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Araştırma Makalesi / Research Article

The Relationship Between Current Account Deficit and CBRT Policy Rates After the 2008 Crisis: ARDL and NARDL Bounds Test Approach

Ayşegül Ladin Sümer[1], Osman Peker[2]

Abstract

The current account deficit continues to be a constant problem due to the structural problems of the Turkish economy and the tight monetary policy implemented after the 2008 crisis. Therefore, the measures taken against the current account deficit constitute the priority agenda items of the CBRT. This study aims to comparatively examine the relationship between the current account deficit and the policy interest rate in the inflation targeting and floating exchange rate system using ARDL and NARDL bounds test methods in the period 2011: Q1-2023: Q1. Cointegration test results confirm the existence of a long-run relationship between the variables. ARDL model long-run and short-run coefficients show that the policy rate does not have a significant effect on the current account deficit. NARDL model long-run and short-run coefficients prove that the policy rate does not have a significant and asymmetric effect on the current account deficit. The findings indicate that the expected impact of policy interest rate adjustments on the current account deficit is limited. As a result, it is concluded that the reaction of the exchange rate to the policy interest in inflation targeting will be more decisive in keeping the current account deficit at a sustainable level.

Keywords: *Current Account Deficit, Policy Rate, ARDL, NARDL.*

2008 Krizi Sonrası Cari Açık ile TCMB Politika Faiz Oranı Arasındaki İlişki: ARDL ve NARDL Sınır Testi Yaklaşımı

Öz

Türkiye ekonomisinin yapısal sorunları ve 2008 krizi sonrası uygulanan sıkı para politikası etkisiyle cari açık sürekli bir sorun olmaya devam etmektedir. Dolayısıyla, cari açığa yönelik alınan önlemler TCMB'nin öncelikli gündem maddelerini oluşturmaktadır. Bu çalışmanın amacı, enflasyon hedeflemesi ve dalgalı döviz kuru sisteminde cari açık ile politika faiz oranı arasındaki ilişkiyi 2011: Q1-2023: Q1 döneminde ARDL ve NARDL sınır testi yöntemleri ile karşılaştırmalı olarak incelemektir. Eşbütünleşme testi sonuçları değişkenler arasında uzun dönemli bir ilişkinin varlığını doğrulamaktadır. ARDL modeli uzun ve kısa vadeli katsayılar politika faizinin cari açık üzerinde anlamlı bir etkisinin olmadığını göstermektedir. NARDL modeli uzun ve kısa vadeli katsayıları ise politika faizinin cari açık üzerinde anlamlı ve asimetrik etkisinin olmadığını kanıtlamaktadır. Elde edilen bulgular, politika faiz oranı ayarlamalarının cari açık üzerinde beklenen etkisinin sınırlı olduğuna işaret etmektedir. Sonuç olarak, enflasyon hedeflemesinde döviz kurunun politika faizine vereceği tepkinin cari açığın sürdürülebilir bir seviyede tutulmasında daha belirleyici olacağı düşünülmektedir.

Anahtar Kelimeler: *Cari Açık, Politika Faizi, ARDL, NARDL.*

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INTRODUCTION

The current account consists of international transaction balances in goods and services trade, net factor income and unilateral transfers (Akbaş et al., 2013; Seyoum, 2020). Accordingly, it is an important external performance criterion closely related to fiscal balances and private savings, which are the main elements of economic growth. This situation has led the economic authorities to a sustainable current account deficit policy within the scope of the determinants of the current account (Uz, 2010). In this regard, theoretical models on the determinants of the current account are as follows (Tarawalie & Marah, 2022): First, the absorption model explains the import obligation that arises when consumption expenditures exceed domestic production. Secondly, the elasticity model evaluates the effects of relative price changes of domestic and foreign goods on the foreign trade balance, depending on the price elasticity of export and import demand. Finally, the intertemporal model takes into account the role of foreign capital investments in imbalances between domestic savings and investments.

Based on the determinants of the current account, the exchange rate channel of the monetary transmission mechanism in practice stands out in the theoretical and empirical literature. The monetary transmission mechanism explains the contribution of changes in policy interest rates to economic performance in the inflation targeting regime through market interest rates, asset prices, credit and exchange rates. In open economies, the effects of policy interest are transmitted through the exchange rate channel. On the subject, Mishkin (1995) stated, for example, that an increase in domestic real interest rates will lead to an appreciation of the national currency through foreign exchange flows to the country and a decrease in net exports by making domestic goods more expensive than foreign goods. Norrbin (2001) approached the issue from the perspective of monetary policy. According to him, tight monetary policy means a strong national currency. Because tight monetary policy increases the real interest rate and ensures capital flow to the country. However, it is noted that the appreciation of the national currency may be detrimental to export revenues and net export balance. Focusing on monetary policy like Norrbin (2001), Ireland (2005) explained that the real effects of the increase in short-run interest rates, which is a monetary policy, emerge through the exchange rate channel. According to him, when the increase in short-run interest rates exceeds its foreign currency equivalent, the domestic currency loses value. In particular, the risk-based returns of domestic and foreign currency debt instruments are equalized depending on the assumption of uncovered interest parity. Therefore, if the expected future depreciation is a slow adjustment in prices, domestic goods will become more expensive than foreign goods and net exports will decrease. Among the later studies focusing on monetary policy, Boivin et al. (2010) explained the role of the exchange rate channel in monetary policy within the framework of the Neoclassical approach. The sensitivity of the exchange rate to changes in interest rates is important here. Because the high price elasticity in the uncovered interest parity causes the exchange rate channel effects to be felt more in developing economies. In summary, within the framework of the literature on the monetary transmission mechanism, pressure occurs on the exchange rate and inflation in the process of current account balance and is reflected in the real economy (Ferrero et al., 2008).

