Cilt/Vol: 22 – Sayı/No: 3

Anadolu Üniversitesi
İktisadi ve İdari Bilimler Fakültesi Dergisi

APA Çelik, İ. E. & Kaplan, M. (2021). TÜRKİYE'DE CARİ IŞLEMLER DENGESİNİN SÜRDÜRÜLEBİLİRLİĞİNDE DOĞRUSAL OLMAYAN DURUM. Anadolu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 22 (3), 73-86

DOI 10.53443/anadoluibfd.986416

Araştırma Makalesi
Başvuru Tarihi: 24.08.2021
Kabul Tarihi: 08.09.2021

Research Article
Date Submitted: 24.08.2021
Date Accepted: 08.09.2021

TÜRKİYE'DE CARİ IŞLEMLER DENGESİNİN SÜRDÜRÜLEBİLİRLİĞİNDE DOĞRUSAL OLMAYAN DURUM

Dr. Öğr. Üyesi İsmail Erkan Çelik[1]
Prof. Dr. Muhittin Kaplan[2]

ÖZET

Anahtar Kelimeler:

- Doğrusal Olmayan Gecikmesi Dağıtılmış Otoregresif Model,
- Asimetrik etki,
- Cari açıkların sürdürülebilirliği
- Doğrusal olmayan eşbütünleşme

Bu çalışma, Türkiye'nin 1992Q1-2021Q1 verileriyle cari açıkların sürdürülebilirliğini test etmeyi amaçlamaktadır. Bu amaçla; reel ihracat, reel ithalat ve dış borç faiz ödemeleri ile ilişkilendiren ampirik bir model hem doğrusal hem de doğrusal olmayan ARDL (NARDL) tekniği kullanılarak tahmin edilmiş ve model değişkenleri arasındaki ilişki doğrusal ve asimetrik eşbütünleşme sınır testi ile test edilmiştir. Doğrusal ARDL modelinin sınır testi sonucu cari hesabın sürdürülebilirliğini destekleyecek herhangi bir kanıt sunmazken, NARDL sınır testi sonuçları Türkiye'nin cari işlemler dengesinin sürdürülebilir olduğunu göstermektedir. Ayrıca, çalışma sonuçları, ithalata yönelik hem pozitif hem de negatif şokların, kısa ve uzun vadede ihracatı önemli ölçüde asimetrik olarak etkilediğini göstermiştir. Pozitif şokların ithalat üzerindeki etkisi, negatif şokların etkisinden önemli ölçüde daha yüksek olmasına rağmen, uzun dönem negatif şoklar, ihracattaki büyümenin kısa dönem pozitif şoklardan daha hızlı düşmesine neden olmaktadır.

NON-LINEARITY IN SUSTAINABILITY OF CURRENT ACCOUNT BALANCE IN TURKEY

Dr. İsmail Erkan Çelik
Prof. Dr. Muhittin Kaplan

ABSTRACT

This study aims to test current account deficits (CAD) sustainability for Turkish data of 1992Q1-2021Q1. To this end, an empirical model that relates real exports to real imports plus interest payments on external debt is estimated using both linear and non-linear ARDL (NARDL) technique, and linear and asymmetric cointegration among the model variables is tested with the bound test for cointegration approach. While the bound test result of the linear ARDL model provides no evidence to support the sustainability of the current account, the NARDL bound test results indicate that Turkey's current account balance is sustainable. Moreover, the study results have shown that both positive and negative shocks to imports affect exports significantly and asymmetrically in the short-run and the long-run. Although the impact of positive shocks to imports on exports is significantly higher than the impact of negative shocks, in the long run, the negative shocks cause export growth to decrease at a higher rate than positive shocks in the short-run.

Keywords:

- Nonlinear Autoregressive Distributed Lag consumption,
- Asymmetric Effect,
- Current Account Sustainability,
- Nonlinear Cointegration

[1]Doğuş Üniversitesi, ismailerkancelik@gmail.com , https://orcid.org/0000-0001-8178-8749
[2]İstanbul Üniversitesi, muhittin.kaplan@istanbul.edu.tr, https://orcid.org/0000-0002-0685-7641

1. INTRODUCTION

The sustainability of the current account balance has always been the focal point of discussions in economic policy for both academic researchers and policymakers. CAD is not a concern per se since it leads to the reallocation of capital to where capital is more productive. The problem arises when the deficit becomes persistent and unsustainable. Doubts about the health and the sustainability of CAD may have serious implications for interest rates, a country's ability to meet its external financial obligations, the standard of living in a country, competitiveness, stability, vulnerability, and performance of the economy. In this sense, the subject has attracted many researchers trying to measure whether a country's current account balance is sustainable empirically.

