International Journal of Business & Economic Studies
Year: 2024, Vol: 6, No: 3, pp.155-170
https://doi.org/10.54821/uiecd.1500767

Harberger-Laursen-Metzler Hypothesis: An Analysis with ARDL Bounds Test Approach

Harberger-Laursen-Metzler Hipotezi: ARDL Sınır Testi Yaklaşımı ile Bir Analiz

Havva KOÇ
Dr., Okan University
havva.koc@okan.edu.tr
https://orcid.org/ 0000-0002-0906-1438

Meltem DUĞRU
Dr., Trakya University
meltemdugru@trakya.edu.tr
https://orcid.org/0000-0003-4280-5651

Senil KETENCİLER
Dr., Çanakkale Onsekiz Mart University
senilketenciler@comu.edu.tr
https://orcid.org/0000-0003-1342-450X

Received : 13.06.2024
Revised : 01.08.2024
Accepted : 15.08.2024
Type of Article : Research

Keywords:

International Trade, Terms of Trade, Balance of Trade, Co-Integration, HLM Hypothesis

Jel Codes:

F32, F41, E12

ABSTRACT

The Harberger, Laursen, and Metzler (HLM) hypothesis posits that a positive (negative) change in terms of trade, ceteris paribus, will lead to positive (negative) movements in the trade balance. When tested on developing countries, the hypothesis yields varying results. Some studies validate the hypothesis, while others suggest it is not applicable. Additionally, causality tests examining long-term relationships also produce different outcomes. Türkiye ranks among the countries with significant trade deficit issues. Therefore, testing the validity of the HLM hypothesis in the context of Türkiye is of great importance. The motivation of this study is to examine the impact of changes in terms of trade on the long-term trade balance in Türkiye from 2013 to 2023. In this context, both the volume and unit value of the terms of trade are considered. According to the findings, there is a positive relationship from terms of trade to the trade balance. Short-term deviations are found to be corrected within approximately three months. The causality test indicates that terms of trade are a Granger cause of the trade balance, and this causality is unidirectional. In this study, Türkiye's terms of trade and trade balance data for the specified periods were meticulously analyzed, and the validity of the HLM hypothesis was carefully tested. The analysis results provide strong evidence supporting the HLM hypothesis. These findings offer significant insights for Türkiye's economy and trade policies.

Anahtar Kelimeler:

Uluslararası Ticaret, Ticaret Hadleri, Ticaret Dengesi, Eşbütünleşme, HLM Hipotezi

Jel Kodları:

F32, F41, E12

ÖZET

Harberger, Laursen ve Metzler (HLM) hipotezi, ticaret hadlerindeki pozitif (negatif) bir değişikliğin, ceteris paribus, ticaret dengesinde pozitif (negatif) hareketlere yol açacağını savunmaktadır. Hipotez, gelişmekte olan ülkeler üzerinde test edildiğinde farklı sonuçlar ortaya koymaktadır. Bazı çalışmalar hipotezi doğrularken, diğerleri geçerli olmadığını öne sürmektedir. Ayrıca, uzun dönemli ilişkileri inceleyen nedensellik testleri de farklı sonuçlar göstermektedir. Türkiye, önemli ticaret açığı sorunları yaşayan ülkeler arasında yer almaktadır. Bu nedenle, hipotezin Türkiye bağlamında geçerliliğinin test edilmesi büyük önem taşımaktadır. Bu çalışmanın motivasyonu, 2013 ile 2023 yılları arasında Türkiye'de ticaret hadlerindeki değişimlerin uzun vadeli ticaret dengesi üzerindeki etkilerini incelemeyi amaçlamaktadır. Bu bağlamda dış ticaret haddi hem miktar hem de birim değer olarak ele alınmıştır. Bulgulara göre, ticaret hadlerinden ticaret dengesine doğru pozitif bir ilişki vardır. Kısa vadeli sapmaların yaklaşık üç ay içinde düzeltildiği tespit edilmiştir. Nedensellik testi, ticaret hadlerinin ticaret dengesinin Granger nedeni olduğunu ve bu nedenselliğin tek yönlü olduğunu göstermektedir. Bu çalışmada, belirtilen dönemler için Türkiye'nin ticaret hadleri ve ticaret dengesi verileri titizlikle analiz edilmiş ve HLM hipotezinin geçerliliği dikkatlice test edilmiştir. Analiz sonuçları, HLM hipotezini destekleyen güçlü kanıtlar sunmaktadır. Bu bulgular, Türkiye ekonomisi ve ticaret politikaları için önemli içgörüler sağlamaktadır.

Suggested Citation: Koç, H., Duğru, M., & Ketenciler, S. (2024). Harberger-Laursen-Metzler hypothesis: An analysis with ARDL bounds test approach. *International Journal of Business and Economic Studies*, 6(3), 155-170, Doi: https://doi.org/10.54821/uiecd.1500767

1. INTRODUCTION

Many countries, both large and small, have embraced trade liberalization to enhance their economic prosperity, thereby increasing the importance of trade balances in policymaking contexts (Deardorff, 2014). Numerous studies have been conducted to explain changes in trade balances, with the Harberger-Laursen-Metzler (HLM) hypothesis being one of them. The relationship between terms of trade and trade balances constitutes a significant research topic in economic literature. The expectation that positive (negative) changes in the terms of trade of a small open economy will lead, ceteris paribus, to improvements (deteriorations) in its trade balance is known as the HLM hypothesis (Mendoza, 1995). This hypothesis highlights the importance of trade balances in the formulation and implementation of economic policies, as it is believed to have a direct impact on the effectiveness of trade policies. Thus, understanding the effects of changes in terms of trade on trade balances is crucial for successful economic policy formulation.

It is noteworthy that the results of testing the HLM hypothesis in developing countries are varied. Some studies validate the hypothesis, while others conclude that it does not hold. Moreover, causality tests examining long-term relationships have also produced differing results. Türkiye is among the countries facing significant trade deficit issues. Therefore, examining whether the HLM hypothesis is valid in Türkiye is crucial. This study aims to analyze the effects of changes in terms of trade on the long-term trade balance in Türkiye between 2013 and 2023. Sudden changes in a country's trade balance, particularly in countries heavily dependent on foreign exchange from exports, can lead to severe balance of payments issues. For example, an adverse shift in the trade balance may exacerbate the trade deficit and disrupt the current account balance. Such situations can increase the need for external borrowing and potentially lead to currency depreciation due to dwindling foreign reserves.

This study is motivated by the need to analyze trade balances as independent variables, considering both volume and unit value. This approach provides a better understanding of the causes and effects of changes in trade balances. Trade volume represents the total amount of trade, while unit value represents the price level of trade. It is essential to determine whether changes in trade balances are driven by volume or price. By addressing these aspects, this study is expected to make a significant contribution to the literature. Understanding the effects of changes in trade balances on long-term trade balances, particularly in a trade-deficit country like Türkiye, can aid in more effective decision-making in both economic policy and international economic relations management. This study offers a new perspective on analyzing trade balances and may enrich the literature and inspire future research.

Research Questions: In this study, the following research questions are formulated to evaluate the relationships between independent and dependent variables: How do changes in the terms of trade affect the trade balance in Türkiye between 2013 and 2023? Are there significant differences in the impacts of trade volume and trade unit value on the trade balance? What are the short-term and long-term effects of changes in the terms of trade on the trade balance? Does the HLM hypothesis hold true for Türkiye during the study period? What are the policy implications of these findings for managing trade deficits and ensuring economic stability in Türkiye?