On the other hand, in addition to the theoretical and empirical literature, crises in the real economy, global uncertainties and structural problems of countries are also among the determinants of the current account. In this case, especially the course of the current account deficit plays a critical role in the decisions of economic authorities as a leading indicator of the

forward-looking behavior of countries. For example, after the 2008 crisis, a gradually tight monetary policy was implemented against the large-scale macro-financial risks caused by the current account deficit. The recession experienced in the 2008-2009 period led to a current account deficit along with sudden fluctuations in capital movements (İyidoğan &Turan, 2018). Based on this, considering the factors underlying the current account deficit, a sustainable current account deficit came to the fore. Devadas and Loayza (2018) defined sustainable current account deficit as the increase in production capacity and savings along with the increase in countries' external borrowings. Josifidis et al. (2021) evaluated the sustainability of the current account deficit within the framework of economic policies. According to them, the current account deficit is sustainable if the long-term intertemporal budget constraint can be met without making any major changes in monetary and fiscal policies.

Within the scope of all the explanations made so far, the high share of oil and intermediate goods imports in total production, high inflation rates that prevent borrowing in Turkish lira, and low savings rates stand out as the main determinants of the current account deficit in the Turkish economy. Accordingly, structural reform policies to eliminate the situation in question are given priority (Karahan, 2020). When the current account deficit exceeded a certain threshold value after the 2008 crisis and the global risk perception was added, the fragility of the Turkish economy increased (Çiğdem, 2019). Therefore, it is important to act in harmony with the current economic conjuncture. For this purpose, how much of the current account deficit, including macro-financial risks, is due to cyclical factors? Under what conditions should monetary policy respond to the current account deficit? (Kara & Sarıkaya, 2014) questions were discussed; a monetary policy strategy has been adopted to limit the current account deficit since the end of 2010.

This study aims to examine the effect of non-traditional monetary policy tools used by the CBRT after the 2008 crisis on the current account deficit. Among the monetary policy instruments in question, as Kara (2015) stated in his study, the policy rate has been perceived by the market as an important indicator of the CBRT's monetary policy stance since 2011. Binici et al. (2016) stated that the weighted average funding cost, which is the actual interest rate, is frequently mentioned in the CBRT policy texts. Accordingly, in the study, the weighted average funding cost represented the policy rate; the autoregressive distributed lag (ARDL) method was used to determine its relationship with the current account deficit. In addition, the non-linear autoregressive distributed lag (NARDL) method, which account considers the possible asymmetric effects of social, political, and economic developments at global and national levels in the period 2011: Q1-2023: Q1, which is the subject of the study, was also used. In summary, this study differs from similar empirical studies, especially on the Turkish economy, and contributes as quantitative research on the current economic cycle.

The rest of the article is organized as follows: Section 1, includes empirical literature compatible with the content. Section 2, covers the methodological investigation. The data and empirical model are presented within the theoretical framework. Empirical analysis and its results are evaluated. Section 3, is the conclusion.

1. RELATED LITERATURE

The open trade structure of the Turkish economy and the adopted floating exchange rate system bring the exchange rate channel to the fore in the CBRT's monetary policy transmission. Accordingly, the reflection of changes in the exchange rate on domestic and foreign prices and

the choice between deposits in domestic currency and foreign currency affect key macroeconomic indicators, especially total domestic production, and inflation, and are decisive in the direction of the interest rate decisions to be taken by the CBRT. For this purpose, empirical studies using alternative monetary policy instruments that contribute to the motivation of the study and the model estimation process are taken as examples.

Lane (1999) analyzed the impact of monetary shocks on the current account balance for the USA with the VAR model based on Mundell's (1963) theory. It is concluded that monetary shocks play an important role in directing the current account in the fixed-price small economy model. Ferrero et al. (2008), drawing on the work of Obstfeld and Rogoff (2005), investigated the relationship between the current account and monetary policy strategies within the scope of the two-country DSGE model. It has been found that total production and inflation are more sensitive to the implemented monetary policy compared to the current account and real exchange rate. In their study, Danmola and Olateju (2013) examined the relationship between current account components and monetary policy for Nigeria using Johansen cointegration, OLS, and ECM; it has been determined that money supply has a significant impact on imports, exports, and industrial production. Therefore, monetary policy measures will expand export volume by encouraging the import of industrial raw materials and equipment. Finally, Schuler and Sun (2022) discussed the factors driving current account and monetary policy developments in the Eurozone. Multi-country DSGE and SVAR estimates for Germany, Italy, and Spain show that investment and preference shocks adversely affected the current account deficit and interest rates. On the other hand, external demand and productivity shocks affected the current account deficit and interest rates in the same direction.

Studies conducted in the Turkish economy are as follows: Oktar and Dalyancı (2011) focused on optimal monetary policy based on the relationship between monetary policy and current account balance. As a result of the study, it was determined that there is no Granger causality relationship between the policy rate and the current account balance in the short term, but there is a reverse cointegration relationship in the long term. Esen et al. (2012) examined the effects of policy interest on the current account deficit, which was a financial risk factor after the 2008 crisis, using SVAR within the scope of the exchange rate and credit channel. It was concluded that the policy rate affects the current account deficit through the credit channel compared to the exchange rate. Cicioğlu et al. (2013) analyzed the role of monetary policy instruments, including the practices implemented after the 2008 crisis, in preventing the current account deficit using the Toda Yamamoto causality test and SVAR. The findings showed that the policy rate was effective in reducing the current account deficit. However, the causality between open market operations and the current account deficit has not been determined. Atış and Kaya (2014) investigated the relationship between the current account deficit and money supply, real interest rate, and real exchange rate regarding the continuity of the current account deficit after 2001, using Johansen cointegration and VEC; at the end of the study, no relationship was observed between the economic variables in question. In the study of Koç and Gövdere (2019), VAR and Granger causality tests were applied to the effect of monetary policy on the balance of payments from the current account deficit to the real effective exchange rate, real interest rates, M2 money supply, and credit volume; a unidirectional causality was found from the growth rate to the current account deficit. In addition, as a result of variance decomposition, it was seen that the changes in the current account deficit were caused by the growth rate, real effective exchange rate, real interest rate and credit volume, respectively. Torusdağ (2021) investigated

