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The Impact of Exchange Rate Fluctuations on Turkish Industry Exports

Maryem Salme Bedda

Department of Economics, Istanbul Ticaret University

Abstract

The effect of exchange rate fluctuations on exports has attracted considerable attention from economic scholars in Türkiye. However, the results in this field have been inconclusive and limited on the sectoral level. To address this gap, the present research undertakes an examination of the impact of exchange rate volatility on industry level exports using quarterly data from the Central Bank of the Republic of Türkiye and the Turkish Statistical Institute databases for the period from 2013Q1 to 2025Q1. The study estimates the impact of the real effective exchange rate using the ARDL bounds approach and error correction mechanism; with a focus on critical variables including Gross Domestic Product, Labor force, Net Taxes and Foreign Direct Investment. The outcome of ARDL analysis indicates that there's a significant effect of REER on industry exports in both short and long term. Reliability of the findings was confirmed using multiple diagnostic tests.

Keywords: ARDL; Exchange Rate; Industry Exports; Türkiye

1. Introduction

During the last years, the emerging economies and particularly Türkiye have been facing repeated exchange rate volatility crises. The Turkish Lira witnessed significant depreciation in its value compared to the main foreign currencies specially the American Dollar (USD) and the Euro (EUR), the exchange rate volatility has been persistent following the 2001 crisis such as the 2009, 2018, the Covid-19 term and the ongoing inflation (Orhangazi & Yeldan, 2021). In this context, a crucial question arises about the effects of these changes on the country's international trade performance. This study aims to answer that question by empirically investigating the effect of exchange rate fluctuations during recent period from the first quarter of 2013 to the first quarter of 2025. At the same time, variation across sectors is important. It was proven that not all exports react in the same way to exchange rate movements as it may have positive effects on some sectors but negative or neutral effects on others (Akça & Akçay, 2024). Therefore, the research focuses solely on the reaction of the industrial sector as it is a growth leading sector in the Turkish economy. The great importance of industrial policies in gaining international competitiveness and boosting the development of the country calls for a comprehensive analysis of this specific sector.

The relationship between exchange rates and exports can be explained through international trade theories and macroeconomic models. The empirical analysis conducted in this work follows the ARDL Bounds testing approach and applies error correction mechanism to capture short term dynamics and the speed of return to equilibrium. ARDL is considered an appropriate method because it allows us to test both the short and the long-term effects. Furthermore, the ARDL is also preferable as it can be applied if variables are integrated in order zero, order one or mixed I (0) and I (1) unlike traditional cointegration techniques

that require variables integrated in the same order. Also, ARDL is more efficient and provides more reliable and consistent estimates in studying smaller sample data sizes. (Fikri et al. 2025; Wang & Sua 2025).

Even though traditional economic theory suggests that a depreciation of the domestic currency empowers the competitiveness of the exports by lowering its prices for the foreign currencies; the reality in Türkiye shows a more complicated situation. The extensive reliance of the industry sector on the imported intermediate and capital goods constrains clear identification of the real response of industrial exports to exchange rate volatility (Demir et al., 2023). Moreover, the state of macroeconomic instability that accompanies currency depreciation forms an environment of risk and uncertainty for the exporters, which can reduce their long-term investments (Gayaker, 2025). Consequently, the main problem of this study lies in the ambiguity of the exact impact of exchange rate variation on the size and value of the industrial sector exports activity.

This study gains its significance through multiple theoretical and practical aspects. Academically, the research will enrich economic theory related to countries in development through testing the complexity of exchange rate impact in the case of Türkiye. It produces an analytic model that can be applied to other emerging economies that rely on a similar policy. Practically, this research is important for policy makers because the results give empirical prove that can help the Turkish central bank and the finance ministry to design more effective monetary and commercial policies. It can also help in supporting the targeted allocation of export incentives through identifying the specific effect of exchange rate fluctuations on the industry sector. Findings of the study may also facilitate understanding the risk environment in a better way for business owners, investors and industrial exporters and assist them with putting effective strategies to manage exchange rate risks and planning for producing and pricing in international markets.

2. Theoretical Background

As Türkiye integrated the global market, it became subject to recurring monetary crises and consequential changes in exchange rates regimes. During the early republic period and before the nineties, Türkiye adapted the fixed rate regime that was later transformed to a crawling peg where authorities intervened continuously to achieve specific exchange rate level in the 1980s (Bulut & Şahin, 2023). In 1994, significant policy errors led to one of the most severe Turkish monetary crises, inflation was amplified and the Central Bank lost most of foreign exchange reserves (Celasun, 1998). This experience pushed the government to a major regime shift from crawling peg to a more flexible regime (Berument & Günay, 2003). Nonetheless, these changes did not prevent a more profound recession in 2001 (Kadri Ekinci & Alp Ertürk, 2007).