Limitations of the Study: Time Frame: The period covered by this study (2013-2023) is marked by specific economic and political events. The impact of these specific events (e.g., the 2018 currency crisis) may limit the generalizability of the results to other periods. Model Assumptions: The ARDL model and other econometric methods used in this study operate under certain assumptions. Violations of these assumptions may undermine the validity of the results. If the model assumptions are not met, the reliability of the findings may be compromised. Macroeconomic Factors: This study focuses on the relationship between terms of trade and the trade balance, excluding other macroeconomic factors (e.g., interest rates, exchange rates, political events). The omission of these factors may affect the analysis. Generalizability: The findings of this study, specific to Türkiye, cannot be directly generalized to other countries. The unique economic, political, and social dynamics of Türkiye limit the applicability of the results to other contexts.

Changes in the real effective exchange rate, which more accurately reflects fluctuations in the purchasing power of the Turkish lira, are considered a critical indicator for understanding Türkiye's foreign trade dynamics. Increases in the real effective exchange rate signify a strengthening of the lira, which leads to higher prices of Turkish goods relative to foreign goods. This directly impacts the country's international trade balance and determines the competitive environment between exports and imports. In Türkiye, the real effective exchange rate has shown a significant downward trend, particularly since 2017. This trend indicates a decrease in the price of Turkish goods compared to foreign goods and a shift in competitive conditions. Data shows that from early 2018 to early 2020, Türkiye's exports increased, but there was no corresponding rise in unit exports (Appendix 6). This suggests that Turkish goods were sold abroad in higher quantities and at more competitive prices. However,

despite the increase in export quantity, the decrease in unit exports suggests that the developments in the foreign trade balance are more complex. This underscores the necessity of addressing both price and quantity dynamics in Türkiye's foreign trade. Testing the validity of the Harberger-Laursen-Metzler (HLM) hypothesis in Türkiye is therefore of great importance. This hypothesis provides a critical framework for understanding the effects of changes in trade balances on the foreign trade balance. This study represents a step toward understanding these significant economic dynamics and shaping Türkiye's foreign trade strategies.

The next section will offer an extensive discussion of the theoretical framework underpinning the study, along with a review of relevant national and international research. Following this, the data sets and analysis methods will be examined in detail, with an explanation of the econometric methods used and a discussion of the results.

2. THEORETICAL FRAMEWORK AND LITERATURE

HLM Hypothesis, which examines the impact of changes in terms of trade on trade balance and the income-consumption relationship, holds a prominent position in economic literature. The foundations of this hypothesis were laid by the works of Harberger (1950) and Laursen & Metzler (1950). Harberger developed a general model to analyze the interaction between price and income mechanisms in the context of a national currency's depreciation (İyibozkurt, 1975). Meanwhile, the hypothesis advocated by Laursen and Metzler is largely based on Keynes' 'Psychological Law of Consumption'. This law posits a stable relationship between real income and consumption. A sudden change in real income necessitates a reassessment of individuals' future consumption plans and lifetime expenditures. Consequently, barring any unforeseen circumstances, future consumption is expected to remain stable (Obstfeld, 1981).

The significance of this hypothesis lies in its ability to elucidate the effects of changes in terms of trade on the trade balance and the income-consumption relationship. The model assumes two countries, where the depreciation of one country's currency against the other's is considered. In such a scenario, it is assumed that the country with the depreciated local currency will experience an increase in imports, while the second country will see a decrease in its imports. The rise in import prices in the country with the depreciated currency will lead to a decrease in real income. Consequently, the proportion of income spent on goods and services, as well as employment, will increase. This increase in income and employment will drive up the demand for imports. Conversely, in the second country where import demand decreases, the proportion of income spent on goods and services will slightly decline, followed by a reduction in production levels and employment, which will, in turn, reduce import demand. As a result, changes in income in the first country will increase imports while decreasing exports. The ultimate outcome of the local currency depreciation will be a trade deficit (Laursen & Metzler, 1950).

According to the Keynesian income-expenditure approach, budget deficits positively impact production and consumption, thereby increasing national income and subsequently boosting demand for imported goods. The rising demand for imports drives up the prices of imported goods, leading to issues in the trade balance (Keynes, 1936: 263). In the 1980s, under President Ronald Reagan, tax cuts and increased public spending led to significant deficits in the current account balance of the United States. This situation, known as "twin deficits," highlights the relationship between the budget balance and the current account balance, providing a different perspective on their interaction. The relationship is articulated through the equations (1), (2), (3), (4), and (5) (Krugman & Obstfeld, 2003: 300-306). In (1), which is the open economy national income equation;

$$Y = C + I + G + EX - IM \tag{1}$$

In equation (1), Y: National income, C: Private consumption expenditures, I: Private investment expenditures, G: Government expenditures, EX: Export, IM: It means import.

CA=EX-IM is obtained when the CA balance between EX and IM of goods and services is called CA. When equation (1) is rearranged according to this equation, equation (2) is obtained.

$$Y - (C + I + G) = CA \tag{2}$$

In a closed economy, investments are equal to savings, that is (S=I). This equation is shown with the help of equations (3) and (4).

$$S = Y - C - G \tag{3}$$

$$I = Y - C - G \quad (4)$$

When the national income identity for open economies is reconsidered, equation (5) is obtained.

$$S = I + CA \quad (5)$$

Savings are examined in two parts as private and public. Private savings are defined as the part of income that is not consumed, that is, accumulated, and is shown in equation (6).

$$S^p = Y - T - C \quad (6)$$

Public savings, on the other hand, consist of the difference between the state's net tax income (T) and expenditure (G) and is expressed by the half of equation (7).

$$S^g = T - G \quad (7)$$

National savings from the sum of private and public savings are included in equation (8).

$$S = Y - C - G = (Y - T - C) + (T - G) = S^p + S^g \quad (8)$$

When this equation is written with the open economy model, the identity number (9) is reached.

$$S^p = I + CA - S^g = I + CA - (T - G) = I + CA + (G - T) \quad (9)$$

When this equation is rearranged for the twin deficit, it is expressed by equation (10).

$$CA = S^p - I - (G - T) \quad (10)$$

In the above equations; S^p: Private savings,S^g: Public savings, S: National savings, T: Taxes.

The channels of transmission mechanism of the terms of trade are expressed with the help of Figure 1 below.

Table 1 below summarizes the studies in the national and international literature.

Table 1. Review of Literature

Author(s)	Timespan	Method	Findings
Otto (2003)	1963 – 1997	SVAR	HLM Hypothesis is valid.
Yamak & Korkmaz (2006)	1991: Q4 – 2003: Q3	Granger Causality – Hsiao Causality	HLM Hypothesis is invalid in the Türkiye.
Mitzal (2010)	1995–2009	VAR	The prevalence of the HLM effect in Poland has been confirmed.
Oktar & Dalyancı (2012)	2004: M01 – 2011: M11	VAR and Cointegration	HLM Hypothesis is valid in the Türkiye.
Aquino & Espino (2013)	1950–2019	VAR	HLM Hypothesis is valid.
Küçükaksoy & Çiftçi (2014)	2003: M1– 2014: M4	Cointegration, Causality and VAR	HLM Hypothesis is valid in the Türkiye.
Lukáčik et al. (2016)	1997: Q1– 2014: Q4	VAR and SVAR	HLM Hypothesis is not valid in the Slovak economy.
Tekgül (2017)	1982: Q1– 2015: Q2	ARDL–Causality	HLM Hypothesis is valid in the Türkiye.
Okyay & Unal (2018)	2005: M1– 2017: M4	Cointegration and Causality	HLM Hypothesis is valid in the Türkiye.
Murshed (2018)	2000 – 2016	Panel Cointegration, VECM and Granger Causality	There is a non-linear relationship between terms of trade and current account movements.
Strojny (2019)	2002 – 2017	VAR	HLM Hypothesis is valid.