the effects of financial crises that emerged with the acceleration of financial integration in the 1990s. For this purpose, the causality relationship between current account deficit/GDP as a low-frequency banking crisis indicator representing financial crises and real exchange rate and deposit interest rate as high-frequency banking crisis indicators was analyzed with Fourier Toda-Yamamoto and Fourier Granger causality tests. A unidirectional causality relationship was found from deposit interest rate and real exchange rate to the current account deficit.

2. RESEARCH METHODOLOGY

2.1. Data and Model

In the empirical analysis based on the exchange rate channel transmission mechanism, current account balance to GDP ratio (*CA/GDP*, %), average of effective dollar and euro buying-selling rates (*Ln AER*, Level), consumer price index (*Ln CPI*, Turkish Statistical Institute, 2003=100, Level), weighted average cost of the CBRT funding (*WAC*, %) were used as variables. *Ln*; indicates that the variable is logarithmic transformation. The data set is compiled from national and international data sources such as the Central Bank of the Republic of Turkey (CBRT)-Electronic Data System (EDS), World Bank (WB)-Indicators, Federal Reserve and Economic Data (FRED). The reason why the analysis period started in 2011 is that, after the 2008 crisis, the CBRT adopted a monetary policy strategy for exiting the crisis as of April 2010. The reason why the analysis period started in 2011 is that, after the 2008 crisis, the CBRT adopted a monetary policy strategy for exiting the crisis as of April 2010. Quarterly data on the weighted average funding cost, one of the alternative monetary policy instruments used to represent the policy rate in the study, has been presented by the CBRT as of the first quarter of 2011.

"*The weighted average cost of funding can be defined as*" (Binici et al., 2016, p. 12):

$$WAC = \frac{WR * WRR + OF * OFR}{TF} \quad (1)$$

where, WR; weekly repo, WRR; weekly repo rate, OF; overnight (marginal) funding, OFR; overnight (marginal) funding rate, TF; is the total funding. The weighted average funding rate is important in pricing the short-run liquidity offered by the CBRT through various monetary transmission channels and financial instruments such as exchange rates, deposits and loans.

For this purpose, the model based on the studies of Oktar & Dalyancı (2011), Kara (2015), Schuler & Sun (2022) is as follows:

$$(CA/GDP)_t = f(Ln\ AER_t,\ Ln\ CPI_t, WAC_t) \quad (2)$$

From this, the effect of *Ln AER, Ln CPI* and *WAC* on *CA/GDP* is defined as:

$$(CA/GDP)_t = \alpha_0 + \alpha_1(Ln\ AER)_t + \alpha_2(Ln\ CPI)_t + \alpha_3(WAC)_t + \epsilon_t \quad (3)$$

2.2. Empirical Analysis

The ARDL method is used to test the existence of a relationship between the dependent variable and a set of regressors. "*The proposed tests are based on standard F and t statistics*" (Pesaran et al., 2001, p. 289). "*The asymptotic distributions of these statistics are not*

standardized under the null hypothesis, regardless of whether all variables and regressors are stationary at the same level as I(0) or I(1)" (Pesaran et al., 2001, p. 289). However, the fact that the variables do not show a normal distribution and the structural breaks that may be encountered during the analysis period lead to asymmetric effects in the long and short term. The hidden cointegration that may arise in this case prevents the detection of a meaningful relationship between the variables. Shin et al. (2014) developed the NARDL method, which analyzes the responses of variables by considering the long and short-term asymmetric effects between variables.

"*Long-run and short-run effects are evaluated by solving the endogeneity problem in the optimal lag length. For ARDL and NARDL methods, first, the stationarity of the variables is determined. Economic shocks encountered by variables in the past period create a trend in the next period, leading to spurious regression*" (Granger and Newbold, 1974, p.111-112). For this purpose, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root test, which is assumed to be more powerful than ADF, were applied in the stationarity analysis of variables containing trends.

In Table 2, ADF and PP unit root test results are presented according to the results of the stationarity tests, all other variables are not stationary at the level, except for *CA/GDP*. *CA/GDP* is a level stationary relative to PP. On the other hand, the null hypothesis of *Ln AER, Ln CPI* and *WAC*, ADF, and PP unit root tests were rejected and the first difference was applied to the data series. For the application of ARDL and NARDL models, PP unit root test results regarding the stationarity levels of the variables were considered.

Table 1: ADF and PP Unit Root Test

Variables	ADF Test		PP Test	
	Constant	Constant & Trend	Constant	Constant & Trend
CA/GDP	-1.906	-3.986**	-3.762	-4.378
Ln AER	3.497**	-0.814	2.345	-0.821
Ln CPI	2.534	1.728	4.265	3.723**
WAC	-1.548	-2.951	-2.038	-2.023
Δ CA/GDP	-4.587	-4.512	-	-
Δ Ln AER	-6.013	-5.001	-6.012	-6.782
Δ Ln CPI	-4.073	-4.831	-2.860*	-3.521**
ΔWAC	-4.678	-4.714	-4.506	-4.526

Notes: *CA/GDP*; current account balance to GDP ratio, *Ln AER*; average exchange rate, *Ln CPI*; consumer price index, *WAC*; is the weighted average cost of funds. ***, ** and * denote the stationarity of the series at 1%, 5% and 10% significance levels, respectively. For constant unit root test, -3.589, -2.930, -2.603 respectively. -4.161, -3.506, -3.183 for constant and trend unit root testing, respectively. Δ indicates that the first difference of the series is taken.

