THE EFFECTS OF MACROECONOMIC VARIABLES ON BANKS' LOANS TO THE LOGISTICS SECTOR: THE CASE OF TÜRKİYE

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Abstract

Globalization, developing technological advancements and digitalization have increased the importance of the logistics sector in global trade. An advanced logistics sector, which plays an important role in the development and therefore growth of countries, provides countries and companies with significant competitive power and can enable them to get a greater share of global trade. The fact that the capital needs of the capital-intensive logistics sector are largely met by banks raises questions about the sector's access to credit and the relationship between credits and macroeconomic variables. In this study, the effects of macroeconomic variables such as interest rates, inflation and exchange rates on the credits given by banks to the logistics sector (road passenger transport and road freight transport, sea transport and air transport sectors) in Türkiye were analyzed. The findings of the study are as follows: While exchange rate (USD/TR) and interest rate (net deposit-returns) variables have a positive impact on seafreight-loans, inflation (CPI) variable has a negative impact. Inflation (CPI) variable has statistically significant positive impacts on loans given by banks for road passenger transportation and road freight transportation.

Keywords: Logistics, Bank Loans, Exchange Rate, Interest Rate, Inflation

JEL Classification: F30, F40, N70, L91

MAKROEKONOMİK DEĞİŞKENLERİN BANKALARIN LOJİSTİK SEKTÖRÜNE VERDİĞİ KREDİLERE ETKİLERİ: TÜRKİYE ÖRNEĞİ

Özet

Küreselleşme, gelişen teknolojik gelişmeler ve dijitalleşme, lojistik sektörünün küresel ticaretteki önemini artırmıştır. Ülkelerin kalkınmasında ve dolayısıyla büyümesinde önemli rol oynayan gelişmiş bir lojistik sektörü, ülkeler ile şirketlere önemli rekabet gücü sağlamakta ve küresel ticaretten daha fazla pay almalarını sağlayabilmektedir. Sermaye yoğun lojistik sektörünün sermaye ihtiyaçlarının büyük ölçüde bankalar tarafından karşılanması, sektörün krediye erişimi ve krediler ile makroekonomik değişkenler arasındaki ilişki hakkında soruları gündeme getirmektedir. Bu çalışmada, Türkiye'de lojistik sektörüne (karayolu-yolcu taşımacılığı ve karayolu-yük taşımacılığı, deniz taşımacılığı ve hava taşımacılığı sektörleri) bankalar tarafından verilen krediler üzerinde faiz, enflasyon ve döviz kuru gibi makroekonomik değişkenlerin etkileri analiz edilmiştir. Çalışmanın bulguları: Döviz kuru (USD/TR) ve faiz oranı (net mevduat-getiri) değişkenleri deniz taşımacılığı kredileri üzerinde pozitif etkiye sahipken, enflasyon (TÜFE) değişkeni negatif etkiye sahiptir. Enflasyon (TÜFE) değişkeninin bankaların karayolu yolcu taşımacılığı ve karayolu yük taşımacılığına yönelik verdikleri krediler üzerinde istatistiksel olarak anlamlı pozitif etkisi bulunmaktadır.

Anahtar Kelimeler: Lojistik, Banka Kredileri, Döviz Kuru, Faiz Oranı, Enflasyon

JEL Sınıflandırması: F30, F40, N70, L91

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1. Introduction

In recent years, the momentum of global trade has slowed down, and the liberal trade order has been shaken by regional conflicts and increasing protectionist measures. On the other hand, interest in regional trade agreements has increased, trade networks have expanded through trade corridors, and transportation and therefore logistics networks have become more prominent. In particular, the protectionist approaches of developed countries that prioritize their own economies not only limit global trade but also stress the supply chain. This approach continues with efforts to draw investments inward and thus position logistics and supply chain processes more flexible, resilient, and on the shore (re-shoring). This approach followed by developed countries shows that global production and supply chains are being restructured in order to reduce economic dependency on other developing countries, especially the emerging economies of Asia, to become self-sufficient in critical sectors, and to establish supply security.

Today, the importance of the logistics sector in the growth of world trade cannot be denied. In order for the global production and supply chain to function properly, the logistics network needs to function smoothly. Many studies have shown a positive relationship between transportation/logistics infrastructure and trade (Nordås and Piermartini, 2004; Behar et al. 2009; Jacks and Pendakur, 2010; Celbis et al. 2014; Bensassi et al. 2015). The reduction of customs tariffs and the reduction of barriers and obstacles to global trade have increased foreign trade and increased the interdependence of nations/countries. The improvement of logistics processes in time for the stable and smooth progress of global trade not only reduces costs but also offers opportunities for new markets and significantly affects the bilateral trade volume. This situation has strengthened the competitive positions of countries/companies that manage logistics and supply chains (Park, 2020). However, the majority of developing countries may lack integration into global production networks and value chains and offering their products to global markets (Hausman et al. 2013; Marti et al. 2014). In a globalizing world, the importance of logistics is becoming even more important in order to get a larger share of trade. In addition to producing the products in demand, it is possible to offer them to consumers in a competitive manner by establishing a strong logistics infrastructure, thereby making international trade and economic growth more sustainable.

In this context, the financing dimension of logistics, which is of critical importance for countries and therefore companies, is the subject of this study. Vehicles and equipment across various modes of transportation in logistics (sea, road, air, rail) require a large-scale financing need. Both in the world and in Türkiye, logistics companies largely meet the capital they

need from commercial banks. Especially in Türkiye, due to high interest rates, macroeconomic problems, increased credit costs, and growing uncertainties make it difficult for banks to provide loans, and this situation can negatively affect companies' investments by restricting access to credit.

The focus of this study is to address the effects of interest, inflation and exchange rates on loans provided by banks to the logistics sector (road, sea, air transportation) in Türkiye. Studies on this subject are quite limited. There are studies that generally focus on how macroeconomic factors affect the risks and costs of these loans. Increases in interest rates increase the costs of loans, which in turn reduces banks' willingness to provide loans. In Türkiye, interest rates remain high at certain periods due to macroeconomic conditions and high inflation rates. In inflationary periods, exchange rate fluctuations can pose a major risk, especially for companies engaged in international transportation. It is revealed that the increase in inflation in Türkiye, especially together with exchange rates, has an impact on banks' lending policies (Özen, et al. 2020).

In addition, sudden increases in exchange rates in import-dependent countries such as Türkiye can increase the costs of logistics companies and weaken their debt payment capacity. Therefore, increasing inflation and fluctuations in exchange rates can increase operational costs in the logistics sectr, which can reduce the profitability of companies and weaken their credit repayment capacity. Since there is a potential to negatively affect companies' investment and credit payment capacity, especially in the capital-intensive transportation sector, the impact of interest rate changes can make investments in the logistics sector difficult. This situation leads to an increase in borrowing costs in financial markets and makes it difficult for companies to access credit (Okay, 2002).

This study will contribute to the literature by addressing the effects of interest, inflation and exchange rates on the loans provided by banks to the logistics sector in Türkiye. The first part of this study is the introduction. The second part presents a literature review. General structure of logistics industry in Turkiye is explained in the third part. The fourth part provides data and anaysis, and the fifth part covers the findings of the research. The last part concludes the study.

2. Literature Review

Logistics functions as a key driver of economic growth by integrating resources and markets, thereby facilitating the expansion and deepening of trade. The increase in global trade and the development of countries affect logistics, and therefore the development of the logistics infrastructure can have a decisive effect on the economic development and growth of countries (Chu, 2012; Lean et al., 2014; Murphy and Knemeyer, 2018). Macroeconomic variables particularly GDP levels and inflows of foreign direct investment are frequently emphasized in the literature as key determinants of logistics performance. Indeed, the development of transportation and logistics infrastructure plays a critical role in shaping investor preferences and supporting long-term economic growth (Saidi et al. 2020).

It is important to provide the financing needs of the sector in order to make the logistics sector competitive and sustainable. The logistics sector, which has a high capital requirement, creates high costs for both infrastructure investments and operational investments. In this sense, the financing dimension of logistics is the issue that this study focuses on. Logistics-supply chain finance is also considered trade finance, theoretically, a well-developed financial system can provide a competitive advantage in sectors that are more dependent on external financing (Kletzer and Bardhan, 1987). As a concept that expresses the integration of the supply chain and the financial ecosystem, logistics financing aims to integrate financial flows with the physical supply chain (Zhou et al. 2022).

Similarly, it has been shown that there is a link between the level of financial development and international trade, with economies with more developed financial system having a comparative advantage (Beck, 2002). The financing aspect of the supply chain, in relation to trade, also plays an important role in terms of both serving the real economy and helping the financing of SMEs (Du et al. 2020).