Since the 2001 meltdown, Türkiye adapted the floating exchange rate regime with Central Bank interventions as needed, but it faced several monetary and currency crises; like the 2009, and the prolonged recession of 2018; primarily driven by high current account deficits and orthodox reforms; these episodes involved sharp lira depreciations, reserve losses, and high inflation (Orhangazi & Yeldan, 2021). Recently, the Turkish lira faced severe pressure from the dramatical inflation, specially after the 2021 crisis, as policy misalignment, structural vulnerability, and unconventional interventions in the exchange rate market played a role in increasing exchange rate fluctuations and elevating the risk of continuous monetary crises (Şenses, 2022).

Overall, studies show that the transition from fixed exchange rates regime to the floating exchange regime was a condition to approve the economic situation, but it also exposed the country to waves of currency

crises and severe volatility, which triggers the need for an in-depth analysis of the exact reaction of important macroeconomic variables to choose the right monetary strategies that benefit the country's economy better.

3. Empirical Literature Review

There is broad consensus in the economic literature that exchange rate affects exports. However, findings of empirical studies reflect differences in the strength and direction of this effect. The complexity of the linkage between exchange rate and exports is observed in global economic studies with various analytical methodologies. Notable research of Simakova (2024) evaluated the impact of exchange rate on international trade in central European countries (Bulgaria, Poland, Hungary, Croatia, Romania and the Czech Republic) on both micro and macro levels using data from 2011 to 2021. The macroeconomic results show the expected pattern where exports react positively to exchange rate fluctuations in all countries except for Poland. while microeconomic results indicate that exchange rate was only significant for Romania and Hungary where the reaction of exports was negative. According to Goda et al. (2024), the real exchange rate depreciation tends to boost manufacturing exports especially in less complex industries in Latin American countries despite the large role of demand from trade partners in defining exports performance. These findings are in line with the outcome of Ekanayake (2022) who investigated the response of top 20 American export products to five countries ; the results of multivariate error correction model revealed that the real exchange rate appreciation and exchange rate volatility both have a negative effect on exports, consistent with theory that a stronger currency makes exports less competitive and that uncertainty in exchange rate discourages exports activity over time.

In the context of Asian economies, a considerable study of Handoyo et al. (2023) applied asymmetric (NARDL) and symmetric (ARDL) approach to the 5 southeast Asian countries (Indonesia, Thailand, Singapore, Malaysia and the Philippines) to prove the impact of exchange rate volatility on exports is significant but displays variation across countries. Similarly to the findings of Asteriou et al. (2016) who examined both nominal and real effective exchange rate data and highlighted that the reaction differs through the emerging MINT economies (Mexico, Indonesia, Nigeria and Türkiye). Gupta and Varshney (2022) further demonstrated that Indian currency devaluation has a significant effect on exports volume that variates through different commodities. Another recent investigation of the Chinese industries data from 2005 to 2018 confirmed that a depreciation of the Renminbi against the American Dollar is beneficial to exports volume and particularly to the competitiveness of tradable goods (He et al., 2021). In contrast, an examination of 22 manufacturing exports in Indonesia by Rasbin et al. (2021) employed the partial equilibrium model of monopolistic competition for exporting firms and the augmented mean group method to clarify that Indonesian manufacturing exports are not significantly affected by exchange rate changes but rather by other variables including previous manufactured exports, real interest rate, real wages, labor productivity and firm growth. These results converge with those of Kurihara (2020) where there was no meaningful association between the Yen depreciation and exports in Japan. Additional empirical research of Brun et al. (2022) in Pakistan tests the asymmetric reaction of exports using dataset from 1996 to 2019 and employing error correction model; the analysis of both quarterly and annual data revealed that a decrease by 10% in real exchange rate is linked to a 4,92% appreciation in exports in the long term. Both macro and product destination level data revealed that exports fall fast after appreciation but struggle to increase when real exchange rate decreases. The researchers suggest that the reason for this situation might be the inability of exporters to increase supply when conditions improve in the country.

For African economies, results vary across studies. A subsequent analytical evaluation of the international trade in Mauritania using ARDL method found a positive and significant effect of exchange rate fluctuations on exports, which means that higher exchange rate volatility might be enhancing the exports activity under specific conditions of economic elasticity. (Elhadj & Koang, 2024). These results confirm the traditional economic theory expectations but contradict with the examination of Ethiopian exchange rate using GARCH by Urgessa (2024) who showed that export earnings are rarely affected by exchange rate fluctuations. Oyelami et al. (2021) on the other hand found that exchange rate changes cause a significant decrease in Nigerian non-oil exports in the short term especially in the major industries like food, manufacturing and agriculture.

