the form

$$Z = \sum_{i=1} \left(\hat{\partial}_i^2 - \hat{\partial}^2\right)^{\wedge 2} / Wi$$

Now the H0 will be

$$H_0: \widehat{Sigma}_i^2 = \widehat{Sigma}^2 \qquad (for\ all\ cross\ sections)$$

when the value of " $\aleph^2$" is greater than the $\rho - value$ or in other words when the $\rho - value$ is smaller than 10% or 0.10, we may conclude that the panel under consideration contains the problem of heteroscedasticity.

4.3.5. LM Test for Serial Correlation

Presence of autocorrelation in panel data may create biasedness in the standards errors that will in turn yield the less efficient outcomes. Econometric literature provides various serial correlation diagnostic tests but Wooldridge (2000) test is more efficient and its application is very simple. This test is applicable for both balanced and unbalanced panel data. This test holds justifiable size and power characteristics with normal sample size. Let's examine the following unidirectional linear model.

$$Y_{it} = \gamma_0 + \gamma_1 a_{it} + \gamma_2 b_i + \mu_i + \varepsilon_{it}$$

Here

i= 123………n

T= 123………t

And

Y_{it} = $Dependent\ variable$

a_{it} = Time variant independent variable

γ_i= $coefficients$

μ_i= individual level impact and ε_{it} peculiar residual

In a case when $\mu_i's$ are correlated with a_{it} or b_i the parameters a_{it} can be measured inevitably by a regression in the first difference transformation. Whereas if $\mu_i's$ are independent of x_{it} or $i's$ than the parameters of the model may be estimated efficiently and inevitably by employing the methodology of suitable generalized least square termed as Random Effect.

We assume that for all such parameters

E (eit + eis) =0

That there is no autocorrelation in the residuals that create S.E biasedness.

4.3.6. Unit Root Test

We tested the stationarity of the variables at level with constant term and also constant with time trend. We also carried out similar exercise to test the stationarity of the variable with constant term and also tested constant term with time trend. We applied Augmented Dickey Fuller (ADF) test which tested the stationarity of the variable under the null hypothesis of 'series is not stationarity' or series is unit root. An underlying assumption of time series involved data is that it be stationary. By stationary time series, we have in view that the mean and variance of time series remain constant overtime. While, the covariance between time series hangs only in the distance not in the real live time at which it is calculated.

They also undertook individual autocorrelation structure of the residuals, supposing that parameters are homogenous at 1st order. They further argued that N and T are incline to infinitude, whereas, T grew swiftly i.e., $N/T \rightarrow 0$. These scholars evolve a course of action by utilizing pooled "t" statistic of the assessment to gauge the conjecture that each time series is stationary.

For its explanation consider the following model

$$\Delta X_{it} = \rho_i X_{it-1} + \acute{Z}_{it}\gamma + \varepsilon_{it}$$

$_i$ = section identity

t = time period

Z_{it} = predetermined element (may be 0, 1 or fixed)

ε_{it} = process stationary

Levin Lin and Chu suppose analogous autoregressive parameters among entities i.e., $\rho_{i=}\,\rho$ for all individuals and examine the hypothesis

$$H_0: \rho_i = \rho = 0$$
$$H_1: \rho_i = \rho < 0$$

Here Ho Strikes a cross equation limitation on partial correlation measures. Hence, this proceeding has greater advantage over a separate stationarity test for each entity. The configuration of LLC assessment can be modeled as follows.

$$\Delta Y_{it} = \rho y_{it-1} + \gamma_{0i} + \gamma_{1it} + \epsilon_{it}$$

Here

γ_{1it} = Time trend

γ_{0i} = Individual effect

We can observe that in this model determinative elements are momentous threshold of heterogeneity following the coefficients of lagged regressend is bound to be homogenous through all entities in the panel. While ϵ_{it} is supposed to be separately assorted over entities and adopt a stationary convertible ARMA procedure for every individual i.e.

$$\epsilon_{it} = \sum_{j=1}^{\infty} \emptyset_{ij}\, \epsilon_{it-j} + \epsilon_{it}$$

5. Estimation Results and Discussion

5.1. Pre-estimation test

5.1.1. Augmented Dickey–Fuller (ADF) test

We presented the unit roots test in the table 2. We tested the stationarity of the variables at level with constant term and also constant with time trend. We also carried out similar exercise to test the stationarity of the variable with constant term and also tested constant term with time trend. We applied Augmented Dickey Fuller (ADF) test which tested the stationarity of the variable under the null hypothesis of 'series is not stationarity' or series is unit root.