While the development of modern logistics requires the support of financial markets, the financial dimension of logistics can also create a large market demand alongside the development of the national economy (Fang et al. 2007). In fact, the lack of financial support can negatively affect the efficiency of the logistics sector. The rapid development of logistics financing can provide the opportunity for new businesses to emerge through cooperation between the logistics and banking sectors (Fang et al. 2007; Du and Liang, 2011). Logistics financing increases the operational efficiency of companies while also improving corporate financing processes. In this respect, logistics financing supports companies in meeting their

capital needs and enables them to continue their operations, necessitating careful management of risks (Yan et al. 2023).

Therefore, financing allows the sector to manage its capital flow more effectively and improves operational efficiency. However, logistics financing encourages strategic collaborations to reduce risks, as companies can reduce financing costs and improve risk management by cooperating (Moretto et al. 2019). It can help develop scalable and high value-added services in order to provide better services to the logistics sector through financial services and to increase its competitiveness and profit (Du and Liang, 2011).

The strength of the financial aspect of logistics can also affect the costs of the sector and therefore its competitiveness. A study shows that while logistics costs constitute 18% of total sales costs in China (Shanghai), while this rate is 5% in the US and the underlying issue (logistics cost) is the financing dimension (Fang et al. 2007). On the other hand, governments' support for environmentally friendly logistics practices, via financial incentives, tax reductions and regulations, the sector is encouraged to take a greener approach (Bui et al. 2024).

A study that examines the relationship between interest rates and banks' lending behavior analyzes how interest rates affect loans, especially to the transportation sector, and shows that bank regulation can be asymmetric depending on the trade-off between costs and benefits (Thamae and Odhiambo, 2022). A study has shown that during periods when interest rates are high, rising credit costs reduce banks' willingness to lend, which causes companies to have difficulty financing their investments and, therefore, their investments decrease, causing economic growth to slow down (Nkusu, 2003). The negative impact on banks’ appetite for lending makes it difficult for companies in the logistics sector to access capital. This situation can negatively affect the growth and operational sustainability of companies by increasing investment costs in the sector. According to a study examining the effect of interest rates on credit risk in the logistics and maritime sectors, credit costs increase as interest rates rise, weakening companies’ debt payment capacities (Woo et al. 2021). Here, especially in the maritime transport (ships) and air transport (planes) sectors, due to the large scale of investments, interest rate fluctuations can affect long-term capital investments. Therefore, the increase in credit costs due to interest rates creates a higher default risk in the logistics sector, and in periods of low interest rates, expansion in the sector can be encouraged if banks provide more credit.

Studies on the effects of inflation on loans given to the logistics sector are limited. Studies usually evaluate the effects of macroeconomic factors. Inflation affects both the credit quality of banks and the debt payment capacity of companies. An increase in inflation can reduce the profitability of logistics companies by increasing their operational costs, which can negatively affect the loan repayment performance of companies. A study shows that high inflation has a negative impact on the financial sector, particularly on bank performance, and although empirical findings are mixed, the majority indicate a negative relationship (Huybens and Smith, 1999; Boyd et al. 2001; Umar et al. 2014). Here, high inflation, such as high interest rates, increases credit risk and reduces banks' appetite for lending. In studies examining the effects of macroeconomic factors such as inflation on banks' lending behavior, inflation negatively affects the quality of banks' credit portfolios, creates difficulties in repayments, and increases the risk of default (Jakubik and Kadioglu, 2022; Moussa et al. 2021; Ahmed et al. 2021).

In studies examining the impact of exchange rate fluctuations on firms' borrowing behavior, it has been found that the cost of firms borrowing in foreign currency increases during periods when local currencies lose value, increasing credit risk (Kim, 2019; Shim et al. 2020). In addition, when firms face exchange rate uncertainty, they may have difficulty in repaying their debts, and banks may be more cautious about providing loans due to this risk. A study examining the effects of exchange rate movements on bank credit supply shows that when banks have assets in foreign currency, they are more affected by exchange rate movements, and therefore credit supply is directly affected (Beck et al. 2022). Therefore, sudden changes in exchange rates can increase the cost of finding credit, especially for logistics companies based on foreign trade, and can weaken their debt payment capacity and increase credit risks.

Table 1. A Review of the Literature

Author	Year	*Journal* / Article	Finding(s)
Beck, 2002	2002	*Journal of international Economics Financial* / Development and International Trade: Is There a Link?	The degree of financial system development is positively associated with international trade performance, as financially advanced economies tend to exhibit greater comparative advantages in global markets.
Nkusu, 2003	2003	*International Monetary Fund* / Interest Rates, Credit Rationing, and Investment in Developing Countries	High interest rates increase borrowing costs, which in turn constrain banks' lending capacity, hinder firms' access to finance, and ultimately suppress investment and economic expansion.
Fang, Songdong and Chunguang (Fang et al. 2007).	2007	*2007 International Conference on Service Systems and Service Management* /Collaborative Analysis on Modern Logistics and Finance	The integration of financial mechanisms within logistics systems holds the potential to stimulate substantial market demand while concurrently contributing to broader national economic development
Du and Liang, 2011.	2011	*2011 International Conference of Information Technology, Computer Engineering and Management Sciences* / Research on Mechanism and Operation Model of Logistics Finance	The accelerated advancement of logistics finance has the capacity to foster employment opportunities by facilitating synergies between the logistics industry and the banking sector.
Huybens and Smith, 1999.	1999	*Journal of Monetary Economics*/ Inflation, financial markets and long-run real activity	High inflation negatively affects bank performance.
Boyd, Levine and Smith, 2001	2001	*Journal of Monetary Economics*/ The impact of inflation on financial sector performance	
Umar, Maijama'a and Adamu (Umar et al. 2014)	2014	*Journal of World Economic Research* / Conceptual Exposition of The Effect of Inflation on Bank Performance	
Kim, 2019	2019	*International Monetary Fund* / Financial Development, Exchange Rate Fluctuations and Debt Dollarization: A Firm-Level Evidence,	Studies assessing the influence of exchange rate fluctuations on firms' financing decisions demonstrate that periods of local currency depreciation significantly increase the cost of external borrowing and exacerbate firms' credit risk exposure
Shim, Kalemli-Ozcan and Liu (Shim et al. 2020).	2020	*International Monetary Fund* / Exchange Rate Fluctuations and Firm Leverage	
Du, Chen, Xiao, Yang and Ma, (Du et al. 2020)	2020	*IEEE Transactions on Engineering Management* / Supply Chain Finance Innovation Using Blockchai	The financial pillar of supply chain operations plays a pivotal role not only in supporting the functioning of the real economy but also in enhancing access to finance for small and medium-sized enterprises.
Özen, Özdemir and Grima (2020).	2020	*Scientific Annals of Economics and Business* / The Relationship Between the Exchange Rate, Interest Rate, and Inflation: The Case of Turkey	Empirical evidence suggests that the rise in inflation in Turkey particularly when accompanied by fluctuations in exchange rates significantly influences the credit allocation strategies and risk assessments of banking institutions

Table 1. A Review of the Literature (Continue)