After the stationarity analysis, the existence of a cointegration relationship between the variables is determined. For this purpose, the estimated unrestricted error correction model is:

$$\Delta\,(CA/GDP)_t = \beta_0 + \beta_1\,(CA/GDP)_{t-i} + \beta_2(Ln\ AER)_{t-i} + \beta_3(Ln\ CPI)_{t-i} + \beta_4 WAC_{t-i} + \sum_{i=1}^{m} \beta_5 \Delta(CA/GDP)_{t-i} + \sum_{i=0}^{m} \beta_6 \Delta(Ln\ AER)_{t-i} + \sum_{i=0}^{m} \beta_7\,\Delta(Ln\ CPI)_{t-i} + \sum_{i=0}^{m} \beta_8\,\Delta(WAC)_{t-i} + \mu_t \quad (4)$$

In Equation 4, m is the optimum lag length.

Akaike Information Criterion (AIC) and autocorrelation test were considered in determining the optimum lag length. According to the results in Table 3, theoptimum lag length was determined as 4.

Table 2: Optimum Lag Length

m	AIC	LM
1	-13.288	4.496 (0.000)
2	-14.241	1.412 (0.100)
3	-14.091	1.086 (0.371)
4*	-14.153	1.142 (0.335)

After stationarity tests and determination of optimal lag lengths, the analysis results for the ARDL and NARDL models are presented step by step as follows:

The existence of cointegration between the series was tested with the Wald test based on the F statistic. The results obtained are presented in Table 4 since the calculated F statistical value exceeded the upper critical value of the table, the hypothesis $H_0: \beta_5 = \beta_6 = \beta_7 = \beta_8 = 0$ was rejected and it was decided that there was a cointegration relationship between the series. Therefore, the long-run relationship between the series is supported.

Table 3: ARDL Bounds Test

Model	k	F-Stat.		I(0)	I(1)
CA/GDP Ln AER Ln CPI WAC	3	10.068***	10%	2.72	3.77
			5%	3.23	4.35
			1%	4.29	5.61

Notes: *CA/GDP*; current account balance to GDP ratio*, Ln AER*; average exchange rate, *Ln CPI;* consumer price index, *WAC*; is the weighted average cost of funds. k; is the number of independent variables. Critical values Pesaran, Shin and Smith (2001, pp. 300) table is taken from CI(iii) ***,** and * denote significance level at 1%, 5% and 10%.

In the long-term analysis, all possible lag values for all variables used in the model were examined. Accordingly, the long-term relationship estimation model is defined as:

$$(CA/GDP)_t = \gamma_0 + \sum_{i=1}^{m} \gamma_{1i}(CA/GDP)_{t-i} + \sum_{i=0}^{n} \gamma_{2i}(Ln\ AER)_{t-i} + \sum_{i=0}^{p} \gamma_{3i}\,(Ln\ CPI)_{i-t} + \sum_{i=0}^{q} \gamma_{4i}(WAC)_{t-i} + \varepsilon_t \quad (5)$$

In Equation 5, m, n, p, q; are optimum lag lengths. Optimum lag lengths were determined where the AIC value is minimal and there is no autocorrelation problem. In this context, the estimated ARDL (4, 2, 0,1) was determined as the best model. Table 5 presents the long-run coefficient and diagnostic test results of the ARDL (4, 2, 0, 1) model. It is remarkable that although the long-run coefficients are statistically significant, the coefficient values are quite small contrary to expectations. *Ln AER* is effective in decreasing *CA/GDP* by 3.921%, while *Ln CPI* and *WAC* are effective in increasing *CA/GDP* by 5.562% and 1.997%, respectively.

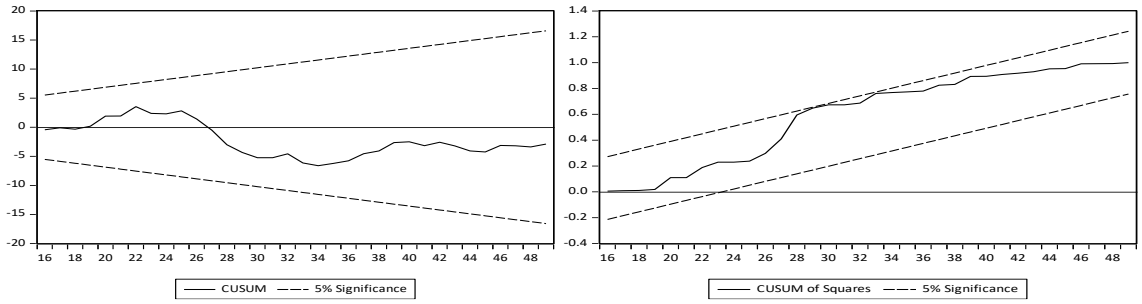
Table 4: ARDL (4, 2, 0, 1) Model The Long-Run Form