Table 2: Augmented Dickey–Fuller (ADF) test

		Level		
Variables	Intercept		Tend and Intercept	
	t-statistic	p-values	t-statistic	p-values
LnUSip	-3.583064***	0.0070	-4.226093***	0.0050
LnPAKip	-1.722778	0.4181	-4.135004***	0.0067
LnREER	-1.843800	0.3585	-1.771725	0.7149
LnTB	-3.537157***	0.0080	-7.403433	0.0000
	1st Difference			
	Intercept		Tend and Intercept	
	t-statistic	p-values	t-statistic	p-values
LnUSip	-2.614046*	0.0919	-2.605597	0.2784
LnPAKip	-3.066887**	0.0309	-3.061597	0.1188
LnREER	-10.58657***	0.0000	-10.58895***	0.0000
LnTB	-9.881459	0.0000	-9.841980	0.0000

In the panel A of table 1, the aftermath of the ADF test depicts that trade balance (TB) are stationary at level with constant term as well as constant term with time trend. While textile export (XTX), industrial production Pakistan (PAKIP) and real effective exchange rate (REER) is not stationary at level with constant term and also constant with time trend. Aftermath of the ADF test depicts that all the variable: industrial production Pakistan (PAKIP) and real effective exchange rate (REER) are stationary at first difference with constant term and also constant with time trend. Finally, if all the variables are stationary at first difference or some stationary at level and some at first difference. Then the preferable model would be Autoregressive Distributed Lag (ARDL) model to estimate the short run relationship and also long run if value of Bound test is significant.

5.1.2. ARDL Bound Testing

As recommended by Pesaran et al. (2001) ARDL bound test can be run and a long run relation can be established through bound ARDL bound testing given that the variables are I(0) and or I(1). Further the ARDL is also tested for if there exists an asymmetry in the effect of exchange rate as suggested by Shin et al. (2011). In this approach, the exchange rate is split in the partial sum of the Pak rupee appreciations (ER_POS) and that of depreciation (ER_NEG). Also, Wald linear restriction test is used to test the hypothesis of ER_POS and ER_NEG being equal, in which case there will not be an asymmetry of the exchange rate impact.

So, if the null hypothesis of the Wald test i.e., the linear restriction of ER_POS being equal to ER_NEG is rejected, there would be an asymmetry, otherwise there will be a symmetry. If there is an asymmetry that means the appreciation and depreciation of the exchange rate impact the variable differently and not the same way.

We presented the ARDL and NARDL F test results in the table 2,3. The ARDL and NARDL bound test technique used to test the presence of the long run estimates. For this purpose, the variable industrial production united states (USIP), industrial production Pakistan (PAKIP) and real effective exchange rate (REER) tested to determine the long run relationship with the trade balance (TB). The estimated ARDL F test value is 7.045758 which is greater than the upper limit at different level of significance and NARDL F test value is 8.274158. The greater estimated value than the table value indicates the rejection of null hypothesis of 'no long run relationship'. Finally, there exist a long run relationship at different level of significance from 10% to 1%.

Table 3: Bound test for ARDL and NARDL

ARDL Bound test for cointegration					
Dependent variable	F-statistics	K	Lower bound 5%	Upper bound 5%	Conclusion
TB	7.045758	3	2.79	3.67	Cointegration
NARDL Bound test for cointegration					
Dependent variable	F-statistics	K	Lower bound 5%	Upper bound 5%	Conclusion
TB	8.274158	8.274158	2.56	3.49	Cointegration

***1% level of significance. **5% level of significance.*10% level of significance.

5.2. Autoregressive Distributed Lag: ARDL and NARDL

We also estimate the linear ARDL model and the non-linear ARDL model in the case of Pakistan with rest of the world. The study uses the time series monthly data from Jul 2003 to June 2023. The sample of Pakistan's and trading partners based on the availability of data. To see if J-curve phenomena exist or not, also whether the effects of changes in exchange rate are symmetric or asymmetric. Part 1 of estimates the short run linear ARDL and NLARDL model and Part 2 provides the long run results of the linear ARDL and NLARDL model. Panel A provides short run coefficients, panel B provides long term coefficients, and panel C provide the diagnostic statistics of the estimation process. We presented the short run estimates in the table 4. While long run estimates are presented in the table 5.