Ayad & Belmokaddem (2019)	1990 – 2017	Cointegration and Causality	There is no co-integration or causality.
Hicham (2019)	2000 – 2017	Cointegration and Causality	There is no evidence of HLM effect.
Shafiullah, Islam, & Navaratnam (2020)	1980 – 2015	Cointegration and Granger (non-) causality	HLM Hypothesis is valid.
Akbulut-Bekar (2021)	1987 – 2018	Cointegration and Causality	HLM Hypothesis is valid in the Türkiye.
Khan & Pradhan (2022)	1981– 2018	ARDL	HLM Hypothesis is valid in Bangladesh
Singh (2023)	1950– 2018	ARDL and ECM	The terms of Trade, financial development, trade openness, and domestic investment have positive and significant long-run effects on economic growth.
Trofimov & Aris (2024)	1980–2018	Panel Cointegration, ARDL and VAR	The findings support the positive effects of exports on savings in a specific period and across regions. Therefore, the hypothesis is valid under certain conditions.

Haynes & Stone (1982) revisited the M-S evidence and found that the deterioration in the terms of trade during the period 1955-1974 did not lead to an improvement in the US trade balance. Building on this, subsequent studies by Backus et al. (1994), Mendoza (1995), and Kouassi (1997) attempted to elucidate the Harberger-Laursen-Metzler (HLM) hypothesis, examining how it interacts with the foreign trade structure and technology, regardless of the duration of shocks, be they short-term or sustained.

Research conducted on both developed and developing countries, as demonstrated by Masson et al. (1998), has yielded nuanced findings, suggesting that the relationship between the terms of trade and the balance of trade varies across different national contexts. For instance, Panal VAR analysis conducted by Masson et al. (1998) for industrialized countries spanning the period 1971-1993, and developing countries from 1982 to 1993, revealed that while the HLM hypothesis holds true for industrialized nations, it does not exert a significant influence on the trade dynamics of developing countries.

Adler et al., (2018) made a different contribution to the literature by discussing the periods 1960-2015 in their study published in 2018. The focus of the discussion, which started with the assumption that the rise in exchange rates will create a strong buffer effect, has recently started a discussion on how the fall in commodity prices has created a shock effect on the terms of trade and what effect this effect has on the economy. In their studies, the focus of the study is on the questions that the fluctuation in the terms of trade will cause a noticeable reaction in the current accounts of commodity exporters and importers, but that price differences can be balanced by quantity adjustment and this will bring a limitation in the current account.

According to the empirical findings reached by the use of modern time series techniques, the terms of trade and the balance of trade gave different results in each country.

The literature review summarizes a range of studies analyzing the Harberger-Laursen-Metzler (HLM) hypothesis and its validity across different contexts. Key findings from the literature are:

2.1. Validation of HLM Hypothesis

Several studies confirm the validity of the HLM hypothesis in various countries and contexts, including Türkiye (Oktar & Dalyancı, 2012; Tekgül, 2017; Okyay & Unal, 2018; Akbulut-Bekar, 2021), Bangladesh (Khan & Pradhan, 2022), and Poland (Mitzal, 2010). Contradictions and Limitations: Some studies, such as those by Lukáčik et al. (2016) and Hicham (2019), find the HLM hypothesis invalid in specific economies or contexts, suggesting that its applicability may vary. Effect of Terms of Trade: Other studies highlight a nuanced relationship between terms of trade and economic indicators. For instance, Murshed (2018) identifies a non-linear relationship between terms of trade and current account movements, while Singh (2023) confirms positive long-term effects of terms of trade, financial development, trade openness, and domestic investment on economic growth. Sector-Specific and Regional Insights: Trofimov & Aris (2024) find that exports positively affect savings under certain conditions, pointing to a more conditional validation of the HLM hypothesis. Methodological Approaches:

Various methodologies, including VAR, SVAR, ARDL, and cointegration techniques, are employed to test the HLM hypothesis, with differing results depending on the approach and sample period.

2.2. Differences from Previous Studies and Literature Gaps

Differences from Previous Studies: Contextual Focus: This study specifically examines Türkiye's trade balance from 2013 to 2023, considering both the volume and unit value of terms of trade. This focused approach helps address the significant trade deficit issues faced by Türkiye, providing new insights into how terms of trade impact long-term trade balance. Unidirectional Causality: The study finds that terms of trade are a Granger cause of the trade balance, with short-term deviations corrected within approximately three months. This provides a clearer understanding of the causality direction in Türkiye, which may differ from findings in other countries.

Literature Gaps: Sector-Specific Analysis: Previous studies often provide broad findings or focus on aggregate indices of terms of trade. This study's consideration of both the volume and unit value of terms of trade may address gaps in sector-specific analysis and offer more detailed insights into how these factors influence the trade balance. Long-Term Dynamics: Many studies focus on shorter time periods or specific structural breaks. This study's extended time frame (2013-2023) and focus on Türkiye's trade deficit issues provide valuable long-term insights that are not fully explored in existing literature.

In summary, this study extends the understanding of the HLM hypothesis by focusing on Türkiye's recent economic context, examining the specific impacts of terms of trade on the trade balance, and addressing gaps in sector-specific and long-term analysis.

3. ECONOMETRIC METHOD AND DATA

ARDL model has short-term and long-term dynamics (Moosa, 2017). Pesaran et al. (2001) the ARDL Model consists of 3 stages. Unconstrained ARDL Model Pesaran & Shin (1999) and Pesaran et al. According to (2001) it is as in the following equation.

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{m} \delta_i \Delta X_{t-i} + \varphi_1 Y_{t-1} + \varphi_2 X_{t-1} + u_t \quad (11)$$

In the equation (11), the long-run coefficients are: φ_1, φ_2; short-run coefficients: β_i , δ_i; error (White noise) term: expressed as u_t. Hypotheses for testing the cointegration relationship:

$H_0 = \beta_0 = \beta_1 = 0$ There is no cointegration.

$H_1 \neq \beta_0 \neq \beta_1 \neq 0$ There is cointegration.

If the existence of cointegration is proven as a result of the established ARDL model, long-term analysis can be started for the variables, which is the second stage. Then, the direction and elasticity of the relationship between the variables are determined by estimating the long-term and short-term coefficients. The equation (12) created for the Long-Term Analysis:

$$Y_t = \beta_0 + \sum_{i=1}^{m} \beta_i Y_{t-i} + \sum_{i=0}^{m} \delta_i X_{t-i} + u_t \quad (12)$$

After estimating the long-term coefficients, the next step is to estimate the short-term coefficients.