Variables				**Coefficient**		**t-Stat.**	
Constant				-0.001		-2.549 (0.016)**	
Ln AER				-3.921		-1.912 (0.064)*	
Ln CPI				5.562		2.143 (0.039)**	
WAC				1.997		3.766 (0.001)***	
$\boldsymbol{R^2}$	0.86	$\overline{\boldsymbol{R^2}}$	0.82	**F-Stat.**	21.64 (0.00)	**D.W.**	1.65
Diagnostic Tests							
Breusch-Godfrey Serial Correlation LM Test		χ^2_{BG}		1.99 (0.15)		No autocorrelation problem	
Breusch-Pagan-Godfrey Heteroscedasticity test		χ^2_{BPG}		1.64 (0.14)		No heteroscedasticity problem	
Jarque-Bera Test		χ^2_{JB}		1.66 (0.44)		No normality problem	
Ramsey-Reset Test		χ^2_{RR}		0.34 (0.56)		No specification problem	

Notes: ARDL (4, 2, 0, 1) selected based on minimum AIC and no autocorrelation problem. *CA/GDP*; current account balance to GDP ratio*, Ln AER*; average exchange rate, *Ln CPI;* consumer price index, *WAC*; is the weighted average cost of funds. Probability values are included in parentheses. ***,** and * denote significance level at 1%, 5% and 10%.

The diagnostic test results also prove that the model is stable and reliable. In addition, the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) graphs show that the long-run coefficients are stable. Because both are in the middle of the upper and lower limits at the 5% level.

Figure 1: The Long-Run CUSUM and CUSUMSQ Graphs



For the error correction analysis, first of all, the optimum lag length was determined as in the long-run relationship. The error correction estimation model is defined as:

$$\Delta\,(CA/GDP)_t = \delta_0 + \sum_{i=1}^{m} \delta_{1i}\Delta(CA/GDP)_{t-i} + \sum_{i=0}^{n} \delta_{2i}\Delta(Ln\ AER)_{t-i} + \sum_{i=0}^{p} \delta_{3i}\,\Delta(Ln\ CPI)_{i-t} + \sum_{i=0}^{q} \delta_{4i}\Delta(WAC)_{t-i} + \vartheta(ECT)_{t-1} + \sigma_t \quad (6)$$

In Equation 6, ECT_{t-1}; represents the error correction term, which indicates the rate at which the long- term equilibrium value is adjusted after a short-term shock. ECT_{t-1} value must be negative and statistically significant, it meets the long-term relationship.

ARDL (2, 3, 3, 1) was determined as the best model, error correction estimated model, and diagnostic test results are given in Table 6. The same is true for short-run coefficient values. Expected coefficient values are quite small but statistically significant except for the *WAC* coefficient. *Ln AER* is effective in increasing *CA/GDP* by 0.005% in one lagged period and by 0.003% in two lagged periods, while *Ln CPI* is effective in decreasing *CA/GDP* by 0.016% in two lagged periods. *ECT(-1)* is negative and statistically significant. As a result, the deviations that will occur in the short-run are corrected after approximately 1.37 quarters and the series converge to the long-run equilibrium value again.

Table 5: ARDL (2, 3, 3, 1) Model The Short-Run Form and Error Correction Regression

Variables	**Coefficient**	**t-Stat.**
Constant	-0.067	-5.157 (0.000)***
Δ CA/GDP(-1)	0.199	1.588 (0.122)
Δ Ln AER	0.001	0.634 (0.531)
Δ Ln AER(-1)	0.005	3.471 (0.002)***
Δ Ln AER(-2)	0.003	2.015 (0.052)**
Δ Ln CPI	0.004	1.456 (0.155)
Δ Ln CPI(-1)	-0.004	-0.898 (0.375)
Δ Ln CPI(-2)	-0.016	-2.866 (0.007)***
Δ WAC	-1.935	-0.405 (0.688)
ECT(-1)	-0.732	-5.169 (0.000)***

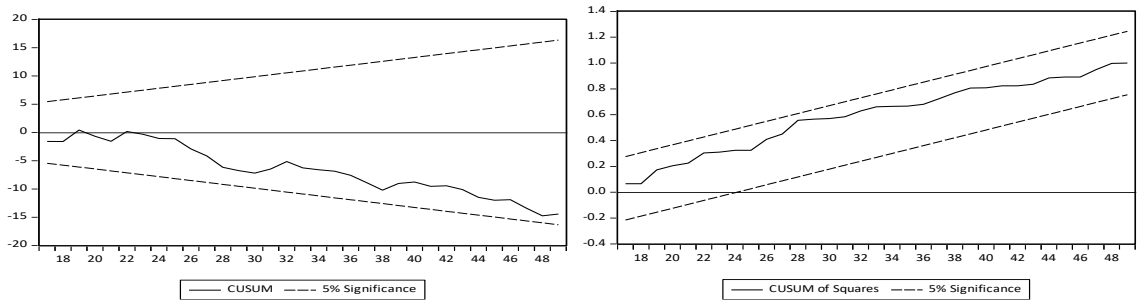
R^2	0.82	$\overline{R^2}$	0.76	**F-Stat.**	12.85 (0.00)	**D.W.**	2.02

Diagnostic Tests			
Breusch-Godfrey Serial Correlation LM Test	χ^2_{BG}	0.64 (0.53)	No heteroscedasticity problem
Breusch-Pagan-Godfrey Heteroscedasticity test	χ^2_{BPG}	0.74 (0.71)	No autocorrelation problem
Jarque-Bera Test	χ^2_{JB}	0.75 (0.69)	No normality problem
Ramsey-Reset Test	χ^2_{RR}	3.84 (0.06)**	No specification problem

Notes: ARDL (2, 3, 3, 1) selected based on minimum AIC and no autocorrelation problem. *CA/GDP*; current account balance to GDP ratio*, Ln AER*; average exchange rate, *Ln CPI;* consumer price index, *WAC*; weighted average cost of funds, *ECT(-1);* is the error term coefficient. Probability values are included in parentheses. ***,** and * denote significance level at 1%, 5% and 10%.