Over time, a vast empirical literature has accumulated on measuring and testing the sustainability of the current account balance of a country or a group of countries. Following a pioneering work of Trehan and Walsh (1991), the empirical literature on testing the sustainability of current account for a country or group of countries has been developed in two strands, namely unit root and cointegration testing (Dissou and Nafie, 2019; Kouadio and N'Guessan, 2021). Some of the examples of these studies include Husted (1992), Wickens and Uctum (1993), Wu et al. (1996), Apergis *et al*. (2000), Wu (2000), Wu et al. (2001), Kalyoncu (2005). However, these early studies have assumed linearity of variables and models in the analysis of the current account. Later, Christopoulos and Leon-Ledesma (2010) have shown that those unit-root and cointegration tests that fail to encounter non-linearity may conclude that the current account is not sustainable even if it is sustainable.

For this reason, recent studies began to employ nonlinear unit root tests and nonlinear cointegration methods in testing the sustainability of CAD. Examples of these studies are Holmes et al. (2011), Dissou and Nafie (2019), Kouadio and N'Guessan (2021), Chen and Xie (2015), Chen (2014) Chortareas et al. (2004). In the literature, researchers have used various nonlinear methodologies to incorporate nonlinearity in testing the sustainability of the current account. Dissou and Nafie (2019) and Kouadio and N'Guessan (2021) have employed the asymmetric autoregressive distributed lag (or NARDL) model to test the sustainability of current accounts based on the model suggested by Husted (1992).

There are also numerous empirical studies investigated the sustainability of the CA of Turkey. The prominent features of the existing studies are that they test for cointegration, assuming a linear relationship between exports and imports. However, there is a strong case for the non-linearity of the relationship between exports and imports. The presence of non-linearity leads to a change in size and sign of parameters of the current account model in the short-run and long-run.

In light of the discussions above, this study attempts to test whether Turkey's current account balance is sustainable using the non-linear ARDL model. NARDL model allows to handle the dynamic nature of time series data adequately and incorporate nonlinearity associated with positive and negative shocks to the current account and related to asymmetric adjustments of the current account in the short-run and the long-run. The rest of the paper is organized as follows. Section 2 reviews the empirical literature on the sustainability of current account balance. Section 3 provides an intertemporal current account model that will be used in empirical analysis. Section 4 introduces the data and methodology employed. Section 5 presents the empirical findings of the study. Section 6 concludes.

2. LITERATURE REVIEW ON CURRENT ACCOUNT SUSTAINABILITY

There are many studies in the literature on current account sustainability. However, when the relevant studies are examined, it is seen that they are generally analyzed over linear models. It is seen that it has recently started to be used in non-linear models. Studies conducted for Turkey have generally reached results in the direction of sustainability in a weak form or unsustainability. Only a few studies mention current account sustainability in Turkey. In the studies conducted on Turkey, no studies using non-linear models were found. Related literature examples studies are shown in Table 1.

Table 1: Examples of Work on Current Account Sustainability

Author	Country	Sample	Method	Variables Used	Results
Kalyoncu (2005)	Turkey	1987:q1 -2002:q4	Johansen and Juselius method	real exports, real imports	Current account is sustainable in the long-run.
Yücel and Yanar (2005)	Turkey	1964 – 2003	Engle–Granger cointegration test	Import and export data including unrequited foreign transfers and foreign interest payments.	Unsustainable
Ongan (2008)	Turkey	1980Q1-2005Q2	Johansen cointegration test	exports and imports	Unsustainable
Polat (2011)	Turkey	January 2000 to June 2010.	ARDL bounds testing	exports and imports	Weak form sustainability
Bildirici & Kayıkçı (2012)	Turkey	1987:4 - 2010:4	Markov-switching model	current account to GDP ratio	The probability of unsustainability is high
Chen (2014)	10 European Countries	1970:Q1–2012:Q2	logistic smooth transition (LSTR) nonlinear trend.	quarterly observations of the current account balance as percentages of GDP	By taking account of the nonlinear trend, the threshold autoregressive and momentum threshold autoregressive models do not detect any asymmetry in the response of the current account imbalance to deviations from its long-run nonlinear trend.