Author	**Year**	***Journal* / Article**	**Finding(s)**
Woo, Kwon and Yuen (Woo et al. 2021)	2021	*Maritime Economics & Logistics* / Financial Determinants of Credit Risk in The Logistics and Shipping İndustries	Empirical research on the impact of interest rates on credit risk in the logistics and maritime sectors suggests that rising interest rates elevate borrowing costs, thereby eroding firms' debt-servicing capacity.
Ahmed, S., Majeed, M. E., Thalassinos, E., and Thalassinos (Ahmed et al. 2021)	2021	*Journal of Risk and Financial Management* / The Impact of Bank Specific and Macro-Economic Factors on Non-Performing Loans in the Banking Sector: Evidence from an Emerging Economy	Empirical studies investigating the impact of macroeconomic variables -particularly inflation- on bank lending behaviour reveal that rising inflation deteriorates credit portfolio quality, hampers repayment capacity, and elevates default risk.
Moussa et al. 2021	2021	*European Journal of Business and Management* / The Impact of Inflation on Bank Financial Performance: Case of Tunisia	
Jakubik and Kadioglu, 2022.	2022	*International Economics and Economic Policy* / Factors Affecting Bank Loan Quality: A Panel Analysis of Emerging Markets	
Thamae and Odhiambo, 2022	2022	*Journal of Banking Regulation* / The Impact of Bank Regulation on Bank Lending: A Review of International Literature	Fluctuations in interest rates significantly affect banks' lending patterns to the transportation sector, and regulatory behaviour may respond asymmetrically depending on perceived economic trade-offs
Beck, Bednarek, Kaat and Westernhagen (Beck et al. 2022).	2022	*CEPR* / The Real Effects of Exchange Rate Depreciation: The Role of Bank Loan Supply	Research analysing the impact of exchange rate fluctuations on bank credit supply suggests that banks with significant foreign currency-denominated assets are more vulnerable to currency volatility, which in turn directly constrains their lending capacity.
Zhou, Chen and Lee (Zhou et al. 2022)	2022	*Sustainability* / Supply Chain Finance: A Research Review and Prospects Based on a Systematic Literature Analysis from a Financial Ecology Perspective	Logistics finance refers to the convergence of supply chain operations and financial systems, aiming to align financial flows with the physical movement of goods to enhance overall value creation and efficiency
Yan, You and Wang (Yan et al. 2023).	2023	*Journal of Innovation and Development* / Overview of Logistics Finance Theories	Logistics financing ensures operational continuity by addressing capital needs, while demanding effective risk management.
Bui, Chan, Do, Nguyen, Lim and Tseng (Bui et al. 2024).	2024	*International Journal of Logistics Research and Applications* / Green Supply Chain Finance Model in Logistics and Transportation Industry: Improving from Policies and Regulation and Financial Digitalisation Practices	Public sector incentives aimed at promoting environmentally sustainable logistics practices play a pivotal role in steering the industry toward more eco-conscious operational strategies.

3. Logistics Sector and Financial Status in Türkiye

Türkiye is a country with high potential in terms of the logistics sector due to its location. The country's geopolitical location, transportation infrastructure, and its production and consumption dynmics play a significant role in the sector's prominence. The share of logistics and transportation sector in Türkiye's exports has increased over the years. Türkiye aims to get a larger share of global trade with its major investments in transportation and logistics infrastructure. For this purpose, the Twelfth Development Plan (2024-2028), under the sub-heading of logistics and transportation, sets the following objectives (SBB, 2024):

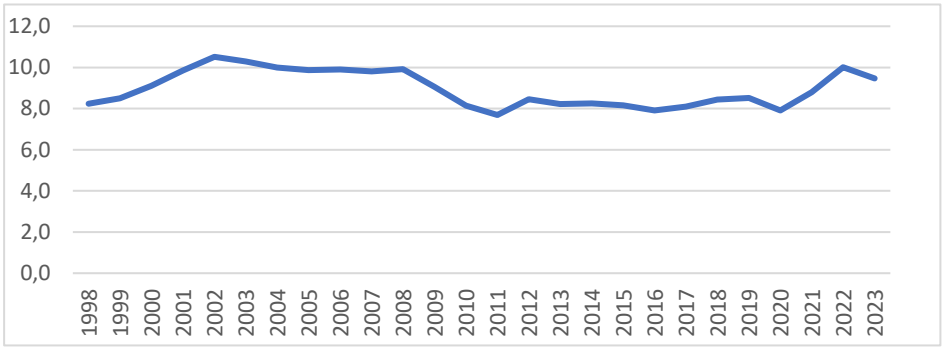
> The main objective is to develop inter-modal and multimodal transportation practices; to establish a safe, accessible, holistic, environmentally friendly, and cost-effective transportation system; and to maximize the utilization of our potential to become a regional hub in transportation and logistics by creating infrastructure that supports competitive production and exports.

In this context, as emphasized in Türkiye's development plan, the claim and potential to be a regional base in the logistics sector is being revealed. This importance is also seen in the public investments given to the logistics sector. According to the public investment program in 2023, the transportation and communication sector ranked first as the area with the most investment with 26.8%, and this rate increased to 32% in 2024 (SBB, 2023; Investment Office, 2024). In the sectoral distribution of public investments between 2002 and 2023, the transportation sector ranked first as the sector with the highest share. Investments in logistics bases, transfer centers, transportation corridors, airports, ports and organized industrial zones come to the fore in this context. Türkiye's intercontinental location and being a transit corridor show that it has the potential to become one of the world's most important logistics centers. The country's strategic location connecting three continents, its proximity to highways and development, being surrounded by seas on three sides, having important ports and its developed infrastructure make it an important player in the country's logistics sector.

The projects and initiatives that Türkiye has recently implemented are important in this respect. The Middle Corridor, of which the country is part of ensuring uninterrupted freight transportation between Asia and Europe, the Baku-Tbilisi-Kars Railway Line and the implementation of Marmaray projects are major projects. The opening of 12 logistics centers in places such as Gelemen (Samsun), Köseköy (İzmit), Halkalı (Istanbul), Türkoğlu (Kahramanmaraş), Kars, and the efforts to put 11 more centers into service are evaluated

within this scope (TCDD, 2023). It is aimed to establish an uninterrupted supply chain network by integrating different transportation modes with logistics centers established in strategic locations. In addition, Türkiye, which claims to be a regional hub with the new Istanbul airport, can reach the centers of 67 countries with a trade volume of 8.6 trillion dollars on three continents with a 4-hour flight time (Raillynews, 2024). Türkiye, which has a high potential to be a transit point in aviation, has increased the number of airports from 26 to 57, the number of countries with which it has an Air Transport Agreement from 81 to 173, and has reached 346 points in 130 countries in terms of international lines (Raillynews, 2024).

Figure 1. Logistics (Transport and Storage) Share in GDP (Turkiye)



Source: TUIK (Turkish Statistical Institute)

The share of the logistics sector in national income fluctuates over the years, but is around 10% on average (Figure 1). While the share of the sector increases in periods of high growth in Türkiye, it is seen to move in parallel with growth in periods of crisis and stagnation. The logistics sector is the third sector with the largest share of national income after the manufacturing industry and wholesale and retail trade, with a share of 9.5% in 2023 (TUIK, 2023a). According to Türkiye's transportation modes, maritime transportation ranks first in foreign trade data, followed by road, railway and air (Table 2). More than half of foreign trade (55%) is carried out by sea, while the share of road transportation is between 20-30%, air transportation 10-15% and railway transportation approximately 1%.

Table 2. Foreign Trade in Türkiye by Transportation Types

Transport Types	Export			Import		
	2019	**2021**	**2023**	**2019**	**2021**	**2023**
Road (million USD)	54.461	68.749	83.235	37.177	48.896	66.942
Share	%30,1	%30,5	%32,5	%17,7	%18	%18,5
Maritime (million USD)	109.114	133.714	143.358	112.967	157.390	195.172
Share	%60,3	%59,4	%56	%53,7	%58	%53,9
Rail (million USD)	971	1.648	1.960	1.447	2.891	1.996
Share	%0,5	%0,7	%0,7	%0,7	%1,1	%0,5
Air (million USD)	14.849	18.735	25.511	29.238	26.057	53.840
Share	%8,2	%8,3	%9,6	%13,9	%9,6	%14,8
Other (million USD)*	1.436	2.366	1.710	29.514	36.189	43.821
Share	%0,8	%1,1	%0,6	%14	%13,3	%12,1
Total	180.832	225.214	255.777	210.345	271.425	361.774

Source: Ministry of Trade *This includes pipeline, postal services, electric power transmission and self-propelled vehicles

The logistics sector, which has an important position within the services sector, also draws attention in this respect. Türkiye's international trade in services, excluding travel, is 98 billion dollars in total, with exports of 56.5 billion dollars and imports of 41.1 billion dollars, and the sector has a surplus of 15.1 billion dollars (TUIK, 2023b). Logistics (transportation services), which has the largest share in service exports, has a 69% share with 38.9 billion dollars, and a 44.7% share with 18.5 billion dollars in imports. In this context, logistics services have a current surplus of 20.4 billion dollars.

According to the characteristics of Türkiye's enterprises, international service trade provides important ideas about the foreign exchange income of the logistics sector. The characteristics of enterprises engaged in international service trade are revealed by matching the data of international service trade statistics (According to International Trade in Services Statistics travel excluded) with structural business statistics and foreign-controlled enterprise statistics. According to the data of statistics on Services Trade by Enterprise Characteristics (STEC), in 2021, service exports were 34.7 billion dollars and imports were 28.4 billion dollars, totaling approximately 63 billion. While 68% of service exports are carried out by enterprises in logistics (transportation and storage) activities, 32% of imports are made by enterprises in this sector (TUIK, 2021). Logistics enterprises create a current surplus of approximately 20 billion dollars. Meanwhile, foreign-controlled enterprises make 18.3% of

service exports and 32.6% of imports, while logistics (transportation services), which has the highest share, is carried out by Turkish-controlled enterprises with high rates of 90% in exports and 85% in imports (TUIK, 2021).