In the Table 5, the coefficient of the real effective exchange rate is 0.410531 and it is statistically significant. The negative coefficient indicates that an increase in the REER, which represents an appreciation of the domestic currency relative to a basket of foreign currencies adjusted for inflation, leads to a deterioration in the trade balance of the textile sector in Pakistan. In practical terms, a 1% increase in the REER is associated with a 0.410531% worsening of the trade balance. This suggests that the appreciation of the currency makes Pakistani textile exports less competitive abroad due to higher prices in foreign markets, and/or it may make imports cheaper, thereby increasing the import of textile-related goods or raw materials.

In the Non-linear Autoregressive Distributed Lag (NARDL) model, the real effective exchange rate is depicting asymmetric impact. It suggest that the impact of appreciation and depreciation is different sign and magnitude. For instance, one percent appreciation and one percent depreciation of exchange rate effects differently on the textile sector trade balance. The positive REER reflecting an appreciation of the domestic currency, has a positive impact on the trade balance of textiles, but not statistically significant impact of currency appreciation on the textile trade balance. The negative real effective exchange rate coefficient is negative and statistically significant, which indicates that a decrease in the REER, or a depreciation of the domestic currency, significantly benefits the trade balance of textiles. This is typically as per expectations, as depreciation usually makes imports more expensive and exports cheaper and making trade balance to rise in a favorable direction.

Currency depreciation can enhance a country's trade balance by making exports more competitively priced in global markets, thus potentially increasing export volumes, particularly if foreign demand for these goods is price elastic. Simultaneously, the higher cost of imports due to depreciation may reduce import volumes as domestic consumers and businesses seek local alternatives, further supporting local industries and leading to a net improvement in the trade balance. This initial impact might lead to a short-term worsening (J-Curve effect), but generally, trade balance improves as adjustments take place. However, this could also heighten inflationary pressures by increasing the prices of imported goods and materials, affecting economic stability. The actual impact varies based on economic conditions, demand elasticity, and the economic structure.

The output of Pakistan and USA has a significant and positive impact on the trade balance of Pakistan. It implies that increase in production of Pakistan and USA both increase the trade balance of Pakistan by increasing the exports of Pakistan. An increase in industrial production in both Pakistan and the USA could positively influence Pakistan's trade balance due to enhanced trade dynamics and economic interdependence. Increased production in Pakistan can boost exports by improving the quality and quantity of manufactured goods, enhancing competitiveness, and driving economic growth, which may lead to higher domestic consumption and job creation. Concurrently, heightened industrial activity in the USA might increase demand for Pakistani raw materials and intermediate goods, and possibly lead to greater U.S. investment in Pakistan. This interaction can create a favorable scenario for Pakistan's trade balance if the rise in exports exceeds any increase in imports, reflecting in a reduced trade deficit. Overall, increased industrial production in both nations could promote more robust trade flows, potentially improving Pakistan's trade balance through greater export opportunities and economic collaboration.

Table 4: Short run estimates of ARDL and NARDL model

Panel A: Short Run Estimates of TB model					
ARDL			NARDL		
Variables	Coefficient	t-Statistic	Variables	Coefficient	t-Statistic
LTB(-1)	0.933691***	12.94611	LTB(-1)	0.858169***	11.71627
LREER	-0.410531**	-2.040759	LREER_NEG	-0.565348***	-2.773718
			LREER_POS	1.897831	1.391100
LPAKIP	0.474999***	2.846587	LPAKIP	-0.053711	-0.338191
LUSIP	1.972754*	1.937674	LUSIP	-1.887776**	-2.117816
C	-4.982308	-3.271174	C	-0.910498	-0.633714

We presented the long-run estimates of the ARDL and NARDL model in the Table 6. The sign and significance of the estimates of the short run and long run remain consistent. However, the magnitude of the coefficients of the long run model is relatively higher. It implies that the liner impact of the deprecation of the exchange rate on the trade balance of textile in Pakistan is higher in the long run than in the short run. Likewise, the non-linear impact of the depreciation of the exchange rate on the trade balance is also higher in the long run than the short run.