In the case of Türkiye, scholars gave great importance to exploring the reaction of exports to exchange rate fluctuations. Following the severe and consistent volatility in Türkiye, interest in this field increased, leading to the emergence of bifurcating analyses in the literature. A prominent strand of the literature contends that the depreciation of the Turkish currency is associated with weaker exports performance. Economists attribute this relationship to multiple underlying factors. Torangali & Yalcin (2016) reported that a 10% depreciation of the currency causes an intense depreciation of 30% in exports, due to the high dependency of Turkish firms on imported raw and intermediate goods. The same justification was confirmed by other studies like Cakir (2021) and Thorbecke & Sengenoul (2023) who found that a depreciation of the TL isn't beneficial for Turkish exporters because it prevents them from importing vital inputs. A range of empirical analyses of the long and short run effects using ARDL method indicate that volatility has a significant and negative impact on exports because it increases risk and uncertainty, discouraging exporters from investing or making long term trade plans (Celik 2018; Alev 2020). Boz et al 2020 on the other hand found that this effect is driven by using foreign currency pricing (Dollar and Euro) instead of Turkish Lira which raises costs and financial risk. While earlier examination of the Turkish export supply and import demand using both the single equation and vector auto regressive models between the years of 1987 to 2003 provides evidence that exports are determined by their prices, unit labor costs and national income rather than currency's variation (Aydın et al. 2004).

From another perspective, exchange rate depreciation is viewed as an accelerator for Turkish exports (Ouattara, 2023). Bilgili et al. (2021) highlights that under flexible or floating exchange rate regime, devaluation of the currency tends to raise exports performance. Further investigation of sector level evidence from Türkiye's agricultural exports shows that exports react positively to currency's devaluation (Çatuk, 2025). An additional recent examination of Türkiye's manufacturing sector exports to Germany revealed that exchange rate instability has no impact in the short term but over time firms can adapt to volatility and turn it to a competitive advantage as noted by Hekim (2025). Prior research of the period from 1982 to 2001 using cointegration techniques and error correction model also argued that volatility has positive short run effects on exports, because traders avoid decreases in income by distributing more (Kasman, 2005). These heterogenous empirical findings confirm that the relation between exchange rate variations and exports growth doesn't always have a clear path as it might depend on country's characteristics like the production structure, price elasticity of the products and political and monetary policies.

4. Data and Methodology

4.1. Data

This study uses quarterly data of Türkiye covering the period from 2013Q1 to 2025Q1. Data were obtained

from the Central Bank of the Republic of Türkiye (TCMB) and the Turkish Statistical Institute (TUIK) databases and were all transformed to logarithmic form. The relevant variables influencing Industrial Exports (EXP) and selected as independent variables are the Real Effective Exchange Rate (REER), Labor Force (LF), Gross Domestic Product (GDP), Taxes less Subsidies (TX) and Foreign Direct Investment (FDI). The specific description and resource of each variable is mentioned in table 1.