Açıkgöz & Akçağlayan (2014)	Turkey	1992:Q1-2011:Q3	ARDL bounds testing, Engle–Granger cointegration test	exports and imports	Weak form sustainability
Koç & Bakırtaş (2016)	Turkey	1992:1-2015:3	ARDL bounds testing	Exports and imports	Weak form sustainability
Çiğdem (2017)	Turkey	1980 – 2016	ADF, PP and Lee–Strazicich Unit root tests	the ratio of CAD to GDP	Sustainable
Iyidogan & Turan (2018)	Czech Republic, Hungary, Poland and Turkey	1998Q1-2014:2	Gregory–Hansen cointegration test, Seo (2006) cointegration test	the export and import series as the percentages of GDP	CAD is unsustainable for Turkey, Poland and Czech Republic.
Ordoñez-Callamand, et al. (2017)	Chile, Colombia, Mexico and Brazil	1996 - 2016	TVEC model, VEC model, generalized impulse response function (GIRF) of the nonlinear model	the income and expenditure of the current account	Chile and Mexico strongly sustainable; Brazil and Colombia weakly sustainable
Dissou & Nafie (2019)	Egypt	1970 - 2017	ARDL	real exports, real trade in goods and services, real interest payments on foreign debt	No strong evidence to support the sustainability of the current account during the study period. In addition, the study results show that the current account follows a nonlinear process that returns to the mean over the working period.
Karış (2020)	Turkey	1980 - 2018	Probit analysis and the marginal effect calculations	CAD /GDP ratio and macroeconomic variables	Increases in all variables except the average exchange rate, M2 money supply and export-import coverage ratio negatively affect the sustainability probability of the CAD .

Abioglu, Koc & Bakirtas (2020)	Turkey	1987Q1-2017Q4	Dickey-Fuller generalized least squares test; ADF test; Phillips–Perron test and Kwiatkowski-Phillips-Schmidt-Shin test	current account to GDP ratio	CAD is sustainable for Turkey in the analysed period.
Akdoğan & Husein (2021)	28 Countries	1981Q1 – 2020Q1	Exponential Smooth Transition Autoregressive (ESTAR) model	average CA/GDP	The results indicate mean-reversion for three quarters of the sample. For nine countries, only non-linear tests suggest mean reversion. This result suggests that the tests should take into account possible asymmetries in the adjustment behaviour.
Kouadio & N'Guessan (2021)	C^ote d'Ivoire	1985q1 - 2017q4	NARDL	macroeconomic data	Current account balance is sustainable. However, this sustainability is weak.
Hepsag (2021)	G7 countries	1956M1-2017M12	ESTAR	the nominal interest rates and the inflation rates	Fisher hypothesis in G-7 countries, cannot reject the null hypothesis of no cointegration for France, Germany, Italy, Japan and the United States, and the test finds evidence of cointegration and also evidence of the validity of Fisher hypothesis for Canada and the United Kingdom.

3. INTERTEMPORAL CURRENT ACCOUNT MODEL

The workhorse model of sustainability literature was due to Husted (1992), and Hakkio and Rush (1991). In his model, Husted (1992) showed that the sustainability of current account is achieved when inter-temporal budget constraint is satisfied. Under the assumptions of a small-open economy with no government, budgetary constraint of a small-open economy at period t can be written as:

$$C_t = Y_t + B_t^f - I_t - (1 + r_t)B_t^f \qquad (1)$$

where C_t, Y_t, B_t^f, I_t, and r_t represent consumption, output, international borrowing, investment and world interest rate at period t. Since $Y_t - C_t - I_t = X_t - M_t$ from GDP identity, Equation (1) can be rewritten in terms of trade balance $TB_t = X_t - M_t$ as:

$$(1 + r_t)B_{t-1}^f - B_t^f = TB_t \qquad (2)$$

Iterating equation (2) and rearranging it one period ahead, we get:

$$B_t^f = (B_{t+1}^f + TB_{t+1})\frac{1}{(1+r_{t+1})} \qquad (3)$$

If we keep substituting the value of B_{t+1}^f in equation (3) until infinity, the economy's budget constraint can be expressed as

$$B_t^f = \sum_{i=1}^{\infty} \mu_i \,[TB_{t+i}] + \lim_{i\to\infty} \mu_i \, B_t^f \qquad (4)$$

where $\mu_i = \prod_{j=1}^{i} \frac{1}{(1+r_{t+j})}$ is a discount factor.

The equation (4) suggests that when $\lim_{i\to\infty} \mu_i \, B_t^f$ is zero, the amount of a country's borrowing (lending) is equal to the present value of the future trade surpluses (deficits).