Today, the most developed places/regions in the world in terms of global trade have a common feature that they have a developed logistics infrastructure. Countries that are aware of their logistics infrastructure make significant investments in this area and ensure that the sector has a developed distribution network. In this context, the World Bank has been showing the current status of countries with the Logistics Performance Index (LPI) published since 2007. At the same time, the index evaluates and scores the logistics activities of countries both internationally and nationally. In this way, it allows for a comprehensive evaluation of the logistics performance of countries and comparison with other countries.

Table 3. Top 10 Countries, Logistics Performance Index

	LOGISTICS PERFORMANCE INDEX - LPI						
No	2023	2018	2016	2014	2012	2010	2007
1	Singapore	Germany	Germany	Germany	Singapore	Germany	Singapur
2	Finland	Sweden	Luxembourg	Netherlands	Hong Kong SAR, China	Singapore	Netherlands
3	Denmark	Belgium	Sweden	Belgium	Finland	Sweden	Germany
4	Germany	Austria	Netherlands	United Kingdom	Germany	Netherlands	Sweden
5	Netherlands	Japan	Singapore	Singapore	Netherlands	Luxembourg	Austria
6	Switzerland	Netherlands	Belgium	Sweden	Denmark	Switzerland	Japan
7	Austria	Singapore	Austria	Norway	Belgium	Japan	Switzerland
8	Belgium	Denmark	United Kingdom	Luxembourg	Japan	United Kingdom	Hong Kong SAR, China
9	Canada	United Kingdom	Hong Kong SAR, China	United States	United States	Belgium	United Kingdom
10	Hong Kong SAR, China	Finland	United States	Japan	United Kingdom	Norway	Canada

Source: World Bank, LPI.

When LPE is examined, it can be seen that it is among the top ten countries with a developed economy and a logistics infrastructure. Singapore is at the top of the list, followed by Finland, Denmark, Germany, the Netherlands, Switzerland, Austria, Belgium, Canada and Hong Kong (World Bank, 2023). According to the index results published to date, the performance of the European Union countries, the USA, Singapore and Hong Kong stands out (Table 3). The index is a strong indicator in terms of comparing the performance of countries in the field of global.

Table 4. Türkiye LPI

Logistics Performance Index	LPI 2023		LPI 2018		LPI 2014		LPI 2010		LPI 2007	
	Rank	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
Customs	47	3,00	58	2,71	34	3,23	46	2,82	33	3,00
Infrastructure	43	3,40	33	3,21	27	3,53	39	3,08	39	2,94
International Shipments	26	3,40	53	3,06	48	3,18	44	3,15	41	3,07
Logistics Competence and Quality	38	3,50	51	3,05	22	3,64	37	3,23	30	3,29
Tracking and Tracing	37	3,50	42	3,23	19	3,77	56	3,09	34	3,27
Timeliness	335	3,60	44	3,63	41	3,68	31	3,94	52	3,38
LPI General	38	3,40	47	3,15	30	3,50	39	3,22	34	3,15

Source: World Bank. (2023). "Logistics Performance Index (LPI)".

The LPI values announced for countries are calculated by taking the weighted average of 6 subheadings: the effectiveness of customs processes, the quality of transportation infrastructure, the ease of international transportation, the competence of logistics services, the ease of tracking shipments and their timeliness (World Bank, 2023). The performance of countries that improve their logistics to gain competitive advantage in global trade positively affects their share in global trade. According to the LPI ranking, which shows Türkiye's status in the logistics field, it was ranked 34th among 150 countries with a score of 3.15 in 2007, and 38th among 139 countries with a score of 3.4 in 2023. (Table 4).

Financial ratios of companies operating in the logistics sector under transportation and storage are shown by the Central Bank of the Republic of Türkiye (Table 5). As can be seen from Table 4, logistic industry in Türkiye runs with relatively high leverage. Furthermore, half of the total loans of the industry are bank loans. This simply indicates that non-bank loans that are provided to this industry account for nearly half of the total loans throughout the years (from 2017 to 2023).

Table 5. Logistics Sector (Transporting and Storage) Financial Ratios

Financial Ratios	2017	2018	2019	2020	2021	2022	2023
Total Loans / Total Assets (Leverage Ratio) (%)	66,2	80,6	83,0	90,7	98,5	83,2	85,4
Shareholders Equity / Total Assets (%)	33,8	19,5	17,0	9,3	1,5	16,8	14,7
Shareholders Equity / Total Loans (%)	64,4	40,7	37,1	27,2	18,3	37,7	35,3
Short-Term Bank Loans / Short-Term Liabilities (%)	27,1	27,5	22,7	37,3	35,9	26,1	22,4
Bank Loans / Total Loans (%)	49,1	54,1	52,1	54,6	52,6	40,2	38,5

Source: TCMB. (2024). "Introduces company accounts statistics".

Despite Türkiye's advantageous position in the logistics sector, the financial situation of companies operating in this sector affects their competitiveness. Türkiye's macroeconomic conditions make it difficult to provide financing to the sector. In this sense, the fluctuation of the exchange rate poses a risk to companies borrowing in foreign currency, high interest rates increase credit costs, and high inflation can increase costs and reduce profits. Türkiye's increasing foreign trade volume makes the logistics sector more important and increases demand for the sector. However, macroeconomic variables such as interest rates, exchange rates and inflation can directly affect the financing of the logistics sector. Because the loans provided by banks to the sector are related to these variables. In fact, macroeconomic instabilities can hinder access to credit.

4. Data and Methodology

4.1. Data

In this part, variables that are used in the econometric analysis are defined.

Table 6. Description of Variables

Variables	Description	Data Source	Period
DENIZ, YOLCU, YUK	Loans granted to Sea-Transport (DENİZ); Road-Passenger-Transport (KARAYOLU YOLCU) Road-Freight-Transport (KARAYOLU YUK TAŞIMACILIK), (Proxy for Sectoral Loans)	TBA (Turkish Banking Association)	Jan 2010-Dec 2023
MEV	TL-Deposit-Return-Index (Proxy of Interest Markets)	BIST (Borsa Istanbul)	Jan 2010-Dec 2023
USDTR	USD/TL Exchange Rate (Proxy for FX Markets)	CBRT (Central Bank of TR)	Jan 2010-Dec 2023
CPI	Consumer Price Index (Proxy for Inflation)	CBRT (Central Bank of TR)	Jan 2010-Dec 2023

4.2. Methodology

Considering the purpose of the research, analysing the data with appropriate methods; Auto-regressive Distributed Lag (ARDL), and diagnostic tests were performed.

4.2.1. Autoregressive Distributed Lag (ARDL) Approach

Engle and Granger (1987) and Johansen (1988; 1995) developed methodologies for the analysis of cointegration relationships in their studies These methodologies are especially important when the degree of integration of the variables is I(1). In this context, the Method of Fully Modified Least Squares (FMOLS) and the Method of Dynamic Least Squares (DOLS) require basic information and definitions when the variables are at I(0) and I(1) levels. Autoregressive Distributed Lag Model (ARDL), another method frequently used in cointegration studies, was developed by Pesaran and Shin (1999) and by Pesaran et al. (2001). The ARDL model can be adapted when the regressor variables are at I(0) and I(1) levels or at both levels. ARDL model is a regression model that includes lags of both dependent and independent variables. The model includes the number of lags of the explained variable p, the number of lags of the first independent variable, denoted as q_1, and the number of lags of the last independent variable, denoted as q_k.

$$y_t = \alpha + \sum_{i=1}^{p} \gamma_i y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_j} X_{j,t-i}' \beta_{j,i} + \varepsilon_t \quad (1)$$

An ARDL model has a structure that can be expressed using mathematical equations. In this structure, even without lag terms ($q_j = 0$), explanatory variables X_j are considered and fixed regressors can be used for static cases and variable regressors can be used for dynamic cases. There are commonly used methods for adjusting the parameters of the model and determining the lag lengths. The ARDL methodology can determine specific lag lengths for each explanatory variable, and these lag lengths are not necessarily symmetric; This situation was highlighted in Pesaran and Shin's study (1999). The estimation process of the model is carried out by the least squares method, and information criteria such as Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC) can be used during determination of model. In a cointegration ARDL model, the long-run coefficients can be calculated by transforming differences in Equation (1). Using these instead of long-run coefficients, the equation below is obtained:

$$\Delta y_t = -\sum_{i=1}^{p-1} \gamma_i^* \Delta y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{q_j-1} \Delta X_{j,t-i}' \beta_{j,i^*} - \widehat{\emptyset} EC_{t-1} + \varepsilon_t \quad (2)$$