Short-Term Error Correction Model (EC):

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{m} \delta_i \Delta X_{t-i} + \varphi EC_{t-1} + u_t \quad (13)$$

By finding the ARDL error correction coefficient (φ) CointEq(-1), it will be examined how many of the short-term shocks in the independent variable will stabilize in the long-term. The coefficient is expected to be negative and statistically significant.

If the existence of cointegration is proven, causality analysis is performed to predict the direction of the variables. This confirms that when two or more time series are integrated together, there must be bidirectional or unidirectional Granger causality between them (Awe, 2012).

According to Granger (1969), given the two-time series variables X_t and Y_t, X_t can be compared to Y_t if $Y_t$can be better predicted using the historical values of both X_t and Y_t than using only the past values of Y_t. It is said to

cause. The economic indicators chosen as the subject of the research were modeled as in the equations below using Pairwise-Granger causality analysis as suggested by Granger (1969).

$$Y_t = \sum_{i=1}^{m} a_i Y_{t-i} + \sum_{i=1}^{m} b_i X_{t-i} + u_{1t} \quad (14)$$

$$X_t = \sum_{i=1}^{m} c_i X_{t-i} + \sum_{i=1}^{m} d_i Y_{t-i} + u_{2t} \quad (15)$$

Granger Causality Analysis: a_i, b_i, c_i, d_i: delay coefficients, m: common delay degree for all variables, u_{1t} , u_{2t}: uncorrelated white noise processes (Granger, 1969:431).

The hypotheses tested are listed below:

H_0: Variable DTD is not Granger cause of variable DTH.

H_1: DTH variable is the Granger cause of DTD variable.

The data obtained for analysis are as follows:

Table 2. Explicit and Implicit Representation of Variables

DTH_b	Terms of Trade (Unit Value) 2013:M1-2023:M3	TURKSTAT
DTH_m	Terms of Trade (Volume) 2013:M1-2023:M3	TURKSTAT
DTD	Balance of Trade (Goods Trade Balance) 2013:M1-2023:M3	CBRT, EDVS

Export and import quantity and unit indices were obtained as monthly data from TURKSTAT, adjusted for seasonal and calendar effects. DTH amount as the ratio of export amount (prices) to import amount (prices); DTHm = $(Pxt / Pmt) * 100$ and DTH units; It was obtained as DTHb= $(Pxt / Pmt) * 100$. Balance of Trade: Goods Trade Balance (Million USD)-Level was obtained from EDDS (Electronic Data Distribution System). Eviews 10. The program seasonally adjusted with Tramo/Seats method (seasonal adjust (_SA).

The chosen time frame (2013-2023) was selected due to the significant changes that occurred in the Turkish economy and trade balance during this period. Various economic and political events that influenced Türkiye's trade terms and trade balance took place during this time. The reasons for selecting this time frame are outlined below:

Global Economic Conditions: Changes in global economic conditions after 2013 had significant impacts on the trade balances of developing countries. The global economic fluctuations during this period also affected Türkiye's external trade balance. Another reason for starting the analysis from 2013 is the impact of the Federal Reserve's initiation of the quantitative easing process on exchange rates. Additionally, the effects of the 2008 financial crisis had begun to wane by this period. Changes in the Turkish Economy: The period from 2013 to 2023 saw substantial structural changes and economic policies implemented in the Turkish economy. These changes have been decisive for the trade balance and trade terms. In particular, the currency crises and economic fluctuations starting from 2018 directly impacted Türkiye's external trade balance. Data Access and Timeliness: The accessibility and currency of data from the 2013-2023 period are crucial for the reliability of the analysis. The availability of adequate and current data for this period enhances the accuracy and reliability of the study.

For these reasons, the period from 2013 to 2023 was chosen as a suitable timeframe to examine the effects on Türkiye's trade terms and trade balance. The economic, political, and structural changes during this period will enrich the study's findings and provide more meaningful results.

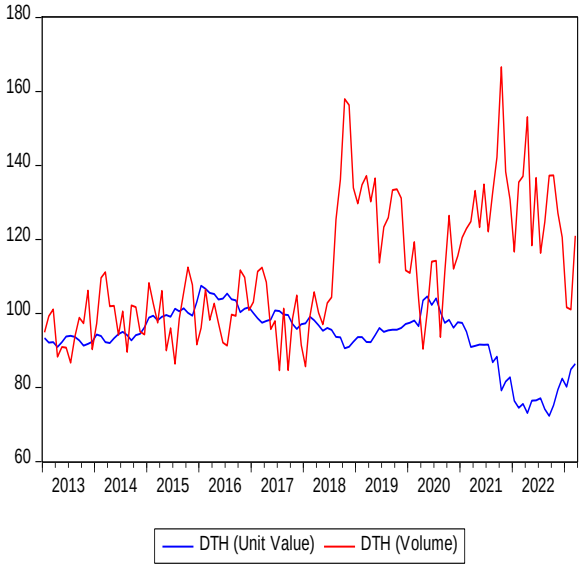


Figure 1. Time Path Chart of Terms of Trade 2013:M1-2023:M3

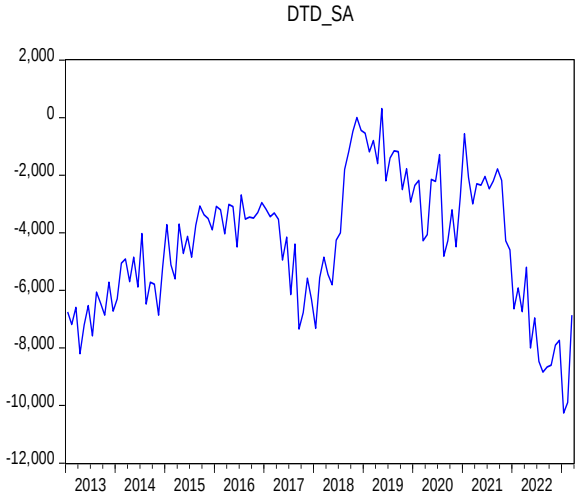


Figure 2. Balance of Trade ((Balance of Goods - Million USD)-Level) Seasonally Adjusted. 2013:M1-2023:M3.

As can be seen much more clearly from Figures 1 and 2, Türkiye exported more goods from the 2nd month of 2018 to the 3rd month of 2020. However, the same increase was not experienced in unit exports, on the contrary, there was a decrease. Later, this gap between the two data continued from the 8th month of 2020 to the 3rd month of 2023. Other conditions being equal, as long as the increase in export prices is less than the increase in import prices, the terms of trade will develop against the country. This difference between the two data means that goods are sold abroad both more and cheaper than before.

The estimated regression model (16) for the analysis is as follows:

Model $$DTD_t = \alpha_0 + \beta_0\, DTHm_t + \beta_1\, DTHb_t + \varepsilon_t \quad (16)$$

In the equation (16), the dependent variable in the Model, DTD_t; balance of trade, $DTHm_t$; terms of trade (volume), $DTHb_t$; terms of trade (unit), α; constant parameter, β; coefficient in front of the independent variables, ε_t; error term, t; shows the time. In the next section, the results of the analysis will be given.