To derive a testable model, assuming that the world interest rate is stationary with unconditional mean r, Equation (4) can be expressed as:

$$M_t + rB_{t-1}^f = X_t + \sum_{i=0}^{\infty} \frac{\Delta X_{t+i} - \Delta Z_{t+i}}{(1+r)^{i-1}} + \lim_{i\to\infty} \frac{B_{t+i}^f}{(1+r)^{i-1}} \qquad (5)$$

where $Z_t = M_t + (r_t - r)B_{t-1}^f$.

After subtracting X_t and then multiplying both sides of Equation (5) by minus 1, we obtain current account equation as:

$$CA_t = X_t - M_t - rB_{t-1}^f = \sum_{i=0}^{\infty} \frac{\Delta Z_{t+i} - \Delta X_{t+i}}{(1+r)^{i-1}} - \lim_{i\to\infty} \frac{B_{t+i}^f}{(1+r)^{i-1}} \qquad (6)$$

Assuming that X_t and Z_t are both I(1) processes and that the term $\lim_{i\to\infty} \frac{B_{t+i}^f}{(1+r)^{i-1}}$ in Equation (6) is zero, empirical model of the sustainability of current account can be written as:

$$LX_t = \alpha + bLM_t + \varepsilon_t \qquad (7)$$

Where LX_t is exports of goods and services, $LM_t = M_t + r_t B_{t-1}^f$, M_t is import of goods and services and $r_t B_{t-1}^f$is interest payments on external borrowing. Equation (7) suggests that intertemporal budget constraint is satisfied when b is equal to 1 and hence ε_t is stationary.

The implications of the model given in Equation (7) for the sustainability of the current account can be summarized as follows: (i) if LX_t and LM_t are not being cointegrated, then the current account is not sustainable; (ii) if there is cointegration among LX_t and LM_t with b = 1, the current account is sustainable; (iii) if LX_t and LM_t are cointegrated but b < 1, the current account may not be sustainable since exports are growing slower than imports of a country.

4. DATA AND METHODOLOGY

The data employed in this study covers quarterly data belonging to the Turkish economy throughout 1994Q1-2021Q2. The availability of data determines the sample period. The sample data is obtained from the Central Bank of Turkey's online electronic data delivery system. The raw data involves the export on goods and services in dollars, imports on goods and services, plus net interest payments on external borrowing in dollars. We divide nominal export and import data by export and import price indices and make real exports and imports. In the empirical analysis, the logarithmic and seasonally adjusted for real exports and real imports are being used.

Unit root tests

Nowadays, it is well known that the first step in econometric analysis with time series data involves determining the level of integration of series. This is being done to avoid spurious regression problems. In this study, we tested the stationarity of variables using three different unit root tests, ADF, PP, and KPSS tests namely. Table 2 provides unit root test results. Examination of Table 2 shows that both real export and real import variables are stationary at their first differences indicating that the series are I(1) series according to ADF, PP, and KPSS unit root test results.

Table 2. Unit Root Tests

Unit Root Tests	Dependent Variable			
	LX	LM	ΔLX	ΔLM
ADF	-1.8127(1)	-1.7111(0)	-13.5995(0)*	-9.3118(0)*
PP	-2.0029(9)	-1.6999(2)	-14.1513(4)*	-9.3118(0)*
KPSS	1.1896(9)*	1.13855(9)*	0.34948(8)	0.2738(1)

Note: * indicates statistical significance at 1% level. Figures in parenthesis show the number of lags chosen by SIC (Schwart Information Criterion) in ADF regession and Bandwith in PP and KPSS tests. Δ is a first difference operator. Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS).

Linear and Non-linear ARDL model and bounds testing

This section introduces the nonlinear autoregressive distributed lag model (NARDL) that will be used to test Turkey's current account balance's sustainability in the empirical analysis of this study. In its original form, distributed lag models have been used to predict the values of a dependent variable based on the lagged values of both the dependent and independent variables. Pesaran and Shin (1998) and Pesaran et al. (2001) have shown how the ARDL model can be used to test cointegrating relationships among variables. Since then, autoregressive distributed lag (ARDL) models have been widely used in empirical studies because the ARDL model performs better in small samples, and it can be used to test cointegration regardless of whether variables are I(0) or I(1). The general form of the ARDL model can be expressed as (Pesaran and Shin, 1998):