The error correction(EC) term in Equation (2) is:

$$EC_t = y_t - \alpha - \sum_{j=1}^{k} X_{j,t}' \hat{\theta}_j \quad (3)$$

It is the OLS residual series extracted from the long-term cointegration regression expressed through the equation. This methodology, developed by Pesaran et al. (2001), defines a method for testing the long-term relationship between the dependent variable and independent variables in the ARDL model using Equation(2). In this approach, the existence of a stationary or long-term relationship between the variables in the model is investigated through the cointegration formulation. The bounds testing procedure gives Equation (2) converts it into a representation as:

$$\Delta y_t = -\sum_{i=1}^{p-1} \gamma_i^* \Delta y_{t-1} + \sum_{j=1}^{k} \sum_{i=0}^{q_j-1} \Delta X_{j,t-1}' \beta_{j,i}^* - \rho y_{t-1} - \alpha - \sum_{j=1}^{k} X_{j,t-1}' \delta_j + \varepsilon_t \quad (4)$$

In this context, testing the existence of relationships becomes a simple form with the expressions: ρ=0 and $\delta 1 = \delta 2 = \ldots\ldots = \delta k = 0$. The test statistic obtained from Equation (4) shows a distribution different from a standard distribution under the null hypothesis (absence of relationship) if all regressors are completely at the I(0) or I(1) level. With the method developed by Pesaran et al. (2001), the critical values determined for the cases I(0) and I(1) can serve as a limit for the complex cases of the regressors - both I(0) and I(1).

ARDL F-statistic is an approach used to evaluate whether a cointegration relationship exists, and two key critical values, namely upper and lower bounds, are used in the approach. If the F-statistic exceeds the upper limit of the determined statistical significance level, the absence of long-term relationship hypothesis is rejected and the existence of cointegration is accepted. However, if the F-statistic remains below the lower limit of the determined significance level, the hypothesis of no long-term relationship is accepted and it is concluded that there is no cointegration. If the F-statistic falls between these two critical values, the result cannot be determined with certainty and uncertainty remains. When cointegration is detected, the cointegration equation is calculated and the resulting long-term error term is added to the error correction model (ECM). This term is commonly known as the Error Correction Term (ECT), and the coefficient of this term indicates how quickly imbalances are corrected and therefore how strong the relationship is. If the F statistic remains between low and high critical values, that is, if it is in an uncertain situation, the error correction term is used as a critical tool in establishing cointegration relationships and analyzing the relationships between variables (Banerjee, et al. 1998).

The ARDL method was used as the main prediction model in this study. It has econometric advantages over traditional cointegration techniques. ARDL modeling can be used efficiently when time series are at I(0) or I(1) levels of integration; This allows the approach to be applied without dependence on the stationarity of the series, unlike other cointegration methods. This methodology can be used in the I(0) and I(1) cases, as long as none of the series is at the I(2) or higher level of integration, and thus is effective even under uncertainty of the order of integration of the variables (Singhal, et al. 2019). The ARDL model makes it possible for estimating both short- and long-run coefficients simultaneously, which reduces spurious regression problems when working with non-stationary series. In ARDL modeling, it is observed that there is no endogeneity problem in estimating both short- and long-term coefficients and lagged dependent and explanatory variables simultaneously (Vasudeva, et al. 2016). Through error correction modeling, the ARDL approach provides the opportunity to detect causal relationships in both the short and long term, which increases statistical strength and reduces measurement errors, especially when working with small samples. The estimation of the Research Models can be carried out using the Ordinary Least Squares (OLS) method and through Equation (5,6,7,8) below (ARDL Frontier approach):

$$\Delta LDENIZ_t = \alpha_0 + \alpha_1 LDENIZ_{t-1} + \alpha_2 \mathrm{LCPI}_{t-1} + \alpha_3 \mathrm{LMEV}_{t-1} + \alpha_4 LUSDTR_{t-1} + \sum_{i=1}^{p} \beta_{1i} \Delta \mathrm{LDENIZ}_{t-i} + \sum_{i=0}^{q_1} \beta_{2i} \Delta \mathrm{LCPI}_{t-i} + \sum_{i=0}^{q_2} \beta_{3i} \Delta \mathrm{LMEV}_{t-i} + \sum_{i=0}^{q_3} \beta_{4i} \Delta \mathrm{LUSDTR}_{t-i} + u_t \quad (5)$$

$$\Delta LYOLCU_t = \alpha_0 + \alpha_1 LYOLCU_{t-1} + \alpha_2 \mathrm{LCPI}_{t-1} + \alpha_3 \mathrm{LMEV}_{t-1} + \alpha_4 LUSDTR_{t-1} + \sum_{i=1}^{p} \beta_{1i} \Delta \mathrm{LYOLCU}_{t-i} + \sum_{i=0}^{q_1} \beta_{2i} \Delta \mathrm{LCPI}_{t-i} + \sum_{i=0}^{q_2} \beta_{3i} \Delta \mathrm{LMEV}_{t-i} + \sum_{i=0}^{q_3} \beta_{4i} \Delta \mathrm{LUSDTR}_{t-i} + u_t \quad (6)$$

$$\Delta LYUK_t = \alpha_0 + \alpha_1 LYUK_{t-1} + \alpha_2 \mathrm{LCPI}_{t-1} + \alpha_3 \mathrm{LMEV}_{t-1} + \alpha_4 LUSDTR_{t-1} + \sum_{i=1}^{p} \beta_{1i} \Delta \mathrm{LYUK}_{t-i} + \sum_{i=0}^{q_1} \beta_{2i} \Delta \mathrm{LCPI}_{t-i} + \sum_{i=0}^{q_2} \beta_{3i} \Delta \mathrm{LMEV}_{t-i} + \sum_{i=0}^{q_3} \beta_{4i} \Delta \mathrm{LUSDTR}_{t-i} + u_t \quad (7)$$

Equation (5) relates to the various parameters and operators used in the econometric modeling process. Here, the symbol Δ (Delta) refers to the first-order difference of the variable under study, that is, the change between consecutive observations in time series data. α_0 indicates the deterministic bias or drift parameter of the model. The term u_t refers to the Gaussian white noise that defines the error term of the model, and this term symbolizes random changes in the model.

Terms such as α_1, α_2,……. α_5 indicate long-term dynamics, while β_{1i}, $\beta_{2i,}$, ……β_{5i} represents short-term dynamics. These parameters are used to model both short- and long-term effects of dependencies and interactions between variables.

In order to determine whether there is a cointegration relationship in the context of the research model, the null hypothesis is: H_o: $\alpha_1=\alpha_2=\alpha_3=\alpha_4=\alpha_5=0$; The alternative hypothesis can be tested with H_a:$\alpha_1\neq\alpha_2\neq\alpha_3\neq\alpha_4\neq\alpha_5\neq0$. In this context, the calculated F-statistic value was compared to Pesaran, et al. (2001) at certain significance levels. If the calculated F value is higher than the upper critical value, the null hypothesis that there is no cointegration is rejected.

In determing the appropriate model, statistical criteria such as R^2, Hannan Quinn Criterion (HQ), Akaike Information Criterion (AIC) and Schwarz Criterion (SBC) play an important role. If the null hypothesis is rejected, estimations are made using the unrestricted error correction model (Unrestricted Error Correction Model - ECM) through Equation (6) proposed by Pesaran et al. (2001). This model examines how short-term imbalances should be corrected in the long term, taking into account the contribution of the error correction term.

$$\Delta LDENIZ_t = \gamma_0 + \sum_{i=1}^{p} \delta_{1i}\Delta LDENIZ_{t-i} + \sum_{i=0}^{q_1} \delta_{2i}\Delta LCPI_{t-i} + \sum_{i=0}^{q_2} \delta_{3i}\Delta LMEV_{t-i} + \sum_{i=0}^{q_3} \delta_{4i}\Delta USDTR_{t-i} + \lambda\ ECT_{t-1} + u_t \quad (8)$$

$$\Delta LYOLCU_t = \gamma_0 + \sum_{i=1}^{p} \delta_{1i}\Delta LYOLCU_{t-i} + \sum_{i=0}^{q_1} \delta_{2i}\Delta LCPI_{t-i} + \sum_{i=0}^{q_2} \delta_{3i}\Delta LMEV_{t-i} + \sum_{i=0}^{q_3} \delta_{4i}\Delta USDTR_{t-i} + \lambda\ ECT_{t-1} + u_t \quad (9)$$

$$\Delta LYUK_t = \gamma_0 + \sum_{i=1}^{p} \delta_{1i}\Delta LYUK_{t-i} + \sum_{i=0}^{q_1} \delta_{2i}\Delta LCPI_{t-i} + \sum_{i=0}^{q_2} \delta_{3i}\Delta LMEV_{t-i} + \sum_{i=0}^{q_3} \delta_{4i}\Delta USDTR_{t-i} + \lambda\ ECT_{t-1} + u_t \quad (10)$$