Table 1. Variables Measurement and Resources

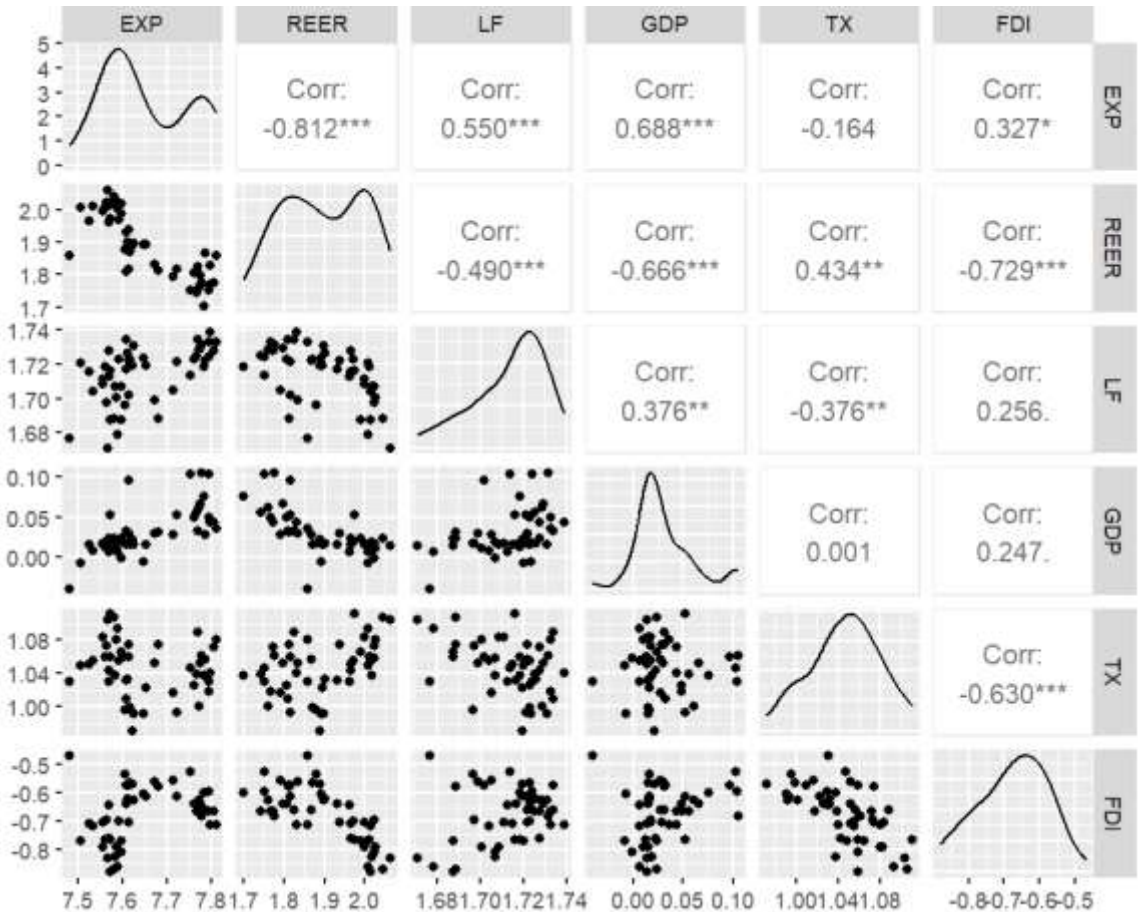
Variable	Unity	Resource
EXP	Industry Exports in 1000 USD	TCMB
REER	Index based on CPI (2003=100)	TCMB
LF	Labor force participation rate (%)	TUIK
GDP	Seasonally adjusted at current prices Gross Domestic Product quarterly change (%)	TUIK
TX	Taxes less subsidies as share in GDP (%)	TUIK
FDI	Foreign direct investment calculated as share of GDP (%)	TCMB

The descriptive statistics and correlation table of the variables were introduced in Table 2 and Table 3 respectively. They work as preliminary steps that help in understanding the data structure and detecting errors and outliers before applying any econometric techniques. Statistics in Table 2 suggest that the dataset under analysis displays relatively low variability across all variables and reflects a stable economic structure. Table 3 results also show that there is no indication of serious multicollinearity among the explanatory variables. The logarithmic transformations have successfully moderated extreme variations, allowing for more consistent and interpretable statistical behavior across the series.

Table 2. Descriptive Statistics

EXP	REER	LF	GDP	TX	FDI
Min	7.482	1.701	1.671	-0.040	0.971	-0.878
Max	7.810	2.061	1.738	0.105	1.110	-0.468
Range	0.328	0.360	0.067	0.145	0.139	0.410
Median	7.614	1.893	1.718	0.023	1.051	-0.665
Mean	7.650	1.896	1.713	0.030	1.046	-0.675
Std-dev	0.095	0.099	0.016	0.029	0.032	0.097
Skewness	0.381	-0.070	-0.805	0.870	-0.186	-0.271
Kurtosis	1.766	1.711	2.843	4.062	2.518	2.384
J-B	4.296	3.43	5.344*	8.499**	0.758	1.377

Note. Jarque-Bera(J-B) test statistics assess normality. Asterisks indicate significance levels: ***= Significant at 1%, **= Significant at 5% and *= Significant at 10%.



Figu Note. Asterisks indicate significance levels: *= Significant at 1%, **=**

4.2. Methodology

The objective of the study is to link industry exports and real effect exchange rate while controlling the effect of LF, GDP, TX and FDI. A basic regression model can be specified as:

$$EXP_t = f(REER_t, LF_t, GDP_t, TX_t, FDI_t) \quad (1)$$

Where EXP_t represents the dependent variable at time *t;* $REER_t, LF_t, GDP_t, TX_t$ *and* FDI_t represent the explanatory variables at time *t*.

This association can be given in the form of a linear empirical model:

$$EXP_t = \alpha_0 + \alpha_1 REER_t + \alpha_2 LF_t + \alpha_3 GDP_t + \alpha_4 TX_t + \alpha_5 FDI_t + \varepsilon_t \quad (2)$$

Where ε_t represents the standard error term and α_0 is the constant.

The Bounds testing approach to cointegration (ARDL) proposed by Pesaran, Shin and Smith (2001) is employed as it allows for variables to be purely integrated of order zero, one or mixed and because it provides valid results for the relatively small sample size (49 observations).