$$LX_t = \gamma_0 + \sum_{j=1}^{p} \gamma_{1j} LX_{t-j} + \sum_{j=0}^{q} \gamma_{2j} LM_{t-j} + u_t \quad (8)$$

where LX_t, LM_t are real exports and real imports respectively. The error correction form of the ARDL model can be written as (Pesaran et al., 2001):

$$\Delta LX_t = \gamma_0 + \rho_1 LX_{t-1} + \rho_2 LM_{t-1} + \sum_{i=1}^{p} \gamma_{1i} \Delta LX_{t-i} + \sum_{i=1}^{q} \gamma_{2i} \Delta LM_{t-i} + \varepsilon_t \quad (9)$$

where Δ is first difference operator. To test for cointegration relationship in the linear model given in equation (9), Pesaran et al. (2001) introduced the bound test that invloves testing the joint null hypothesis that the coefficients of the lagged level variables are jointly equal to zero, that is, H_0: ρ_1=ρ_2=0.

NARDL

As mentioned above, there is a strong case that transaction costs and twin deficits may lead to nonlinearities in the current account adjustment, and failing to incorporate such nonlinearity in testing cointegration may lead to an incorrect conclusion. Shin et al. (2014) developed the asymmetric version of the ARDL model based on the partial sum decomposition method of Schorderet (2001). The essence of the partial decomposition method involves separating the positive and negative variations in the independent variables. Hence, the general asymmetric form of the NARDL model can be specified as:

$$LX_t = \beta_0 + \beta_1^+ LM_t^+ + \beta_2^- LM_t^- \quad (10)$$

where β_1^+, β_2^- are long-run parameters, LM_t^+ is the partial sum of positive changes of imports, and LM_t^- is the partial sum of negative changes in imports. LM_t^+ and LM_t^- variables are measured as:

$$LM_t^+ = \sum_{i=1}^{t} \Delta LM_i^+ = \sum_{i=1}^{t} \max(\Delta LM_i, 0) \quad (11)$$

$$LM_t^- = \sum_{i=1}^{t} \Delta LM_i^- = \sum_{i=1}^{t} \min(\Delta LM_i, 0) \quad (12)$$

Dividing the independent variable LM_t into two partial sums, LM_t^+ and LM_t^- allows us to measure the asymmetric effect of the independent variable on the dependent variable. That is, we will be able to measure and test whether signs and sizes of the coefficients of partial sums, LM_t^+ and LM_t^- are equal to each other in the long-run as well as in the short-run.

An error correction version of the asymmetric NARDL model of Equation (10) can be specified as:

$$\Delta LX_t = \beta_0 + \rho LX_{t-1} + \gamma_1^+ LM_{t-1}^+ + \gamma_2^- LM_{t-1}^- + \sum_{j=1}^{p} \delta_i \Delta LX_{t-j} + \sum_{j=0}^{q} (\theta_j^+ \Delta LM_{t-j}^+ + \theta_j^- \Delta LM_{t-j}^-) + \varepsilon_t \quad (13)$$

where ε_t is error term, p and q are lag lengths. The long-run and short-run asymmetric effects of positive and negative changes in imports on exports are measured as follows.

The asymmetric long-run parameters :

$\beta_1^+ = -\left(\frac{\gamma_1^+}{\rho}\right)$, $\beta_2^- = -\left(\frac{\gamma_2^-}{\rho}\right)$

The asymmetric long-run parameters: $\sum_{j=0}^{q} \theta_j^+$, $\sum_{j=0}^{q} \theta_j^-$

5. RESULTS AND DISCUSSIONS

This section provides estimation and cointegration test results obtained from the sustainability model in equation (7) using the linear and nonlinear ARDL model. Table 3 provides estimation results from both the linear and nonlinear ARDL models. The number of lags employed in the estimation of the ARDL form of the sustainability models given in Equations (8) and (9) is determined by the Akaike Information Criterion (AIC).