The ECT (Error Correction Term) defined in Equations (9,10,11,12) cover the residuals of the model, and the λ term represents the parameter expressing the duration of the correction process (Murthy and Okunade, 2016). Analyses made through the error correction model reveal the speed at which the system returns to long-term equilibrium after the impact of short-term shocks. Various diagnostic tests are performed to test the accuracy of the model used. By means of these tests, possible problems such as serial correlation, functional form errors and heteroskedasticity in the model are determined. Additionally, the CUSUM (Cumulative

Sum) test is applied to evaluate the stability of the model parameters over time. The statistics resulting from this testing are used to evaluate structural breaks during the period. If the CUSUM plots remain within the critical limits determined at the 5% significance level, this indicates that the regression coefficients are stable over time (Jalil, et al. 2013). In this research, Akaike Information Criterion (AIC) was used to determine the lag length of the ARDL model and the maximum lag length was determined as four.

5. Findings

In this part of the research, the findings obtained in the context of the linear ARDL approach are included. The findings regarding the series included in the analysis were obtained within the framework of the linear ARDL approach, and these findings were expressed and interpreted in the form of tables and figures. ARDL bounds test results regarding the cointegration results of the series are shown in Table 7 below. Additionally, "k" in this table refers to the number of basic explanatory variables in the model.

Table 7. F-Bounds Tests Null Hypothesis: No levels relationship

Models	Test Statistic	Value	Signif.	I(0)	I(1)
Model 5	F-statistic k	4.670663 3	10% 5%	2.72 3.23	3.77 4.35
Model 6	F-statistic k	7.062180 3	10% 5%	2.72 3.23	3.77 4.35
Model 7	F-statistic k	12.45038 3	10% 5%	2.72 3.23	3.77 4.35

According to Table 7, as a result of the ARDL Bounds Test conducted within the scope of the study, the null hypothesis of no cointegration is rejected at the 0.01 significance level for Models 5,6 and 7. In other words, it is observed that there is cointegration among the variables in the context of the created working models. It can also be stated that there is a long-term relationship between

DENIZ and CPI, MEV, USDTR variables.

YOLCU and CPI, MEV, USDTR variables.

YUK and CPI, MEV, USDTR variables.

The lag length selection for the ARDL method was based on the Akaike Information Criterion, and the lag length information for the 20 most suitable models selected according to this criterion is presented in Figure 2.

Figure 2. Graphical Representation of Optimal Model Selection for Model 5

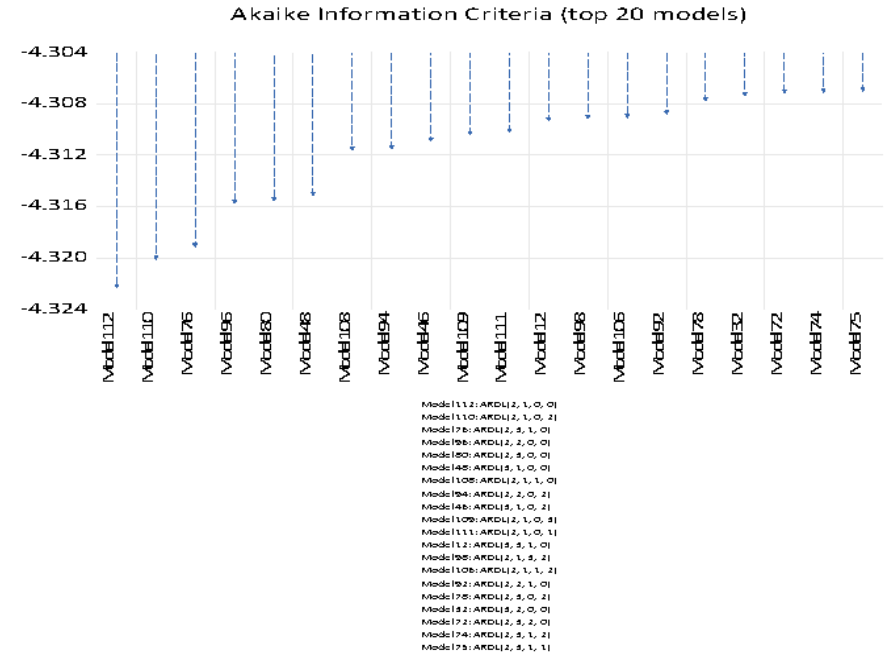


Figure 3. Graphical Representation of Optimal Model Selection for Model 6

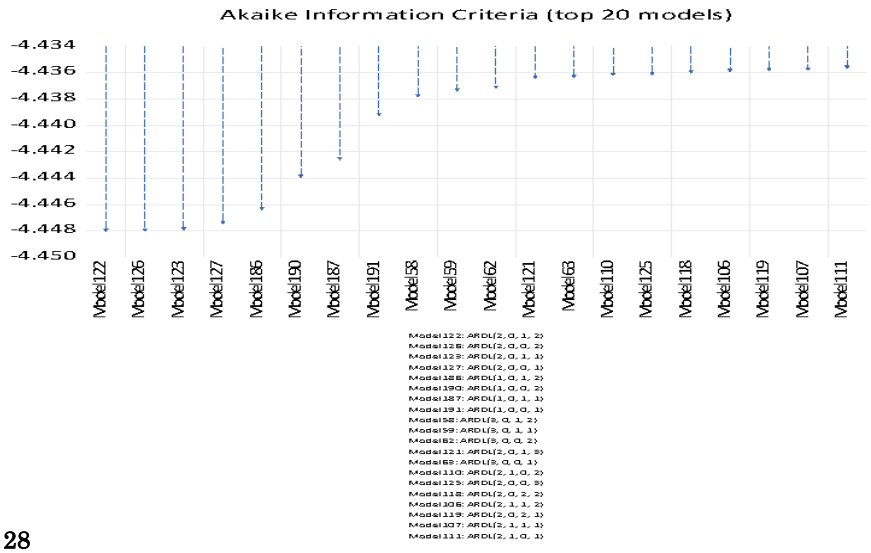
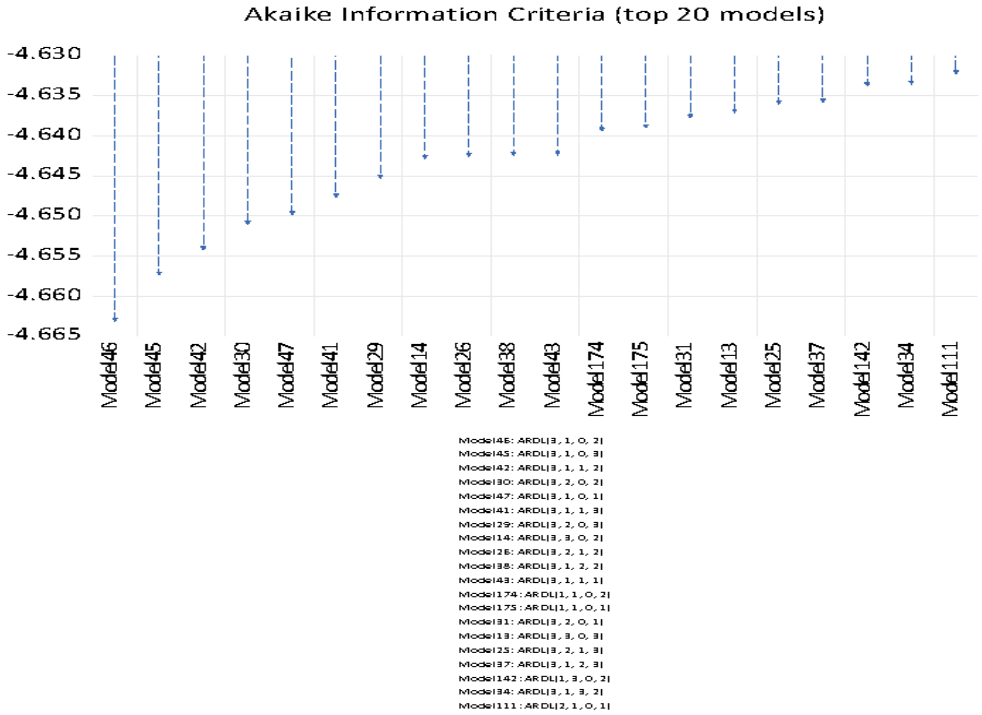