In line with the ARDL approach, the model of the study is specified as:

$$\Delta EXP_t = \theta + \sum_{i=1}^{p1} \beta_{1i} \Delta EXP_{t-i} + \sum_{i=1}^{p2} \beta_{2i} \Delta REER_{t-i} + \sum_{i=1}^{p3} \beta_{3i} \Delta LF_{t-i} + \sum_{i=1}^{p4} \beta_{4i} \Delta GDP_{t-i} + \sum_{i=1}^{p5} \beta_{5i} \Delta TX_{t-i} + \sum_{i=1}^{p6} \beta_{6i} \Delta FDI_{t-i} + \beta_7 EXP_{t-1} + \beta_8 REER_{t-1} + \beta_9 LF_{t-1} + \beta_{10} GDP_{t-1} + \beta_{11} TX_{t-1} + \beta_{12} FDI_{t-1} + \varepsilon_t \quad (3)$$

Where Δ is the difference operator, p is optimal lag order; ε is a vector of the error term; β_i are short and long run coefficients and θ is the constant.

If the F-statistic result is found to be higher than the critical value of the upper bounds of I(0) and I(1), the null hypothesis of no integration (H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6$) is rejected and the alternative hypothesis H_1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6$ is maintained.

The error correction mechanism is used to estimate short run parameters after the long run association is confirmed between the variables of the study. It can be written as:

$$\Delta EXP_t = \theta + \sum_{i=1}^{p} \beta_{1i}\, \Delta EXP_{t-i} + \sum_{i=0}^{p} \beta_{2i}\, \Delta REER_{t-i} + \sum_{i=0}^{p} \beta_{3i}\, \Delta LF_{t-i} + \sum_{i=0}^{p} \beta_{4i}\, \Delta GDP_{t-i} + \sum_{i=0}^{p} \beta_{5i}\, \Delta TX_{t-i} + \sum_{i=0}^{p} \beta_{6i}\, \Delta FDI_{t-i} + \alpha ECT_{t-1} + \varepsilon_t \quad (4)$$

Where αECT is the error correction term with coefficient α that represents the speed of adjustment towards equilibrium when short term shock happens. The coefficient must be negative and included between 0 and -1 to show the fraction corrected each period. Otherwise, the system would be unstable showing a growing deviation from equilibrium over time.

5. Empirical Results

5.1. Pre-estimation tests results

5.1.1. Unit root tests

The integration level of time series variables is evaluated to examine the ability to apply autoregressive distributed lag (ARDL) model. In order to get stronger confirmation, the tests of Augmented Dickey-Fuller (ADF), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and Phillips-Perron (PP) were conducted.

The unit root tests results mentioned in Table 3 consistently indicate that all six variables EXP, REER, LF., GDP, TX, and FDI are nonstationary in levels. This conclusion is reached based on the ADF and PP test statistics that did not reject the null hypothesis of a unit root for either variable at standard levels of significance. At the same time, the KPSS test, with stationarity as the null hypothesis, rejected the null at standard significance in most cases at the 1%, further confirming that the level series are nonstationary.

Once the first differences of the series were taken, immediate improvements in the stationarity properties of the series occurred. The ADF and PP tests rejected the null of a unit root for most of the differenced series, especially in the case of the PP test where all variables were statistically significant at the 1%. Additionally, the KPSS test did not reject the null of stationarity for the differenced series. This consistent evidence across all three tests suggests that the variables are stationary following the first difference. Thus, the data can be considered for ARDL modeling since it allows a mixture of I(0) and I(1) variables, but not I(2) (Pesaran et al., 2001).

Table 3. Unit Root Tests Results

	EXP	REER	LF	GDP	TX	FDI
At level						
ADF	-2.038	-0.905	-2.286	-2.324	-1.459	-0.694
	(0.559)	(0.944)	(0.460)	(0.445)	(0.791)	(0.965)
KPSS	1.107	1.174	0.599	0.772	0.419	0.788
	(0.010)	(0.010)	(0.023)	(0.010)	(0.069)	(0.010)
PP	-0.787	-1.699	-2.958	-4.518	-3.673	-1.914
	(0.1)	(0.1)	(0.048)	(0.010)	(0.010)	(0.1)
At first difference						
ADF	-3.115	-3.727	-2.670	-5.177	-3.735	-3.712

	(0.129)	(0.032)	(0.306)	(0.010)	(0.032)	(0.034)
KPSS	0.109	0.233	0.193	0.067	0.151	0.234
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
PP	-9.457	-9.321	-7.341	-15.795	-12.102	-8.525
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

Note. p-values are reported in parentheses below each statistic.

5.1.2. Lag Selection

The Akaike Information Criterion (AIC) proposed by Hirotugu Akaike (1974) was carried out to specify the optimal lag length without overfitting. The top models according to AIC were reported in Figure 2. With respect to the dependent variable (EXP), The AIC criteria indicated the selection of a maximum of two lags for REER; 3 lags for LF and TX; and four lags for all other variables.

