A Case Study of Examining the Relationships Between Maritime Foreign Trade, GDP, and the Construction in Turkey

Denizyolu Dış Ticareti İle GSYİH Ve Yapı Sektörü Arasındaki İlişkilerin İncelenmesine Yönelik Türkiye Örneği

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Abstract

Although there are many types of transportation in foreign trade, maritime transportation is of great importance. In the globalizing world, foreign trades between countries have started to become more common and maritime transport has become one of the main actors. Transportation demand increases in this area, even more, the fact that it is cheaper, reliable, and environmentally friendly. However, economic crises in the world and increases in sea freight prices can affect maritime transport. This situation can affect not only maritime transport but also the economic situation of countries. The purpose of this study is to examine the relations between gross domestic product (GDP) and maritime exports, maritime imports, and the construction sector (which is one of the most important economic dynamics of the country), due to the decline in maritime transport in Turkey in recent years. The data of the study for the last years were obtained from the Turkish Statistical Institute (TSI). The stationarity levels of the data were analyzed with unit root statistics tests. Since all series are stationary at the I (1) level, the Granger causality method is preferred. As a result, GDP is the Granger cause of maritime exports, maritime imports, and the construction industry but no correlation could be established between maritime imports with other data. Also, the construction industry is the Granger cause of maritime exports.

Keywords: Maritime transport, International Logistics, Supply Chain Management, GDP, Granger Causality

Öz

Dış ticarette kullanılan birçok taşımacılık türleri olmasına rağmen denizyolu taşımacılığının önemi gün geçtikçe artmaktadır. Küreselleşen dünyada ülkelerin birbirleri arasındaki alış verişler daha yaygın hale gelemeye *başlamış* ve denizyolu taşımacılığı baş aktörlerden birisi olmuştur. Daha ucuz, güvenilir ve çevreci bir taşımacılık türü olması bu alandaki talebi daha da arttırmaktadır. Fakat dünyada meydana gelen ekonomik krizler ve navlun fiyatlarında meydana gelebilen artışlar denizyolu taşımacılığını etkileyebilmektedir. Bu durum sadece denizyolu taşımacılığını değil aynı zamanda ülkelerin ekonomik durumlarını da etkileyebilmektedir. Bu çalışmanın amacı, Türkiye'nin son yıllardaki denizyolu taşımacılığındaki gerilemeye bağlı olarak gayrı safi yurtiçi hasıla (GSYİH) ile denizyolu ihracatı,

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denizyolu ithalatı ve ülkenin en önemli ekonomik dinamiklerinden birisi olan yapı sektörü aralarındaki ilişkileri incelemektir. Araştırmada kullanılan son yıllara ait
veriler, Türkiye İstatistik Kurumu'ndan (TÜİK) elde edilmiştir. Verilerin durağanlık seviyeleri birim kök istatistik testleri ile analiz edilmiştir. Tüm serilerin I(1) seviyesinde durağan olmasından dolayı Granger nedensellik yöntemi tercih edilmiştir. Sonuç olarak, GSYİH ile denizyolu ihracat arasında pozitif çift yönlü, denizyolu ithalat ile pozitif tek yönlü güçlü Granger nedensellik ilişki varken yapı sektörü arasında pozitif tekyönlü zayıf ilişki bulunmaktadır. Bunların yanında yapı sektörü ile denizyolu ihracat arasında pozitif tek yönlü güçlü Granger nedensellik ilişki bulunurken, denizyolu ithalat ile diğer seriler arsında Granger nedensellik ilişki tespit edilememiştir.
Anahtar Kelimeler: Denizyolu Taşımacılığı, Uluslararası Lojistik, Tedarik Zinciri Yönetimi, GSYİH, Granger Nedensellik.