Figure 4. Graphical Representation of Optimal Model Selection for Model 7



When Figures 2,3,4 are examined, it can be observed that the most appropriate estimations according to Akaike Information Criterion for models 5,6 and 7 are the ARDL(2,1,0,0), ARDL(2,0,1,2) and ARDL(3,1,0,2) respectively . In this context, the most appropriate models were taken as the basis for the analyzes carried out. The estimation results of the ARDL(2,1,0,0), ARDL(2,0,1,2) and ARDL(3,1,0,2) models with optimal lag lengths according to the information criteria are shown in Table 8 below

Table 8. ARDL Model Estimation Results

Dependent Variable: DENIZ **Sample (adjusted): 2010M032023M12** **Selected Model: ARDL(2, 1, 0, 0)** ***HAC* standard errors&covariance**			**Dependent Variable: YOLCU** **Sample (adjusted): 2010M032023M12** **Selected Model: ARDL(2, 0, 1, 2)** **HAC standard errors&covariance**			**Dependent Variable: YUK** **Sample (adjusted): 2010M04 2023M12** **Selected Model: ARDL(3, 1, 0, 2)** **HAC Standard errors& covariance**		
Variable	**Coefficient**	**t-Statistic**	**Variable**	**Coefficient**	**t-Statistic**	**Variable**	**Coefficient**	**t-Statistic**
DENIZ (-1)	0.827948	14.34838***	YOLCU (-1)	1.091506	14.68585***	YUK (-1)	1.018729	16.33414***
DENIZ (-2)	0.104641	1.86432*	YOLCU (-2)	-0.116182	-1.653606	YUK (-2)	-0.253834	-2.109430**
USDTR	0.811278	21.50973***	USDTR	-0.026728	-1.061446	YUK (-3)	0.188892	2.084745**
USDTR (-1)	-0.736830	-18.50372***	CPI	-0.101024	-1.001740	USDTR	0.185916	3.957901***
CPI	-0.042696	-1.99267**	CPI(-1)	0.188861	1.924066**	USDTR (-1)	-0.218825	-4.731718***
MEV	0.014249	0.35794	MEV	-0.164072	-0.082393	CPI	0.118659	5.651853***
C	1.147730	3.24841***	MEV(-1)	-2.513059	0.650499	MEV	-0.727424	-0.465169
			MEV(-2)	2.677544	1.370214	MEV(-1)	-2.847600	-0.836554
			C	-0.034065	-0.109978	MEV(-2)	3.614838	1.858996*
						C	-0.149411	-0.491502
R-squared 0.998600 Adjusted R-squared 0.998547 F-statistic 18901.12 Prob(F-statistic) 0.000000			R-squared 0.998754 Adjusted R-squared 0.998690 F-statistic 15728.84 Prob(F-statistic) 0.000000			R-squared 0.999420 Adjusted R-squared 0.999386 F-statistic 29654.26 Prob(F-statistic) 0.000000		

**** shows significance at %1 , ** shows significance at %5 and * shows significance at %10 respectively*

The CUSUM Test Graphs, which are applied to measure the stability of the coefficients in the analysis results of the ARDL(2,1,0,0), ARDL(2,0,1,2) and ARDL(3,1,0,2) models and to determine whether there is any structural break in the models, is shown in Figure 2,3,4.

Figure 5. CUSUM Test Results of ARDL(2,1,0,0) Model

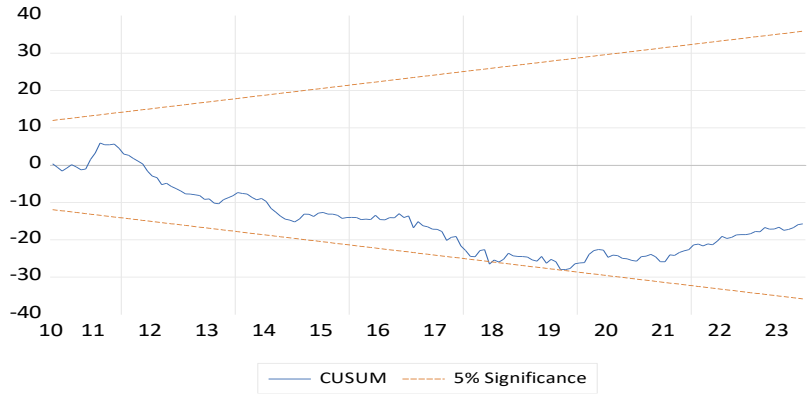


Figure 6. CUSUM Test Results of ARDL(2,0,1,2) Model

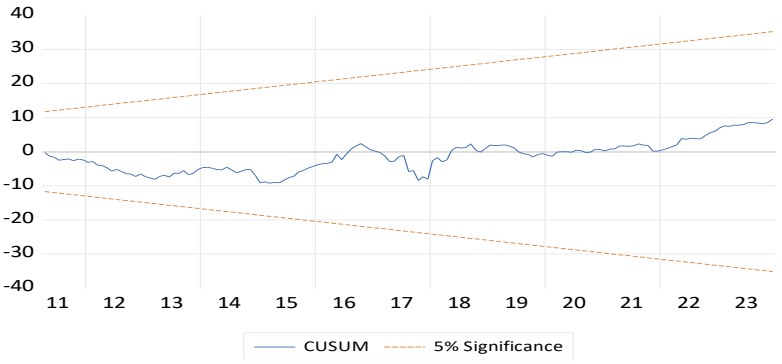
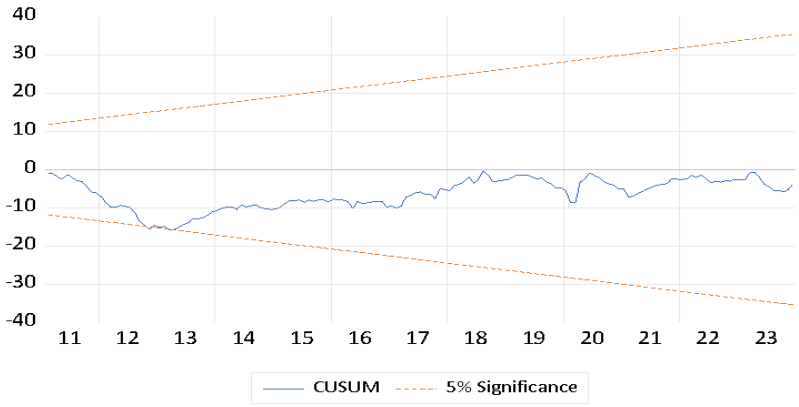


Figure 7. CUSUM Test Results of ARDL(3,1,0,2) Model



According to Figure 5, 6 and 7, it is observed that there is no break at the 0.05 significance level for the CUSUM test charts. Therefore, it is concluded that the coefficients of the ARDL cointegration test are stable (consistent) and there is no structural break in the models.

When these outcomes are considered, it is concluded that the ARDL model estimation results are consistent. In this context, the results for the long-term coefficients are presented in Table 9 below.

Table 9. Estimation Results of ARDL Long-Term Coefficients

Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
USDTR	1.104389	0.437548	2.524038	0.0126
CPI	-0.633374	0.334485	-1.893582	0.0601
MEV	0.211368	0.561780	0.376247	0.7072
*EC = DENIZ - (1.1044*USDTR -0.6334*CPI + 0.2114*MEV)*				
USDTR	-1.083158	1.173533	-0.922989	0.3574
CPI	3.559597	1.684385	2.113293	0.0362
MEV	0.016772	1.461338	0.011477	0.9909
*EC = YOLCU - (-1.0832*USDTR + 3.5596*CPI + 0.0168*MEV)*				
USDTR	-0.712109	0.564896	-1.260602	0.2093
CPI	2.567623	0.722853	3.552066	0.0005
MEV	0.861518	0.805923	1.068984	0.2867
*EC = YUK - (-0.7121*USDTR + 2.5676*CPI + 0.8615*MEV)*				

When Table 9 is examined, for ARDL(2,1,0,0) model,it is observed that CPI and USDTR variables have statistically significant impacts on DENIZ variable. However, it appears that the impact of the other variable, MEV, on DENIZ is not statistically significant. While USDTR and MEV variables have a positive impact on DENIZ, the CPI variable has a negative impact. For ARDL(2,0,1,2) model, it is observed that only CPI variable have statistically significant impacts on YOLCU variable. CPI has positive impact on YOLCU variable in the long run. In the model, rest of the variables don't have statistically significant impact on YOLCU variable. As for ARDL(3,1,0,2) model,similar to ARDL(2,0,1,2) model, only CPI has statistically significant and positive impact on YUK variable.