Table 3. Results from the linear and the asymmetric ARDL models

Dependent Variable: LX							
Linear ARDL (2,1)				Asymmetric ARDL (2,4,1)			
Variable	Coefficient	Std. Error	t-Statistic	Variable	Coefficient	Std. Error	t-Statistic
LX(−1)	0.558*	0.084	6.613	LX(−1)	0.4611*	0.0874	5.274
LX(−2)	0.313*	0.076	4.138	LX(−2)	0.2164**	0.0829	2.611
LM	0.570*	0.076	7.545	LM^+	0.1843	0.1313	1.404
LM(−1)	-0.428*	0.087	-4.951	$LM^+(-1)$	-0.1550	0.1886	-0.822
Constant	-0.063	0.058	-1.074	$LM^+(-2)$	0.1032	0.1846	0.559

				$LM^+(-3)$	-0.1896	0.1793	-1.058
				$LM^+(-4)$	0.3097**	0.1296	2.390
				LM^-	0.7791*	0.1105	7.048
				$LM^-(-1)$	-0.6472*	0.1234	-5.245
				Constant	1.4274*	0.3138	4.549
Diagnostic Statistics				Diagnostic Statistics			
R^2	0.993	$\bar{R}^2$	0.992	R^2	0.994	$\bar{R}^2$	0.993
$F-\text{stat.}$	3740	Normality	0.820	$F-\text{stat.}$	1742	Normality	2.3787
χ^2_{sc}	3.4416	χ^2_{het}	7.7259	χ^2_{sc}	2.2097	χ^2_{het}	7.7958

Note: χ^2_{sc} Breusch-Godfrey LM Test:χ^2_{het}Heteroskedasticity Test: Breusch-Pagan-Godfrey Normality: Jarque-Bera Test, $\bar{R}^2$, R^2, $F-\text{stat.}$ *,**,*** indicate statistical significance at 1%, 5% and 10% level, respectively.

As seen in Table 3, the linear ARDL model with optimal lag length is ARDL(2.1) and the selected NARDL model is an asymmetric ARDL (2,4,1). Examination of diagnostic statistics in Table 3 shows that the error terms are normally distributed, not serially correlated, have a constant variance in both the linear and nonlinear ARDL models. Coefficent of determination R^2 is very high for both models impliying that about 99 percent of change in dependent variable is explained by regressors of the models. Figure 1 and 2 presents the results from the CUSUM test which shows the stability of models in Table 3. As seen from the Figure 1 and 2, while the NARDL model is stable, the linear ARDL model is not stable.

Figure 1. CUSUM test for the linear ARDL model

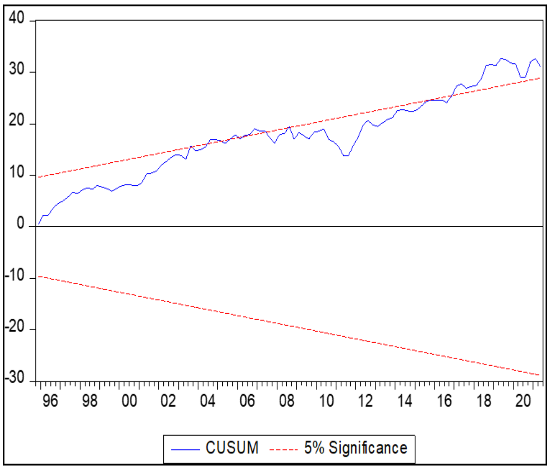
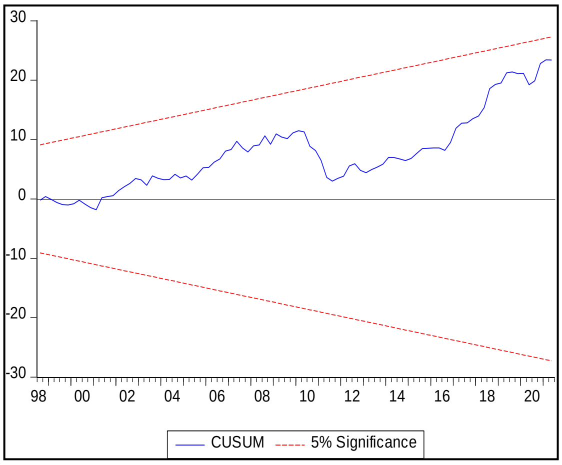


Figure 2. CUSUM test for the NARDL model



Having estimated and determined the diagnostic properties of the ARDL form of the sustainability model, we next test for the cointegration relationship in both the linear and nonlinear models using the bounds testing model of Pesaran et al. (2001). The bound test involves testing the null hypothesis that the coefficients of the lagged level variables are jointly equal to zero using F-test. Suppose the F-statistic obtained from the linear and nonlinear ARDL model is higher than the upper bound. In that case, we reject the null hypothesis of no cointegration among exports and imports variables implying the sustainability of the current account of Turkey. However, suppose the calculated F-statistic is lower than the lower bound. In that case, we cannot reject the null hypothesis of no cointegration, concluding that the current account balance of Turkey is unsustainable. Table 4 presents bound tests results related to the linear and asymmetric ARDL models. Examination of the F-test results presented in Table 4 reveals that since the F-statistics value is lower than 95% upper bound critical value, the null hypothesis of no cointegration cannot be rejected in the linear ARDL model. However, we reject the null hypothesis of no cointegration for the Asymmetric ARDL model. Taken together, the findings of Table 4 shed light on a very important issue that the linear and nonlinear econometric techniques provide different results on the sustainability of the current account in Turkey. These findings can be interpreted as a sign of nonlinearity in current account adjustments in Turkey.