Table 3. Summary Statistics

	DTD	DTHm	DTHb
Mean	-4390.572	111.2103	94.12791
Median	-4257.737	106.1994	95.44824
Maximum	316.4907	166.5848	107.5022
Minimum	-10262.22	84.64206	72.33722
Std. Dev.	2279.247	17.59797	7.882129
Skewness	-0.206849	0.744042	-1.074650
Kurtosis	2.447004	2.964583	3.795103
Jarque-Bera	2.444368	11.35520	26.91487
Probability	0.294586	0.003422	0.000001
Sum	-540040.3	13678.87	11577.73
Sum Sq. Dev.	6.34E+08	37782.00	7579.611
Observations	123	123	123

To summarize Table 3: Balance of Trade (DTH): Mean: The average trade balance is -4390.572, indicating a persistent trade deficit over the period. Median: The median value of -4257.737 is close to the mean, suggesting that the distribution of trade balance values is relatively symmetric around the mean. Maximum/Minimum: The range between the maximum (316.4907) and minimum (-10262.22) values highlights the substantial volatility in the trade balance. Std. Dev.: The standard deviation of 2279.247 indicates significant variability in the trade balance. Skewness: The negative skewness (-0.206849) suggests a slight leftward skew, indicating that extreme

negative values are more common. Kurtosis: The kurtosis value of 2.447004 is close to 3, indicating a distribution with tails that are somewhat heavier than the normal distribution. Jarque-Bera Test: The probability value of 0.294586 suggests that the distribution of trade balance values does not significantly deviate from normality.

Terms of Trade (DTHm): Mean: The average terms of trade is 111.2103, reflecting the average price level of DTHm over the period. Median: The median value of 106.1994 is close to the mean, indicating a relatively symmetric distribution. Maximum/Minimum: The range between the maximum (166.5848) and minimum (84.64206) values shows the variability in import prices. Std. Dev.: The standard deviation of 17.59797 indicates moderate variability in DTHm. Skewness: The positive skewness (0.744042) indicates a rightward skew, suggesting that higher values of terms of trade are more common. Kurtosis: The kurtosis value of 2.964583 is slightly below 3, indicating that the distribution has slightly lighter tails than the normal distribution. Jarque-Bera Test: The probability value of 0.003422 indicates that the distribution of terms of trade significantly deviates from normality.

Terms of Trade (DTHb): Mean: The average export terms of trade is 94.12791, reflecting the average price level of DTHb over the period. Median: The median value of 95.44824 is close to the mean, suggesting a symmetric distribution around the mean. Maximum/Minimum: The range between the maximum (107.5022) and minimum (72.33722) values shows variability in DTHb. Std. Dev.: The standard deviation of 7.882129 indicates relatively low variability in export terms. Skewness: The negative skewness (-1.074650) indicates a leftward skew, suggesting that lower values of terms of trade are more common. Kurtosis: The kurtosis value of 3.795103 indicates heavier tails compared to the normal distribution. Jarque-Bera Test: The probability value of 0.000001 suggests that the distribution of terms of trade significantly deviates from normality.

Overall, the statistics reveal significant volatility and non-normal distributions for the trade balance and terms of trade measures, highlighting the need for further analysis to understand the underlying factors driving these variations.

Table 4. Correlation Matrix

	DTD	**DTHm**	**DTHb**
DTD	1	0.432146540919098	0.4406799816838101
DTHm	0.432146540919098	1	-0.5591462188464253
DTHb	0.4406799816838101	-0.5591462188464253	1

According to Table 4, DTD and DTHm: Correlation Coefficient: 0.4321. There is a moderate positive correlation between the DTD and DTHm. This suggests that as the DTHm increases, the balance of trade tends to improve, indicating a possible relationship where higher trade volumes are associated with better balances of trade.

DTD and DTHb: Correlation Coefficient: 0.4407. There is a moderate positive correlation between the DTD and DTHb. This implies that as the DTHb increases, the DTD also tends to improve. Similar to the previous correlation, this suggests that higher trade volumes (in unit terms) are linked with better trade balances.

Summary from the table, the balance of trade has a positive relationship with both measures of trade volume, indicating that improvements in trade volume are associated with better trade balances. These insights can help understand how changes in trade volume and unit values impact the trade balance and highlight areas for further investigation into the dynamics of trade volumes and their effects on economic indicators.

4. FINDINGS

For the analysis of the effect of terms of trade on the balance of trade for the economy of Türkiye between 2013:M1-2023:M3 periods, ARDL, autoregressive distributed lag, developed by Peseran et al., (2001), was applied. When the F statistical value calculated according to the ARDL Bounds test result is found to be less than the lower limit of the significance levels, H0 cannot be rejected, that is, there is no cointegration relationship; If the calculated F statistical value is greater than the upper limit of the significance levels, the alternative hypothesis is valid and we will have sufficient evidence to reject H0. Hypotheses for testing the cointegration relationship (Peseran et al., 2001):

$H_0 = \beta_1 = \beta_2 = 0$ There is no cointegration.

$H_1 \neq \beta_1 \neq \beta_2 \neq 0$ There is cointegration.

The econometric analysis was first started by performing unit root tests of the series. PP and ADF unit root tests were used for unit root testing. The Schwarz Information Criterion (SIC) was chosen for the test. Unit root results are given in Appendix 1.

According to the PP unit root analysis, the balance of trade is stationary at 10% and the terms of trade (unit) at 5%. The terms of trade (volume), on the other hand, contain a unit root at the level and are nonstationary, since the probability value of the t-statistics value is seen above the critical value of 0.10. When we look at the ADF unit root analysis, the level does not contain a unit root, since only the terms of trade (volume) probability value are seen below the critical value of 1%. Other variables are nonstationary at the level.

For the ARDL Model, the dependent variable must be I(1), and the explanatory variables must be I(0) or I(1). Unit Root Test results show that the data is suitable for the ARDL Model.

Model selection criteria are given in Figure 3 below.