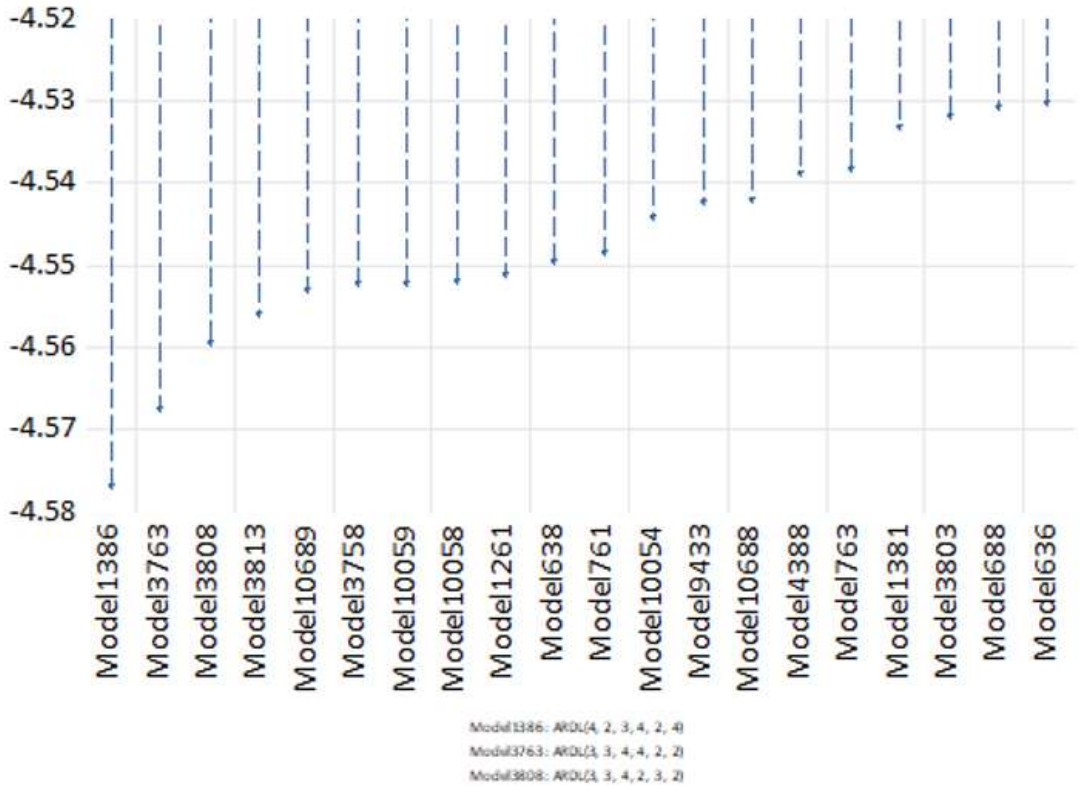


Figure 2. Akaike Information Criteria Top Models

5.1.3. Cointegration test

The Bounds Testing approach (Pesaran et al., 2001) was employed and results were displayed in Table 4. This test allows to test the null hypothesis of no level relationship (no cointegration) against the alternative hypothesis of the existence of a long-run cointegrating relationship among dependent and explanatory variables.

The computed F-statistic is 3.574430 which is above the upper critical bounds of 5% significance in the model with five regressors (k = 5) and large sample (T = 1000), which provides strong statistical evidence in rejecting the null hypothesis of no cointegration.

Finding cointegration also supports the conclusion to apply the ARDL model methodologically to study both short-run and long-run effects. Hence, it is worthwhile to continue estimating the Error Correction Model (ECM) to identify the speed of adjustments towards equilibrium when quick shocks occur in the short run.

Table 4. ARDL Cointegration test

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.574430	10%	2.08	3.00
k	5	5%	2.39	3.38
n	1000	2.5%	2.70	3.73
1%			3.06	4.15

5.2. ARDL and ECM estimations

The results for the short and long run impact of independent variables (REER, LF, GDP, TX and FDI) on the dependent variable (EXP) under the ARDL and ECM framework have been shown in Table 5. The error correction term ($ECT_{(t-1)}$) is negative and statistically significant with a value of 0.313, this supports the cointegration test result (F-stat) confirming the existence of an established long-term relationship between the estimated variables. This output signifies that 31.3% of the deviation from long run equilibrium is corrected in each quarter of a year, implying a relatively moderate speed of adjustment.