Table 4. Bound tests for cointegration in the linear and the asymmetric ARDL models

	F-Statistic	95% Lower bound	95% Upper bound	Conclusion
Linear ARDL (2,1)	5.6688	4.94	5.73	No cointegration
Asymmetric ARDL (2,4,1)	7.3293*	3.79	4.85	Cointegration

Note: *,**,*** indicate statistical significance at 1%, 5% and 10% level, respectively.

Although the bound test for nonlinear cointegration results confirmed that Turkish current account balance is sustainable once we incorporate nonlinearity in current account adjustment, we further need to search for the sources of nonlinearity using symmetry tests. As explained above, symmetry tests allow us to determine whether the impact of shocks to import on exports is symmetrical or not, both in the short-run and long-run. Panel A of Table 5 presents the results obtained from estimating the conditional error correction form of the sustainability model given in equation (3). The results show that the error correction term is negative and statistically significant, indicating that about 32% of deviations in the short-run will be corrected in each quarter. This result also shows that deviations in the current account adjust to their long-run equilibrium level rather slowly. The results also indicate that the impact of both positive $(\mathrm{LM}^{+}(-1))$ and negative shocks $(\mathrm{LM}^{-}(-1))$ to imports on dependent variable (the growth of exports, $\Delta\mathrm{LX}$) are statistically significantly different from zero implying that positive change in imports affects the growth rate of exports in the short-run. The results also confirmed that there is significant short-run relationship between positive $(\Delta\mathrm{LM}^{+})$ and negative $(\Delta\mathrm{LM}^{-})$ change in imports and change in exports $(\Delta\mathrm{LX})$.

Table 5. Dynamic Asymmetric in the NARDL Model

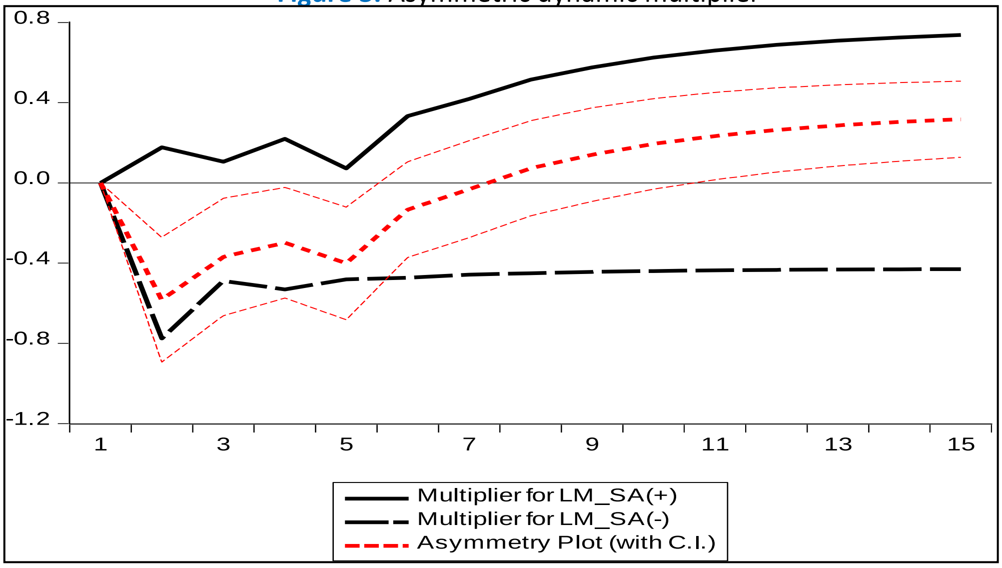
Panel A: Conditional Error Correction Regression-Dependent Variable is : ΔLX					
Variable	Coefficient	Value	Standard Error	t-Statistic	Probability
Constant	β_0	1.4274*	0.3138	4.5488	0.0000
$\mathbf{LX(-1)}$	ρ	-0.3225*	0.0732	-4.4045	0.0000
$\mathbf{LM^+(-1)}$	γ_1^+	0.2526*	0.0548	4.6120	0.0000
$\mathbf{LM^-(-1)}$	γ_2^-	0.1319*	0.0494	2.6714	0.0089
$\mathbf{\Delta LX(-1)}$	δ_1	-0.2164**	0.0829	-2.6112	0.0105
$\mathbf{\Delta LM^+}$	θ_0^+	0.1843	0.1313	1.4036	0.1637
$\mathbf{\Delta LM^+(-1)}$	θ_1^+	-0.2233	0.1405	-1.5895	0.1153
$\mathbf{\Delta LM^+(-2)}$	θ_2^+	-0.1201	0.1287	-0.9330	0.3532
$\mathbf{\Delta LM^+(-3)}$	θ_3^+	-0.3097**	0.1296	-2.3900	0.0188
$\mathbf{\Delta LM^-}$	θ_1^-	0.7791*	0.1105	7.0484	0.0000
Panel B: Long-run Effects					
Variables	Coefficient	Value	Standard Error	t-Statistic	Probability
$\mathbf{LM^+}$	β_1^+	0.7832*	0.0734	10.6665	0.0000
$\mathbf{LM^-}$	β_2^-	0.4089**	0.1568	2.6074	0.0106
Panel C: Symmetry tests-Wald Test					
	H_0	t-statistic (95)	F-statistic (1,95)	Chi-square (1)	Decision
Long-run	$\beta_1^+ = \beta_1^-$	4.3217*	18.6772*	18.6772*	Asymmetric
Short-run	$\sum_{j=0}^{q} \theta_j^+ = \sum_{j=0}^{q} \theta_j^-$	-3.9071*	15.2655*	15.2655*	Asymmetric