On the other hand, diagnostic test results indicate that the model is stable and reliable. Since the CUSUM and CUSUMSQ graphs are in the middle of the upper and lower limits at the 5% level, their long-term coefficients are fixed.

Figure 2: The Short-Run CUSUM and CUSUMSQ Graphs



The findings reflect the interrelation between inflation targeting and changes in policy rates in the floating exchange rate system between inflation and current account deficit. Increasing interest rates in the fight against high inflation encourages foreign capital, especially hot money, for the country. Accordingly, the increase in imports negatively affects net exports, as domestic currency prices increase and imported goods become cheaper. In addition, high inflation increases the external debt burden as it limits long-run borrowing opportunities in national currency. Therefore, high inflation and high current account deficit make the actual effect of the policy rate difficult.

However, considering the domestic and global developments during the period in which the study was conducted will enable a more objective evaluation of the analysis results. Accordingly, gradual changes in countries' policy interest rates in the process that started with the 2008 crisis began to normalize as of 2015. Health measures related to the Covid-19 pandemic have led to social and economic contractions. This situation has led to divergences in the monetary policies of countries as a result of the widespread perception of recession, especially in developed countries. Empirical analysis continued with the NARDL model to examine the effects and consequences of the developments in the said period on the variables used in the analysis.

The asymmetric long-run NARDL model can be described as follows:

$$\begin{aligned}\Delta\left(CA/GDP\right)_t = {} & \beta_0 + \beta_1\left(CA/GDP\right)_{t-i} + \beta_2^{+}(Ln\ AER)_{t-i}^{+} + \beta_2^{-}(Ln\ AER)_{t-i}^{-} \\ & + \beta_3^{+}(Ln\ CPI)_{t-i}^{+} + \beta_3^{-}(Ln\ CPI)_{t-i}^{-} + \beta_4^{+}(WAC)_{t-i}^{+} + \beta_4^{-}(WAC)_{t-i}^{-} \\ & + \sum_{i=1}^{m}\beta_5\Delta(CA/GDP)_{t-i} + \sum_{i=0}^{m^{+}}\beta_6^{+}\Delta(Ln\ AER)_{t-i}^{+} + \sum_{i=0}^{m^{+}}\beta_6^{-}\Delta(Ln\ AER)_{t-i}^{-} \\ & + \sum_{i=0}^{m^{+}}\beta_7^{+}\Delta(Ln\ CPI)_{t-i}^{+} + \sum_{i=0}^{m^{-}}\beta_7^{-}\Delta(Ln\ CPI)_{t-i}^{-} + \sum_{i=0}^{m^{+}}\beta_8^{+}\Delta(WAC)_{t-i}^{+} \\ & + \sum_{i=0}^{m^{-}}\beta_8^{-}\Delta(WAC)_{t-i}^{-} \\ & + \mu_t \end{aligned} \quad (7)$$

In Equation (7), the notations "+" and "-" denote the partial sum of the positive and negative changes of the independent variables, respectively. The situation in question is as follows in detail:

$$Ln\ AER_t^+ = \sum_{i=1}^{+} \Delta\ Ln\ AER_i^+ = \sum_{i=1}^{+} \max(\Delta\ Ln\ AER_i, 0) \quad (8)$$

$$Ln\ AER_t^- = \sum_{i=1}^{-} \Delta\ Ln\ AER_i^- = \sum_{i=1}^{-} \min(\Delta\ Ln\ AER_i, 0) \quad (9)$$

$$Ln\ CPI_t^+ = \sum_{i=1}^{+} \Delta\ Ln\ CPI_i^+ = \sum_{i=1}^{+} \max(\Delta\ Ln\ CPI_i, 0) \quad (10)$$

$$Ln\ CPI_t^- = \sum_{i=1}^{-} \Delta\ Ln\ CPI_i^- = \sum_{i=1}^{-} \min(\Delta\ Ln\ CPI_i, 0) \quad (11)$$

$$WAC_t^+ = \sum_{i=1}^{+} \Delta\ WAC_i^+ = \sum_{i=1}^{+} \max(\Delta\ WAC_i, 0) \quad (12)$$

$$WAC_t^- = \sum_{i=1}^{-} \Delta\ WAC_i^- = \sum_{i=1}^{-} \min(\Delta\ WAC_i, 0) \quad (13)$$

The Wald test results based on the F statistic regarding the existence of long-term asymmetric cointegration between the series are presented in Table 7. Since the calculated F statistic value exceeded the upper critical value of the table, the hypothesis $H_0: \beta_5^+ = \beta_5^- = \beta_6^+ = \beta_6^- = \beta_7^+ = \beta_7^- = \beta_8^+ = \beta_8^- = 0$ was rejected and it was decided that there was asymmetric cointegration between the variables in the long-run.

Table 6: NARDL Bounds Test

Model	k	F-Stat.		I(0)	I(1)
CA/GDP Ln AER Ln CPI WAC	3	7.383***	10%	2.72	3.77
			5%	3.23	4.35
			1%	4.29	5.61

Notes: *CA/GDP*; current account balance to GDP ratio*, Ln AER*; average exchange rate, *Ln CPI;* consumer price index, *WAC*; is the weighted average cost of funds. k; is the number of independent variables. Critical values Pesaran, Shin and Smith (2001, pp. 300) table is taken from CI(iii) ***,** and * denote significance level at 1%, 5% and 10%.