Within the short run estimations, lagged dependent variable values are highly significant and negatively related reflecting correction toward equilibrium. Lagged REER with a coefficient of 0.465 has a positively significant at 1% impact on Turkish industrial exports. During the same period, REER has no significant effect revealing that industrial exports in Türkiye do not react to REER changes at the same time, but they are affected positively by the variation of the preceding period. However, this relationship does not persist in the long term. This result is similar to the outcome of Balcılar et al. (2014) who stated that there was a positive reaction of exports to currency appreciation in the short run and no evidence of j-curve effect for the Turkish economy, the authors explained this by the high proportion of imported inputs because stronger currency reduces production costs, especially initially. Demirhan & Demirhan (2015) also found that volatility of exchange rate in the short run reduces exports, they argue that the currency risk and uncertainty caused by volatility discourages exporters and harms international trade performance.

Similarly to that, GDP and LF presented highly significant positive effects on EXP. These effects appeared both in the current period and the periods before. The immediate changes of TX and FDI are not statistically significant, but they showed a delayed important negative influence on EXP through their lagged values. Overall, the empirical results of the model yield evidence that the activity of industry sector's exports in Türkiye in the short term is shaped by dynamic interactions between REER, LF, GDP, TX and FDI with having delayed but significant effects from REER, TX and FDI and immediate effects from GDP and LF.

On the other hand, the long-term estimation results indicate that REER is statistically significant at the 5% level in the long term with a coefficient of -1.949. This means that REER is a strong predictor of EXP, a 1% increase in REER, causes a decrease by 1.949% in the industrial sector exports for the case of Türkiye. This result is in line with the findings of Alev (2020) and Çelik, R. (2018) who found that REER affects

aggregate exports of Türkiye negatively in the long run. The remaining explanatory variables showed insignificant effects, with negative coefficients for GDP and FDI and positive coefficients for LF and TX. The R-squared (R^2) value of 0.872 provides evidence that approximately 87.2% of the variability in EXP is explained by the selected model, the adjusted R-squared (Adj. R^2) also reaffirms this by explaining nearly 78.3 % of the variability. Thus, the model appears to have a strong fit. When considered jointly, these results point out to the importance of currency variations in forming industrial exports volume within the Turkish economy. EXP appeared to be primarily driven by exchange rate competitiveness. Exchange rates competitiveness can be considered as a sustainable EXP growth strategy because long-term export growth is highly related to currency value.

Table 5. ARDL Model Estimation

EQN	Variable	Estimate	Standard Error	p-value
	$ECT_{(t-1)}$	-0.313*	0.055	0.000
Short-run	ΔEXP(-1)	-0.379**	0.145	0.016
	ΔEXP(-2)	-0.449***	0.148	0.007
	ΔEXP(-3)	-0.290**	0.117	0.023
	ΔREER	-0.107	0.122	0.390
	ΔREER(-1)	0.465***	0.148	0.005
	ΔLF	1.007**	0.455	0.039
	ΔLF(-1)	1.759***	0.528	0.003
	ΔGDP	0.518***	0.175	0.008
	ΔGDP(-1)	1.028***	0.239	0.000
	ΔGDP(-2)	0.615***	0.216	0.010
	ΔGDP(-3)	0.461***	0.141	0.004
	ΔTX	-0.274	0.193	0.171
	ΔTX(-1)	-0.592***	0.209	0.010
	ΔTX(-2)	-0.351*	0.174	0.057
	ΔTX(-3)	-0.352**	0.160	0.040
	ΔFDI	-0.078	0.108	0.481
	ΔFDI(-1)	0.029	0.110	0.798
	ΔFDI(-2)	-0.376***	0.092	0.001
Long-run	REER	-1.949**	0.732	0.015
	LF	1.122	1.092	0.316
	GDP	-2.670	2.338	0.267
	TX	2.027	1.361	0.152
	FDI	-0.145	0.486	0.769
	R^2	0.872		
	Adj. R^2	0.783		
	F-stat	3.574**		

Note. *** Significance at 1%, ** Significance at 5% and * Significance at 10%.

5.3. Post-estimation diagnostics

Since the presence of a long-term relationship doesn't necessarily ensure credibility. The diagnostic and

structural changes tests were performed to confirm the reliability and validity of the estimations results. In Table 6, the Breusch-Godfrey test (statistic 4.023 and p-value 0.4029) failed to reject the null hypothesis of no autocorrelation in residuals. The errors do not appear correlated over time. Similarly, Breusch-Pagan-Godfrey test (statistic 23.476 and p-value 0.6592) did not reject the null hypothesis of homoscedasticity or constant variance of errors, suggesting the absence of heteroscedasticity. Lastly, with the null hypothesis of a normally distributed data, the Shapiro Wilk Test results assume that data is normally distributed with a statistic of 0.96209 and a P-value of 0.1468.