Note: *,**,*** indicate statistical significance at 1%, 5% and 10% level, respectively. The coefficients in the table corresponds to the coefficients of current account sustainability Equation (13): $\Delta LX_t = \beta_0 + \rho LX_{t-1} + \gamma_1^+ LM_{t-1}^+ + \gamma_2^- LM_{t-1}^- + \sum_{j=1}^{p} \delta_i \Delta LX_{t-j} + \sum_{j=0}^{q} (\theta_j^+ \Delta LM_{t-j}^+ + \theta_j^- \Delta LM_{t-j}^-) + \varepsilon_t$. Figures in parenthesis in t-statistic, F-statistic and Chi-square statistic shows degrees of freedom.

Panel B of Table 5 shows the results from estimating the long-run form of the sustainability model given in equation (10). The results show that while the level of exports increases 0.78% in response to 1% increase in positive values of imports, the level of exports decreased only 0.41% in response to 1% decrease in negative values of imports in the long-run. The coefficients of positive and negative import variables clearly show that imports affect exports asymmetrically in the long-run. Panel C of Table 4 presents the symmetry test results. The Wald test results confirm that both short-run and long-run effects of imports on exports are asymmetrically confirming the presence of nonlinearity in current account adjustments in the short-run and long-run.

To analyse the dynamic effects of the negative and positive shocks to imports on the exports, Figure 3 presents the asymmetric cumulative dynamic multiplier effect on exports (LX) of one percent change in it variation in LM^+ and in LM^-. Figure 3 shows the adjustment of exports to negative (dashed black line) and positive (continuous black line) and negative (dashed black line) shocks over time. The dashed red line is called asymmetry curve and it shows the difference between the dynamic multipliers (difference between continuous black and dashed black lines). The Figure 3 show that the asymmetric effects of positive and negative shocks to imports on exports are significant since the 95% confidence interval around the asymmetry curve does not include zero.

Figure 3. Asymmetric dynamic multiplier



CONCLUSION

This study tested the sustainability of the current account in Turkey using both the linear and nonlinear ARDL model. Departing from the argument that positive and negative shocks to imports may have different sign and size effects on exports, this study employed an asymmetric autoregressive distributed lag model. The study results showed that while the cointegration relationship between exports and imports is rejected in the linear ARDL model, the bound test confirmed the presence of cointegration for the nonlinear ARDL model. Furthermore, the study results have shown that both positive and negative shocks to imports affect exports significantly and asymmetrically in the short-run and in the long-run. Although positive shocks to imports on exports are significantly higher than the impact of negative shocks in the long-run, the negative shocks cause export growth to decrease at a higher rate than positive shocks in the short-run.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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