The short-term impacts of the variables involved in the model were reached with the error correction model estimated using the ARDL method. In this context, the estimation results regarding the error correction form of the ARDL model and therefore the short-term coefficients are shown in Table 10 below.

Table 10. Estimation Results of ARDL Error Correction Models

ECM Regression
Case 3: Unrestricted Constant and No Trend

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	1.147730	0.262122	4.378614	0.0000
D(DENIZ(-1))	-0.104641	0.043720	-2.393432	0.0179
D(USDTR)	0.811278	0.042199	19.22493	0.0000
CointEq(-1)*	-0.067411	0.015451	-4.362930	0.0000
R-squared	0.696601			
C	-0.034065	0.010473	-3.252648	0.0014
D(YOLCU(-1))	0.116182	0.076204	1.524614	0.1294
D(CPI)	-0.101024	0.116873	-0.864389	0.3887
D(MEV)	-0.164071	1.695639	-0.096761	0.9230
D(MEV(-1))	-2.677544	1.843584	-1.452358	0.1484
CointEq(-1)*	-0.024676	0.004599	-5.365492	0.0000
R-squared	0.221299			
C	-0.149411	0.023860	-6.262038	0.0000
D(YUK(-1))	0.064942	0.068986	0.941388	0.3480
D(YUK(-2))	-0.188892	0.069836	-2.704793	0.0076
D(USDTR)	0.185916	0.035149	5.289354	0.0000
D(MEV)	-0.727424	1.530872	-0.475170	0.6353
D(MEV(-1))	-3.614838	1.727789	-2.092176	0.0381
CointEq(-1)*	-0.046213	0.006486	-7.124984	0.0000
R-squared	0.408289			

Diagnostic Statistics on Estimation Results						
	ARDL(2,1,0,0)		ARDL(2,0,1,2)		ARDL (3,1,0,2)	
Tests	T-Statistics	P-value	T-Statistics	P-value	T-Statistics	P-value
Ramsey Reset Test	1.483856	0.1398	1.313510	0.1909	1.365200	0.1742
Breusch-Pagan-Godfrey Test	3.463662	0.7488	3.998136	0.8573	26.56399	0.0017
Breusch-GodfreySerial Correlation LM Test	1.123572	0.7714	1.136873	0.7682	0.283271	0.9631

In Table 10, It is observed that the error correction term (ECT) in ARDL(2,1,0,0) model is negative and statistically significant (ECT(-1) = -0.067411). In the context of the study, this rate was found to be approximately 6.7%, and it is concluded that 6.7% of the shocks that occurred in the system created for the model were corrected within a month. In other words, the deviations from the balance coming back into the balance in approximately 15 months. For ARDL(2,0,1,2) and ARDL(3,1,0,2) models, ECT (-1) values are -0.024676 and -0.046213 respectively.

In the models, Functional form error Ramsey Reset test; Heteroscedasticity was investigated by applying the Breusch-Pagan-Godfrey test and serial correlation by applying the Breusch-Godfrey Serial Correlation LM test. In this context, in the models; It is observed that there is no functional form error and serial correlation problem. However, it seems that there is a heteroscedasticity problem in ARDL(3,1,0,2) model, and White correction was applied to the model in order to achieve more consistent results.

6. Conclusions

Türkiye's strategic location and developing transportation infrastructure provide significant advantages to the logistics sector. Globalization and digitalization have highlighted the significance of the logistics sector in world trade. Logistics industry plays a key role in the development and therefore welfare of countries, therefore it provides states and also firms with important competitive power. In return this enable them to get a relatively higher share from worldwide trade.

This study provides a comprehensive analysis of how macroeconomic variables —interest rates, inflation, and exchange rates— affect the credit dynamics of Turkey's logistics sector, which includes sea transport, road passenger transport, and road freight transport. At a time when logistics plays a pivotal role in shaping global economic competitiveness, the financing of logistics has become not only a business concern but a strategic national issue.

The funding needs of the capital-intensive logistics sector are considerably met by banks. This very fact raises questions regarding the industry's access to loans and the relationship between loans and macroeconomic variables. In this study, the effects of macroeconomic variables such as interest, inflation and exchange rates on the loans provided by banks to the logistics industry (road-passenger-transport and road-freight-transport, sea transport and air-transport sectors) in Turkiye is examined. All the banks that operate in Turkiye are covered

in the quantitative analysis, commercial banks (deposit/conventional bank), participation banks (non-interest banks) and development and investment banks. Monthly data is employed between 2010-2023. Econometric analysis is conducted in order to determine if exchange rate, interest rates and inflation have statistically significant effects upon the change in loans provided by banks for logistics industries.

The findings reveal that macroeconomic conditions are deeply intertwined with sectoral credit flows, but their impact varies across transport modes. Sea transport loans are significantly and positively influenced by exchange rates and interest rates, but negatively by inflation. Road transport loans (both passenger and freight) show a positive and significant relationship with inflation, while interest and exchange rates have statistically insignificant effects.

These differences highlight the heterogeneity in credit behaviour and sensitivity across logistics subsectors, likely due to their distinct cost structures, financing needs, and exposure to foreign currency risks.

Econometrically, the application of the ARDL bounds testing approach validated the presence of long-term equilibrium relationships among macroeconomic variables and sector-specific credit supply. The error correction terms confirmed that these systems correct short-term disequilibria over time, albeit at different speeds.

Turkey's logistics industry is strategically positioned due to its geopolitical location, multimodal infrastructure investments, and export-oriented growth strategy. Despite this potential, the study emphasizes the vulnerabilities arising from macroeconomic instability. High inflation, interest volatility, and exchange rate shocks not only increase operational costs for logistics firms but also weaken their creditworthiness, posing risks to the banking sector and slowing investment in logistics infrastructure and services.

Moreover, the study situates the Turkish logistics sector within the broader context of global supply chain reconfiguration, digitalization, and protectionism. The push for reshoring and regional trade corridors underlines the urgency for countries like Turkey to fortify their logistics financing ecosystems.

Policy implications of the study: From a policy standpoint, some implications stand out for sustained credit flow to the logistics sector, controlling inflation and exchange rate volatility is essential. Predictable macroeconomic conditions reduce credit risk and enhance banks' lending willingness. Given the different sensitivities of logistics subsectors, targeted

financial products—such as hedged FX loans for maritime firms or inflation-linked instruments for domestic road transport—should be developed. Banks should adopt differentiated credit scoring models based on the macro-sensitivity and currency exposure of logistics subsectors.

Turkey's strategic investments in logistics hubs and corridors should be supported by coordinated financial infrastructure, ensuring access to long-term, low-cost financing through development banks, guarantees, and subsidies. Promoting logistics-fintech collaboration could streamline supply chain financing and improve transparency in trade finance, reducing transaction risks and easing access to capital.

In conclusion, the research offers critical insights into how macroeconomic management can influence the depth and quality of financing in a strategically vital sector. As Turkey continues to position itself as a logistics powerhouse, ensuring financial resilience and accessibility will be key to converting infrastructure into competitive advantage. The findings are not only relevant for Turkey but offer broader lessons for emerging economies navigating global trade disruptions while trying to strengthen their logistics backbone. Considering all the findings, it is concluded that while exchange rate (USD/TR) and interest rate (net deposit returns) variables have a positive impact on seafreight-loans, but inflation (CPI) variable has a negative effect. On the other hand, inflation (CPI) variable have statistically significant positive effect on loans given by banks for road-passenger-transportation and also road-freight-transportation.

Limitation of the study and suggestions for the future research: While the present research provides granular insight into Turkey's logistics credit dynamics, two limitations merit acknowledgement. The analysis relies on aggregate banking data that may mask heterogeneity across individual banks and firm sizes; future work could match loan-level microdata with firm-level financial statements to test for asymmetric transmission channels. In addition, the post-pandemic period saw unprecedented policy interventions and supply-chain shifts; incorporating structural-break tests or time-varying parameter models would help disentangle temporary from permanent regime changes. Another suggestion for the future research is that future studies can use bank-specific variables as independent variables instead of macro variables for the purpose of determining the role of bank-specific variables (net profit, deposit etc.) upon the loans given to the logistic industry in Türkiye.

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