Graphical representations of both cumulative sum (CUSUM) and CUSUM of Squares were illustrated in Figure 3 and Figure 4 respectively, the graphs remained within the critical boundaries of 5% significance level which ensures the stability of the model parameters and rules out the possibility of structural changes. Taken together, these diagnostic tests confirm that there are no challenges of heteroscedasticity, autocorrelation, normality or structural changes in the estimates. Accordingly, the model satisfies the key classical regression assumptions; this implies that the analysis carried out in this study is robust and reliable for making inferences.

Table 6. ARDL Model Diagnostics Tests

Test	Statistic	p-value
Breusch-Godfrey Test	4.023 (4)	0.4029
Breusch-Pagan-Godfrey Test	23.476 (27)	0.6592
Shapiro-Wilk Test	0.96209	0.1468

Note. Degrees of freedom are reported in parentheses below each statistic.

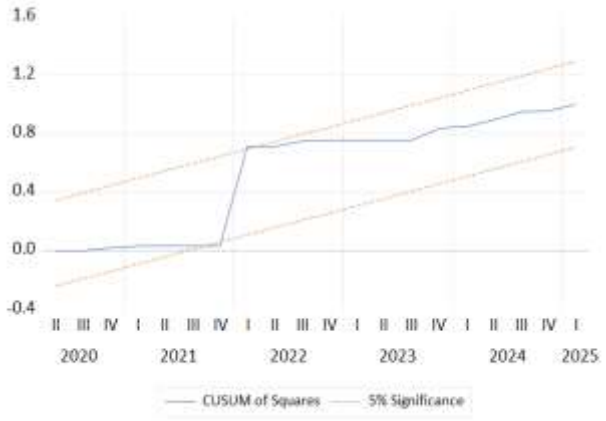


Figure 4. CUSUM of Squares Graph

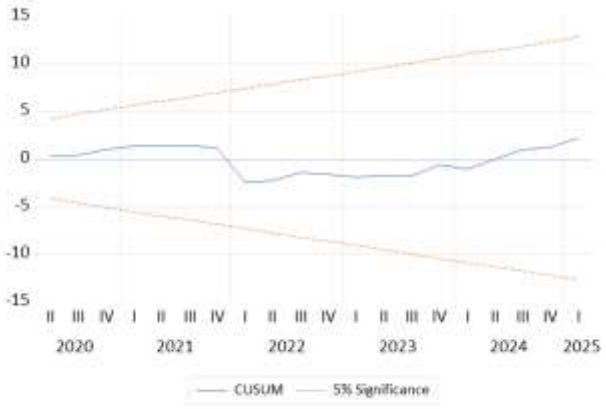


Figure 3. CUSUM Graph

6. Summary and Conclusion

Türkiye underwent multiple monetary crises in its history and faced persistent currency volatility recently, which encouraged wide research in this field. Nevertheless, mixed results were found throughout the literature both globally and within the Turkish framework. Sectoral evaluation can also be considered limited for the context of industry exports in Türkiye. Therefore, this research empirically studied the long-term and short-term dynamics between EXP and its explanatory variables: REER, LF, GDP, TX and FDI in Türkiye using the ARDL bounds testing and ECM approach for the period from 2013Q1 to 2025Q1. The data's structure and reliability were initially investigated. The descriptive statistics and the correlation results displayed a stable dataset with no multicollinearity. The unit root tests of ADF, PP and KPSS further confirmed that the data is suitable for the ARDL method as it becomes stationary at the first difference. The lag structure of the model was defined following AIC and the residuals were estimated. The model's estimate calculations indicate that the lagged real effective exchange rate (REER) exerts a highly significant positive impact on industry exports in the short run, whereas its effect becomes negative in the long run. Meaning that there was no significant immediate adjustment of EXP, but a later temporary enhancement of its performance. Other studies supporting the existence of positive reactions are Balcilar et al. (2014) and Demirhan and Demirhan (2015).

The long-term findings showed that EXP has a significant negative response to an increase of REER. Implying that persistent currency appreciation leads to a reduction in international competitiveness and weakens industrial exports over time. Previous econometric studies reaffirm this conclusion for aggregate exports (Ouattara (2023) and Bilgili et al. (2021)). In view of these results, policymakers should adopt a stable competitive exchange rate regime to support durable development in industry exports performance. Effective trade policies play a pivotal role in sustaining trade balance and promoting macroeconomic stability, both of which constitute fundamental pillars of a robust economic system.

The present paper identifies several directions for future research that may further add to the current literature. Future research might extend the analysis by incorporating broader time periods, the duration of this study was limited due to recent data availability. Researchers may also consider including more countries or doing comparative cross-country frameworks to enhance the generalizability of the findings. Exploring sub-sectoral level effects also could provide more nuanced evidence.

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