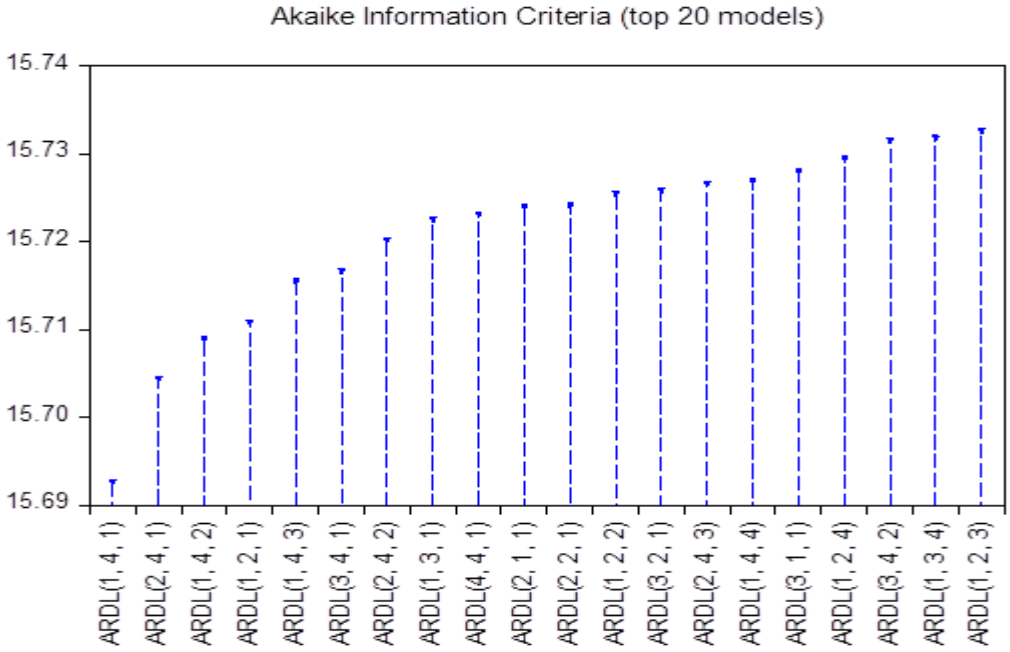


Figure 3. Model Selection Criteria

According to Figure 3, it was decided that the best model was ARDL (1,4,1). If the obtained F-statistic value is greater than the critical upper bound, it provides sufficient evidence for the existence of a co-integration relationship, leading to the rejection of the null hypothesis (H0). Conversely, if the F-statistic value is smaller than the critical lower bound, it indicates insufficient evidence for a co-integration relationship, resulting in the acceptance of the null hypothesis. In such cases, it is necessary to consider additional cointegration tests to verify the accuracy of the results (Peseran et al., 2001). This approach ensures a proper evaluation of the relationship among variables and enhances the reliability of the econometric model. The results of the bounds test related to the analysis are presented in Appendix 2. According to the data obtained from the table, the F-statistic has reached a value greater than the critical upper bound (6.172852). Table 5 provides the long-term coefficients derived from the analysis.

Table 5. ARDL (1,4,1) Model Long-Term Results

Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DTHm	140.9424	13.01868	10.82617	0.0000
DTHb	316.2277	25.32647	12.48605	0.0000
C	-49840.20	3496.521	-14.25422	0.0000
EC = DTD- (140.9424*DTHm + 316.2277*DTHb-49840.1973)				

According to the long-term results of the ARDL model, it has been determined that changes in the terms of trade have a positive and statistically significant effect on the trade balance. A one-unit increase in DTHm results in an average increase of $140,942 in the trade balance. Similarly, a one-unit increase in DTHb results in an average increase of $316,227 in the trade balance. The calculation of terms of trade based on both unit value and volume indicates that these results are based on a more robust and comprehensive analysis. These findings play a crucial role in shaping Türkiye's foreign trade policies and economic objectives.

The error correction model (ECM) is estimated in Table 6.

Table 6. ARDL (1,4,1) Model ECM

Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DTHm)	97.50568	5.469339	17.82769	0.0000
D(DTHm(-1))	-12.83866	5.634399	-2.278622	0.0246
D(DTHm(-2))	0.958215	5.563591	0.172230	0.8636
D(DTHm(-3))	12.84788	5.358170	2.397811	0.0182
D(DTHb)	235.9227	27.91643	8.451033	0.0000
CointEq(-1)*	-0.360766	0.071632	-5.036349	0.0000

*R- squared: 0.773308, Adjusted R-squared: 0.763277, Durbin-Watson stat: 2.116605, BG Serial Correlation LM Test: 0.792586 (F(2.108) probe: 0.4553), JB Normality Test: 0.318397 (0.852827), Heteroskedasticity test: BPG: 0.625389 (F(8,110) probe: 0.7549). * p-value incompatible with t-Bounds distribution.*

Tables summarizing ECM regression and F-Bounds Test and the diagnostic tests are presented in Appendices 3, 4, and 5. According to Appendix 4, there is no evidence of serial autocorrelation in the residuals. Appendix 5 indicates that there is no heteroscedasticity problem in the estimated model (p>0.01).

According to Table 6 above, there is a short-term relationship between the variables. According to CointEq(-1) value, the convergence process of short-term deviations to long-term value: $\frac{1}{\text{CointEq}(-1)} = 2.77$ It takes about three months (period). Therefore, an improvement in the terms of trade in Türkiye during the mentioned period causes an improvement in the balance of trade within three months. CUSUM and CUSUMSQ tests were used to test the stability of the ARDL (1,4,1) model and whether there is a periodic structural break in the variables.

Structural break tests for the ARDL (1,4,1) model:

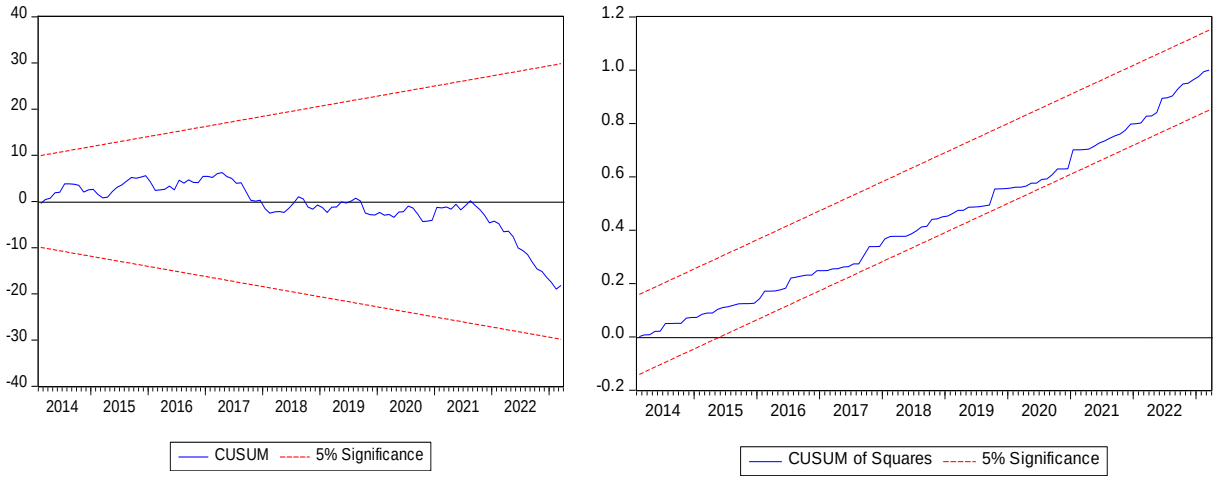


Figure 4. Charts of ARDL (1,4,1) CUSUM and CUSUMSQ

Figure 4. As a result of the CUSUM and CUSUMSQ tests, we cannot talk about the structural break problem as there is no deviation from the 5% range in both graphs except the specified areas. The model has been found to be consistent and statistically significant.

The causality test, which was introduced by Granger (1969) and later developed by Sims (1972), is based on the basic principle that "the use of past values of one variable increases the predictive performance of the other variable". The causality test results are given in Table 7.

Table 7. Pairwise Granger Causality Tests

Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
DTHm does not Granger Cause DTD	122	5.43438	0.0214
DTD does not Granger Cause DTHm		0.03505	0.8518
DTHb does not Granger Cause DTD	122	4.64824	0.0331
DTD does not Granger Cause DTHb		2.27033	0.1345

As a result of the causality test performed to test the causality relationship between the variables, it was understood that the terms of trade were the Granger cause of the balance of trade. Specifically, the analysis unveiled a positive and unidirectional causality, indicating that changes in the terms of trade significantly influenced the balance of

trade DTH→DTD. Thus, our findings furnish compelling evidence to reject the null hypothesis H_0, which posits the absence of a causality effect.

5. CONCLUSION

According to the empirical findings reached by the use of modern time series techniques, the terms of trade and the balance of trade gave different results in each country. The motivation of this study is to consider trade balances as independent variables in terms of both volume and unit value. Because this helps us better understand the causes and effects of changes in trade balances. The aim of the study is to analyze the effect of the changes in the terms of trade in Türkiye between the years 2013-2023 on the long-term balance of trade.