Introduction

International trade is one of the most important activities of the country's economy. While some of the products produced in the country are evaluated in the foreign market, the needed products are also purchased from abroad. The international activity that constitutes the most significant foreign exchange input of the countries is export. Globalizing and developing with information systems the variety and amount of products are increasing in the world. Many types of transportation such as road, rail, sea, air, and pipeline transportation are used in international trade. International trade is carried out by using one or more of these transportation types.

Maritime transport is one of the most important links in the supply chain. It plays an active role in transporting products from one point to another in pre-and post-production processes. It is suitable for sending large pieces of products and it is 14 times cheaper than an airline, 3.5 times cheaper than a railway and 7 times cheaper than the road in terms of logistics cost. Compared to other types of transportation, carbon emission rates and lower accidents and risks are among its other advantages. However, there are also disadvantages such as having a slower type of transportation, not being suitable for small-part products, and high initial investment costs (Develi, 2020; Dördüncü, 2021).

Foreign trades in the world are carried by maritime 85% of the products that will be subject (Esmer 2019; Michael 2021). Although there were continuous developments in world trade and maritime transport until 2019, growth rates declined at the levels of the 2008-2009 financial crisis due to the economic recession. Especially in the first half of 2020 which has become a Covid-19 epidemic, global ship demand decreased by 8.7% and container ship demand by 5.8%. Maritime transport directly affects the economic growth of developed and developing countries. The costs of countries that cannot carry out maritime transport will increase and the high cost will affect the welfare level of the products. Maritime transport can provide an important competitive advantage in terms of countries' political, economic, military, and businesses (Emeç, 2021: 2).

Almost all kinds of international trade products can be transported maritime. Among these products, they can be in unit load (pallet, bale, big bag, etc.) as well as in liquid and solid bulk cargoes. Bulk cargo can be given as an example of products such as iron mine, grain, agriculture, etc. In addition, processed or semi-processed iron materials and products used in the construction industry can be transported by sea (Tarı, 2019; Esmer, 2019).

The studies in the literature mainly include the relations between maritime exports, imports, GDP, economy, industrial production, and foreign trade. In some of the domestic and foreign studies positive relationship between the series while in some studies a negative relationship was found and in some studies, there is no relationship.

Adam et al. (2021) conducted a study on the effect of maritime transport on economic growth. The study found that a 10% increase in the seaway causes an increase in the economy between 0.4% and 1.6%. According to Michael et al. (2021), which is about the effects of sea container transportation on GDP, maritime container transportation has a positive and strong effect on GDP. However, Igberi and Ogunniyi (2013) investigated the effects of maritime transport on the economy in Nigeria and they could not detect a significant relationship between maritime transport on economic growth.

Tunalı and Akarçay (2018) examined the relationship between maritime transport and industrial production in Turkey and concluded that a 1% increase in industrial production increases maritime transport by 0.559%. However, the study highlighted that the development of maritime transport did not directly affect the industry. Usta and Sarı (2021) explored the relationships between maritime exports, imports, economic growth, and terms of trade in Turkey, and there was a long-term negative relationship between maritime exports and terms of trade. However, the long-term relationship between maritime imports and economic growth was not statistically significant.

Osadume et al. (2020) stated that "While most academics believe that maritime trade openness will transform the economy into a developed nation, some do not believe in the same idea". Maritime transport can be affected by economic crises, political policies, and freight prices. In this respect, its effects on national economies may change over time. Studies on these subjects in Turkey are limited, and some studies have found positive effects of maritime exports and imports on GDP, economic growth, and industrial production while some studies have not found any effects. In this study, using the data of recent years, the relations between GDP and maritime foreign trade as well as the relations with the construction sector which is a different field are also examined. The construction sector has been discussed so that it is one of the most important economic dynamics of Turkey and includes many sectors under it. Two-way analyzes were conducted for each of the temporal series as dependent and independent variables.

Literature Review

In this part of the study, national and international literature on the relationship between maritime exports and maritime imports, GDP, economic growth, and industrial production are included. In addition, information about the construction sector which will be the subject of the study is also mentioned.