Based on Equation 5, NARDL (2, 3, 2, 3, 0, 1), estimated according to the optimum lag length where the AIC value is minimum and there is no autocorrelation problem, was determined as the best model.

Table 8 presents the long-run coefficient and the short-run coefficient, Wald test and diagnostic test results for the NARDL (2, 3, 2, 3, 0, 1) model. Although there are statistically significant values among the estimated model coefficients, the coefficient values are quite small, contrary to expectations. While the long-run one lagged period *Ln AER*$^+$ coefficient is negative and significant, the one lagged period *WAC*$^-$ coefficient is positive and significant. Accordingly,

in the long-run, 1% increase in *Ln AER* reduces *CA/GDP* by 0.008%, while a 1% decrease in *WAC* increases CA/GDP by 0.002%. In the short-run, the $Ln\ AER^{+}$ coefficient is significant and positive. Accordingly, 1% increase in *Ln AER* will increase *CA/GDP* by 0.004%. On the other hand, when the Wald test results regarding long-run and short-run symmetry are examined, it is seen that *Ln AER* and *WAC* are not statistically significant. As a result, *Ln AER* and *WAC* have a symmetric effect on *CA/GDP*. Other estimation results obtained are evaluated as follows: The long-run one lagged period $Ln\ AER^{-}$ coefficient is positive but statistically insignificant. Although the long-run one lagged period *Ln CPI* is statistical, it does not show "+" and "-"changes; the same situation is observed in the short-run one and two lagged period *Ln CPI.* Finally, *ECT(-1)* is negative and statistically significant. Thus, the deviations that will occur in the short term are corrected after approximately 1,17 quarters and the series converges again to the long-run equilibrium value.

Table 8: NARDL (2, 3, 2, 3, 0, 1) Model

Variables	Coefficient	t-Stat.
Constant	-0.133	-4.715 (0.000)***
Ln AER⁺(-1)	-0.008	-2.943 (0.006)***
Ln AER⁻(-1)	0.001	0.121 (0.905)
Ln CPI(-1)	0.025	4.599 (0.000)***
WAC⁺	2.383	0.402 (0.690)
WAC⁻(-1)	0.002	2.517 (0.017)**
Δ CA/GDP(-1)	0.543	3.796 (0.000)***
Δ Ln CPI(-1)	-0.029	-3.533 (0.001)***
Δ Ln CPI(-2)	-0.021	-2.428 (0.021)**
Δ Ln AER⁺	0.004	-1.976 (0.057)*
Δ Ln AER⁻(-1)	-0.008	-0.928 (0.360)
Δ Ln AER⁺(-1)	0.005	1.434 (0.162)
Δ Ln AER⁺(-2)	0.003	1.115 (0.273)
Δ Ln CPI	0.003	0.763 (0.451)
ECT(-1)	-0.858	-5.976 (0.000)***

Wald Tests

	t-Stat.		t-Stat.
$W_{LR,\ Ln\ AER}$	-1.426 (0.164)	$W_{SR,\ Ln\ AER}$	-0.242 (0.811)
$W_{LR,\ WAC}$	-1.464 (0.153)		

R^2	0.84	$\overline{R^2}$	0.74	**F-Stat.**	8.969 (0.00)	**D.W.**	2.218

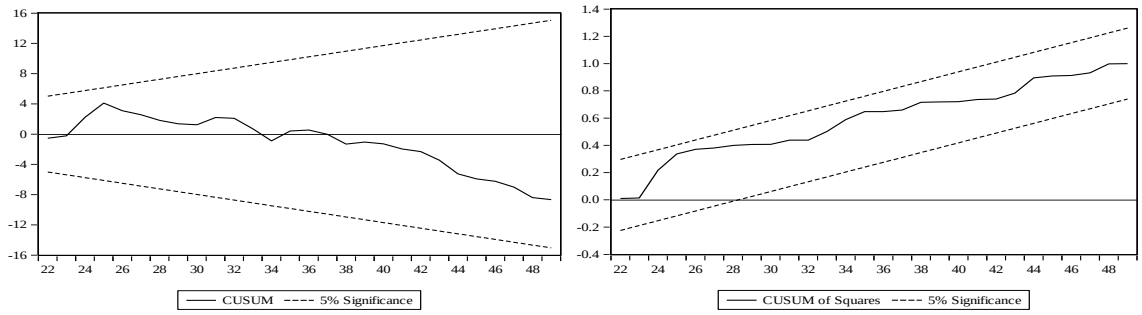
Diagnostic Tests

Breusch-Godfrey Serial Correlation LM Test	χ^2_{BG}	1.84 (0.18)	No autocorrelation problem
Breusch-Pagan-Godfrey Heteroscedasticity test	χ^2_{BPG}	0.76 (0.72)	No heteroscedasticity problem
Jarque-Bera Test	χ^2_{JB}	0.40 (0.82)	No normality problem
Ramsey-Reset Test	χ^2_{RR}	2.10 (0.16)	No specification problem

Notes: *CA/GDP*; current account balance to GDP ratio*, Ln AER*; average exchange rate, *Ln CPI;* consumer price index, *WAC*; weighted average cost of funds, ARDL (2, 3, 3, 1) selected based on minimum AIC and no autocorrelation problem. *CA/GDP*; current account balance to GDP ratio*, Ln AER*; average exchange rate, *Ln CPI;* consumer price index, *WAC*; weighted average cost of funds, *ECT(-1);* error term coefficient. $W_{LR;}$ long-run Wald test, W_{SR}; is the short-run Wald test. Probability values are included in parentheses. ***,** and * denote significance level at 1%, 5% and 10%.