Table 5: Long run estimates of ARDL and NARDL model

Panel B: Long Run Estimates of TB model					
ARDL			NARDL		
Model	3,0,1,4		Model	4,0,1,0,4	
Lags	4		Lags	4	
Variables	Coefficient	t-Statistic	Variables	Coefficient	t-Statistic
LREER	-1.289337**	-2.163333	LREER_NEG	-1.276517***	-2.977053
			LREER_POS	0.440369	0.931138
LPAKIP	1.756260***	4.030044	LPAKIP	-0.121277	-0.335160
LUSIP	-0.044431	-0.043149	LUSIP	0.076159	0.109587
C	-15.64770	-3.871113	C	-2.055842	-0.639912
Panel C: Diagnostic Testing					
R-squared	0.891048		R-squared	0.857648	
Ad R squared	0.882109		Ad R squared	0.794607	
Durbin-Watson	2.133862		Durbin-Watson	2.055491	
Wald				14.73 {1,182} [0.00]	
ECM(-1)*	-0.271649***	-5.423792		-0.328386***	-6.395987
ARCH-1 lag	8.957982***		ARCH-1 lag	17.99914***	
LM-1 lag	0.437295	[0.6465]	LM-1 lag	0.053235	[0.8178]
Jarque- Bera	17.22***	[0.00]	Jarque- Bera	23.42***	[0.00]
***1% level of significance. **5% level of significance.*10% level of significance					
{ } = Degree of freedom; [ ] = P-Values					

The pre-estimation diagnostic of the model suggest that the model has rich explanatory power of variation in the dependent variable coming from independent variable as it confirmed from the adjusted R-square which is almost 89%. While the lower level of Durbin-Watson test indicates the lack of presence of autocorrelation in the model. The negative and significant ECM also makes it understood that the system would come to its equilibrium if an external shock disturbs it. The speed of recovery ranges from 22% to 48% in one year. The LM test shows that the model is free from problem of serial correlation. In addition, there is no evidence of heteroscedasticity because the ARCH test is insignificant at the 5% level. Furthermore, the Jarque–Bera test shows that the functional form is correct and the distribution is normal. Therefore, the approximate ARDL model is reliable.

6. Conclusion

This study aims to examine the effects of the real effective exchange rate on the exports and imports of the textile industry in Pakistan, utilizing monthly data from June 2003 to June 2023. The short-run results are estimated using ARDL and NARDL models after confirming the unit root condition of the series. Long-run estimates are derived with the help of the ARDL and NARDL Bound testing approach. Both short-run and long-run estimates are analyzed for the textile trade balance model. Based on the results discussed in the previous section, conclusions will be drawn and policy recommendations will be derived in this section.

There is a negative relationship between the real effective exchange rate and coefficient indicates that an increase in the REER, which represents an appreciation of the domestic currency relative to a basket of foreign currencies adjusted for inflation, leads to a deterioration in the trade balance of the textile sector in Pakistan. This suggests that the appreciation of the currency makes Pakistani textile exports less competitive abroad due to higher prices in foreign markets, and/or it may make imports cheaper, thereby increasing the import of textile-related goods or raw materials. In the Non-linear Autoregressive Distributed Lag (NARDL) model, the real effective exchange rate is depicting asymmetric impact. The estimates of the NARDL model suggest that appreciation of exchange rate does not impact the trade balance of textile. While depreciation has favorable impact on trade balance. It has been also observed that long-run impact exchange rate on textile trade balance is greater than the short run.

The study suggest that it is important consider adopting a managed float regime for the exchange rate to prevent excessive appreciation of the domestic currency. The State Bank of Pakistan could intervene in foreign exchange markets to prevent rapid appreciations that could harm export competitiveness. While currency depreciation has been observed to benefit the textile trade balance, deliberate depreciation may not be advisable in an import-reliant economy due to potential inflationary consequences. Therefore, alternative strategies to enhance trade balance are recommended. These include enhancing export incentives, promoting import substitution, negotiating favorable trade agreements, investing in research and development, and bolstering training and development initiatives. Such measures could collectively support sustained improvements in trade balance without the adverse effects of manipulating currency values directly.

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