In this study, answers were sought to the following questions: How do changes in the terms of trade affect the trade balance in Türkiye between 2013 and 2023? Are there significant differences in the impacts of trade volume and trade unit value on the trade balance? What are the short-term and long-term effects of changes in the terms of trade on the trade balance? Does the HLM hypothesis hold true for Türkiye during the study period? What are the policy implications of these findings for managing trade deficits and ensuring economic stability in Türkiye?

Time Frame: The period covered by this study (2013-2023) is marked by specific economic and political events. The impact of these specific events (e.g., the 2018 currency crisis) may limit the generalizability of the results to other periods. The reason for starting the analysis from 2013 is the impact of the Federal Reserve's initiation of the quantitative easing process on exchange rates. Additionally, the effects of the 2008 financial crisis have also been ignored. Model Assumptions: The ARDL model and other econometric methods used in this study operate under certain assumptions. Violations of these assumptions may undermine the validity of the results. If the model assumptions are not met, the reliability of the findings may be compromised. Macroeconomic Factors: This study focuses on the relationship between terms of trade and the trade balance, excluding other macroeconomic factors (e.g., interest rates, exchange rates, political events). The omission of these factors may affect the analysis. Generalizability: The findings of this study, specific to Türkiye, cannot be directly generalized to other countries. The unique economic, political, and social dynamics of Türkiye limit the applicability of the results to other contexts.

Except for the terms of trade (volume) series, it has been proven that the other variables are stationary in difference according to the PP and ADF unit root tests. Accordingly, the ARDL model was the most suitable model for the analysis. According to the results of the analysis, the cointegration relationship has been proven. The long-run coefficients show us that a rise in the terms of trade (volume) will lead to a rise of $140,942 on the dependent variable. Similarly, a rise in the terms of trade (unit) will lead to a rise of about $316,227 in the dependent variable. Therefore, an effect of more than twice of DTHm (volume) increase comes from DTHb (unit). Calculating the terms of trade over unit value and volume has been important in this respect. In the economy of Türkiye, more goods were exported from the 2nd month of 2018 to the 3rd month of 2020 compared to the previous data time. However, the same increase was not experienced in unit exports, on the contrary, there was a decrease. Then, according to Figure 1, this gap between the two data continued from the 8th month of 2020 to the 3rd month of 2023. This difference between the two data means that export goods are sold abroad both more and cheaper than in the previous period.

According to the ECM, short-term fluctuations come to equilibrium in the long run. Therefore, the upswing in the terms of trade in the specified periods causes an upswing in the trade balance within three months. As a result of the causality test, it is understood that the terms of trade are the Granger cause of the balance of trade. Causality was found to be positive and unidirectional. There is evidence showing that the HLM hypothesis is accepted in the economy of Türkiye for the periods mentioned in this study. The findings of the study are supported by existing literature. For instance, Otto (2003), Strojny (2019), and Aquino & Espino (2013) provide support for the findings. Additionally, Oktar & Dalyancı (2012), Okyay & Unal (2018), Tekgül, (2017), and Akbulut-Bekar, (2021) indicate the validity of the HLM hypothesis in Türkiye. These results contribute significantly to understanding the dynamics of foreign trade and economic relations in Türkiye.

As a policy recommendation, long-term improvements in the balance of trade can be achieved through the expansion of foreign trade and high-value-added products. In addition, it is of great importance to preserve the value of the Lira and keep inflation under control in order to prevent deteriorations in the balance of trade. Future studies can explore the impact of terms of trade on the trade balance in more detail by examining specific sectors (agriculture, industry, and services). Additionally, more comprehensive time series analyses can be conducted to understand the changing dynamics of this relationship across different periods and under varying economic

conditions. Furthermore, there is a need for in-depth studies that assess the effects of policy recommendations, such as the expansion of foreign trade and the trade of high-value-added products, for policymakers.

AUTHORS' DECLARATION:

This paper complies with Research and Publication Ethics, has no conflict of interest to declare, and has received no financial support.

AUTHORS' CONTRIBUTIONS:

Conceptualization, writing-original draft, editing and data collection – **HK**, methodology and formal analysis – **MD**, Final Approval and Accountability – **SK**

REFERENCES

Adler, G., Magud, N. E., & Werner, A. (2018). Terms-of-trade cycles and external adjustment. *International Review of Economics & Finance*, *54*, 103-122.

Akbulut-Bekar, S. (2021). Türkiye'de Harberger-Laursen-Metzler yaklaşımının varlığı. *Dicle Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, (26), 156-170.

Aquino, J. C., & Espino, F. (2013). Terms of trade and current account fluctuations: A vector autoregression approach. *Central Reserve Bank of Peru Working Paper Series No*, *8*.

Ayad, H., & Belmokaddem, M. (2019). The effect of terms of trade on economic growth in Maghreb countries: Harberger-Laursen-Metzler effect for the period 1990-2017. *el-Bahith Review*, *19*(1), 563-576.

Backus, D. K., Kehoe, P. J., & Kydland, F. E. (1994). VDynamics of the trade balance and the terms of trade: The J&Curve. *V American Economic Review*, *84*(1), 84-103.

Deardorff, A. V. (2014). *Terms of trade: glossary of international economics*. World Scientific.

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: Journal of the Econometric Society*, 424-438.

Harberger, A. C. (1950). Currency depreciation, income, and the balance of trade. *Journal of political Economy*, *58*(1), 47-60.

Hicham, A. (2019). The effect of terms of trade on current account balance: Harberger-Laursen-Metzler effect in Arabic countries. *Journal of Smart Economic Growth*, *4*(1), 17-30.

İyibozkurt, M. E. (1975). Ödemeler bilançosu genel teorisi: Serbest piyasa, karma ekonomi ve planlı ekonomilerde. *Akademi: Bursa İktisadi ve Ticari İlimler Akademisi Dergisi*, *4*(2-3), 23-50.

Keynes, J. M. (1936), *The General theory of employment interest and money*, London: Macmillan.

Khan, M. G. U., & Pradhan, M. A. H. (2022). How do the terms of trade influence economic growth? Empirical evidence from Bangladesh. *International Journal of Sustainable Economy*, *14*(3), 254-268.

Krugman, P., & Obstfeld, M. (2003). *International economics theory and policy*, Sixth Edition, Harper Collins College Publisher, New York.

Kouassi, E. (1997). Analyzing and simulating terms of trade shocks on ivorian macro-economic variables: An error corrected-var approach. *Studies in Economics and Econometrics*, *21*(1), 91-108.

Laursen, S., & Metzler, L. A. (1950). Flexible exchange rates and the theory of employment. *The Review of Economics and Statistics*, *32*(4), 281-299.

Murshed, M. (2018). The Harberger-Laursen-Metzler effect and dutch disease problem: Evidence from South and Southeast Asia. *Journal of Accounting, Finance and Economics*, *8*(1), 134-166.

Masson, P. R., Bayoumi, T., & Samiei, H. (1998). International evidence on the determinants of private saving. *The World Bank Economic Review, 12*(3), 483-501.

Mendoza, E. G. (1995). The terms of trade, the real exchange rate, and economic fluctuations. *International Economic Review*, 101-137.

McKinnon, R. (1989). The International gold standard 1879-1913. *Unpublished paper, Stanford University (May)*.