The diagnostic test results also prove that the model is stable and reliable. In addition, the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) graphs show that coefficients are stable. Because both are in the middle of the upper and lower limits at the 5% level.

Figure 3: CUSUM and CUSUMSQ Graphs



When a general evaluation is made, the implementation of inflation targeting within the scope of the exchange rate transmission mechanism in the floating exchange rate system reveals the spiral relationship between the current account deficit and inflation. High policy rate decisions to be taken as a precaution against inflation will increase hot money inflows, and the current account deficit will increase while the exchange rate decreases. Therefore, tight monetary policy based on price stability, which is the main objective of the CBRT, may primarily require a choice between inflation and economic growth. Accordingly, a short-run tight monetary policy aimed at reducing inflation permanently will ensure that the current account deficit is sustainable, along with exchange rate stability, which will initially slow down economic growth.

3. CONCLUSION

The relationship between the current account and the policy rate is decisive in the design of monetary policy in open economies that adopt the floating exchange rate system under inflation targeting. In particular, the effects of large-scale macro-financial risks caused by the current account deficit after the 2008 crisis on inflation and exchange rates led to the implementation of monetary policy instruments with different strategies. This study aims to analyze the relationship between the current account deficit and the CBRT policy rate in the 2011: Q1-2023: Q1 period using the ARDL and NARDL bounds test method. The theoretical and empirical results achieved are as follows:

Theoretically, the starting point is the exchange rate transmission channel, which reflects an open economy based on the cause-effect relationship between inflation and the policy rate. In practice, the weighted average funding cost used to represent the CBRT policy rate is the key variable in terms of objectively evaluating the period from the post-2008 crisis to the present. Accordingly, the short- and long-term relationship between the ratio of current account balance to *GDP* (*CA/GDP*) and the weighted average cost of funds (*WAC*) was investigated through the average exchange rate (*Ln AER*) and the consumer price index (*Ln CPI*).

Firstly, the cointegration between *CA/GDP*, *Ln AER*, *Ln CPI* and *WAC* was determined according to the ARDL and NARDL bounds test procedure. The existence of a long-term

relationship between CA/GDP and WAC regarding the ARDL (4, 2, 0, 1) model was supported. Although the long-term coefficient values were quite small, contrary to expectations, they were found to be statistically significant. *Ln AER* was effective in decreasing *CA/GDP* by 3.921%, while *Ln CPI* and *WAC* were effective in increasing *CA/GDP* by 5.562% and 1.997% respectively.

ARDL (2, 3, 3, 1) model short-term coefficient values are small but statistically significant except for the *WAC* coefficient. *Ln AER* was effective in increasing *CA/GDP* by 0.005% in one lagged period and by 0.003% in two lagged periods, while *Ln CPI* was effective in decreasing *CA/GDP* by 0.016% in two lagged periods. Besides, the error correction coefficient *ECT(-1)* was found to be negative and statistically significant. It has been determined that the short-run deviations will be corrected after approximately 1.37 quarters and the series will converge to the long-run equilibrium value again. CUSUM and CUSUMSQ graphs were used to test the stability of short-run and long-run models. Both graphs were located between the lower and upper limits at the 5% level. The stationarity of the models was proven.

In the NARDL (2, 3, 2, 3, 0, 1) model, an asymmetric cointegration relationship was detected between the variables in the long-run. Although the estimated long-run coefficient and short-run coefficient results were statistically significant, the coefficient values were found to be quite small, contrary to expectations. In the long-run, a 1% increase in *Ln AER* reduced CA/GDP by 0.008%, while a 1% decrease in *WAC* increased CA/GDP by 0.002%. In the short term, a 1% increase in *Ln AER* increased *CA/GDP* by 0.004%. When the Wald test results for long-run and short-run symmetry were examined, it was determined that *Ln AER* and *WAC* were not statistically significant. The error correction coefficient *ECT(-1)* was found to be negative and statistically significant. It has been determined that the short-run deviations will be corrected after approximately 1.17 quarters and the series will converge to the long-run equilibrium value again. Finally, CUSUM and CUSUMSQ graphs were used to test the stability of the NARDL (2, 3, 2, 3, 0, 1) model. Since both graphs were located between the lower and upper limits at the 5% level, the model was found to be stationary.

The findings obtained are similar to Oktar and Dalyancı (2011), Esen et al. (2012), Cicioğlu et al. (2013) is compatible with the theoretical and empirical studies conducted by Torusdağ (2021) specifically for the Turkish economy. On the other hand, when evaluated in terms of current monetary policy practices, Kara (2015), Binici et al. (2016) is consistent with the studies conducted by Schuler and Sun (2022).

Based on the empirical results, the study pointed to the impact of the potential relationship between the current account deficit and inflation. Because interest rate increases for price stability increase national currency prices and long-run borrowing costs due to hot money inflows. It limits the impact of the policy rate, which is the primary monetary policy tool to combat both inflation and current account deficit. However, it is understood that the exchange rate channel, which is affected by the policy rate, is more effective on the current account deficit. Therefore, in the inflation targeting monetary policy regime, the response of the exchange rate to the policy rate will have very decisive results. Accordingly, keeping the current account deficit at a sustainable level depends on the stability of the exchange rate.

As a result, real sector priority solutions can be sought against the industrial structure with high oil and intermediate goods imports, high inflation that makes borrowing in Turkish lira difficult, and low domestic savings rates, which can be counted as the main causes of the current account deficit in the Turkish economy.

AUTHOR STATEMENT

Statement of Research and Publication Ethics

This study has been prepared in accordance with scientific research and publication ethics.

Author Contributions

The authors contributed equally to the study.

Conflict of Interest

There is no conflict of interest for the authors or third parties arising from the study.

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