Obstfeld, M. (1982). Aggregate spending and the terms of trade: Is there a Laursen-Metzler effect?. *The Quarterly Journal of Economics*, *97*(2), 251-270.

Okyay, U., & Unal, A. E. (2018). Is Harberger-Laursen-Metzler hypothesıs valid in Turkey?. *Journal of Economics Finance and Accounting*, *5*(2), 152-159.

Otto, G. (2003). Terms of trade shocks and the balance of trade: There is a Harberger-Laursen-Metzler effect. *Journal of International Money and Finance*, *22*(2), 155-184.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326.

Shafiullah, M., Islam, F., & Navaratnam, R. (2020). The Harberger–Laursen–Metzler effect: Evidence from five SAARC countries. *Empirical Economics*, *58*, 1749-1777.

Singh, T. (2023). Do terms of trade affect economic growth? Robust evidence from India. *Economics of Transition and Institutional Change*, *31*(2), 491-521.

Sims, C. A. (1972). Money, income, and causality. *The American economic review*, *62*(4), 540-552.

Strojny, J. (2019). An assessment of Harberger-Laursen-Metzler effect in agribusiness sector in Poland. *Annals of Agricultural Economics and Rural Development*, *106*(1), 36-50.

Tekgül, Y. B. (2017). Harberger-Laursen-Metzler etkisi: Türkiye ekonomisi üzerine ekonometrik bir analiz. *Yönetim ve Ekonomi Dergisi*, *24*(2), 649-663.

Trofimov, I. D., & Aris, N. M. (2024). Do exports enhance savings in the developing economies? An analysis of Maizels' hypothesis. *Journal of Social and Economic Development*, *26*(1), 156-185.

APPENDİX

Appendix 1. Results of Unit Root

UNIT ROOT TEST TABLE (PP)				
		At Level		
		DTD	DTHb	DTHm
With Constant	t-Statistic	-2.6996	-1.2731	-3.4363
	Prob.	0.0770	0.6405	0.0115
		*	n0	**
With Constant & Trend	t-Statistic	-2.5911	-1.8924	-5.0044
	Prob.	0.2852	0.6524	0.0004
		n0	n0	***
Without Constant & Trend	t-Statistic	-1.0832	-0.4159	0.1407
	Prob.	0.2512	0.5316	0.7250
		n0	n0	n0
		At First Difference		
		d(DTD)	d(DTHb)	d(DTHm)

With Constant	t-Statistic	-16.6082	-11.2496	-23.2831
	Prob.	0.0000	0.0000	0.0000
		***	***	***
With Constant & Trend	t-Statistic	-16.2739	-11.2553	-24.2371
	Prob.	0.0000	0.0000	0.0000
		***	***	***
Without Constant & Trend	t-Statistic	-16.6834	-11.2914	-22.6286
	Prob.	0.0000	0.0000	0.0000
		***	***	***

UNIT ROOT TEST TABLE (ADF)

		At Level		
		DTD	DTHb	DTHm
With Constant	t-Statistic	-1.9380	-1.2965	-3.7730
	Prob.	0.3140	0.6298	0.0041
		n0	n0	***
With Constant & Trend	t-Statistic	-1.7717	-1.8976	-5.1086
	Prob.	0.7125	0.6497	0.0003
		n0	n0	***
Without Constant & Trend	t-Statistic	-0.7926	-0.4102	0.0480
	Prob.	0.3708	0.5338	0.6962
		n0	n0	n0
		At First Difference		
		d(DTD)	d(DTHb)	d(DTHm)
With Constant	t-Statistic	-15.9754	-11.2423	-9.6181
	Prob.	0.0000	0.0000	0.0000
		***	***	***
With Constant & Trend	t-Statistic	-16.0440	-11.2478	-9.5904
	Prob.	0.0000	0.0000	0.0000
		***	***	***
Without Constant & Trend	t-Statistic	-16.0444	-11.2839	-9.6504
	Prob.	0.0000	0.0000	0.0000
		***	***	***

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant

*MacKinnon (1996) one-sided p-values.

Appendix 2. Bounds Test

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.172852	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
Actual Sample Size	119		Finite Sample: n=80	
		10%	2.713	3.453
		5%	3.235	4.053
		1%	4.358	5.393

Appendix 3. ECM Regression and F-Bounds Test

ECM			
R-squared	0.773308	Mean dependent var	11.28261
Adjusted R-squared	0.763277	S.D. dependent var	1209.606
S.E. of regression	588.5233	Akaike info criterion	15.64221
Sum squared resid	39138639	Schwarz criterion	15.78234
Log likelihood	-924.7118	Hannan-Quinn criter.	15.69911
Durbin-Watson stat	2.116605		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.172852	10%	2.63	3.35
k	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5

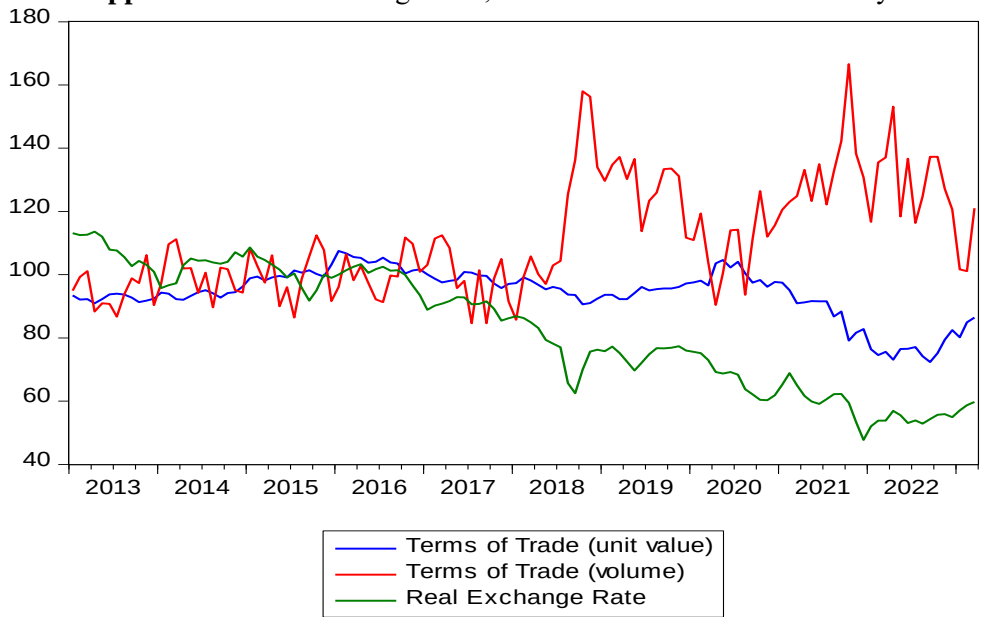
Appendix 4. Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	0.792586	Prob. F(2,108)	0.4553
Obs*R-squared	1.721360	Prob. Chi-Square(2)	0.4229

Appendix 5. Heteroskedasticity Test: Breusch-Pagan-Godfrey

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.625389	Prob. F(8,110)	0.7549
Obs*R-squared	5.176995	Prob. Chi-Square(8)	0.7385
Scaled explained SS	4.091795	Prob. Chi-Square(8)	0.8487

Appendix 6. Real Exchange Rate, and Terms of Trade in the Türkiye



Source: TURKSTAT, CBRT