Maritime Transport

World economies survive by transforming resources into products such as raw materials, semi-finished products, and finished products. While some of the converted products are consumed in the domestic market, some are exported. Sea transport is used extensively in imports and exports. However, maritime transport is not simply and directly related to the world economy. Therefore, freight prices, political policies, and economic shocks in the world can change maritime transport (Antonellin, 2021).

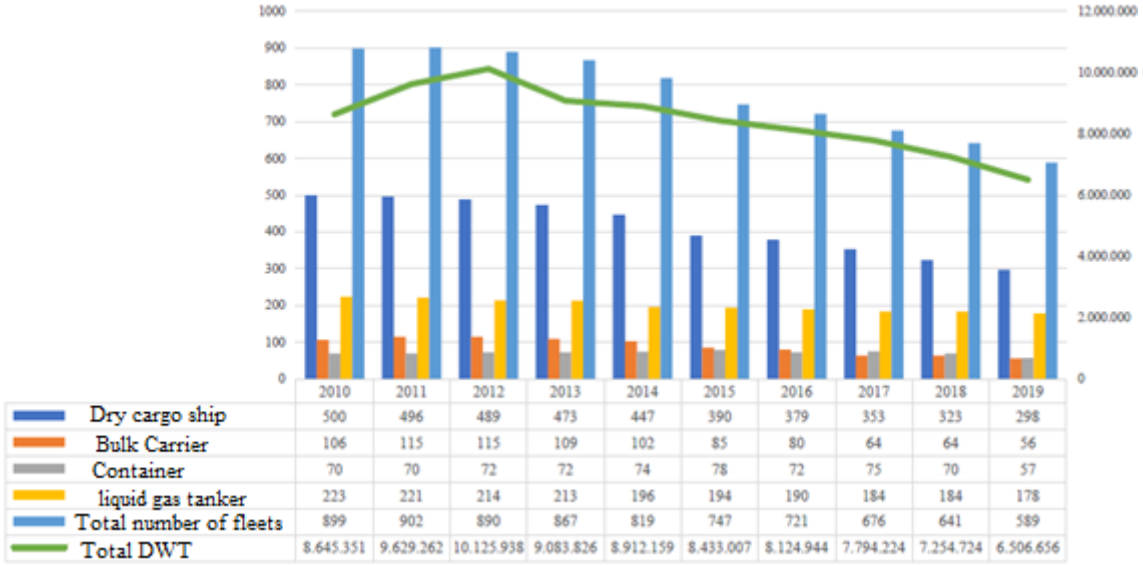
Osadume et al. (2020) applied the Granger causality test to determine the relationships between maritime transport and economic development. In the research, they found a strong bidirectional

relationship between maritime transport and economic development. Park et al. (2019) used Granger analyses to examine the relationship between economic growth and land, air, and maritime transport. In the study maritime transport has the most impact on economic growth compared to road and air transport. However, they concluded that land and air transport have a negative effect on economic growth in developing countries. Prandeka and Zarkos (2014) investigated the effects of maritime transport on the Greek economy, and maritime freight and tourism transportation was determined as the most important economic resource of the country. Also, it played a major role in the country's recovery from the economic crisis.

Saeed et al. (2021) compared maritime exports and imports with GDP per capita. While a two-way relationship was found between maritime exports and per capita income, no relationship was found between maritime imports and per capita income. Taghvaee et al. (2016) investigated Granger causality relationships between maritime transport, economic growth, and environmental pollution. There is a positive relationship between environmental pollution and maritime transportation and economic growth, while the relationship between economic growth and maritime transportation is at low levels.

Dwarakish et al. (2015) explored the effects of maritime transport port factors on GDP, and they found that maritime transport affects the GDP ratios positively and effectively. Igberi and Ogunniyi (2013) investigated the relationships between the GDP of maritime transport and industrial production in Nigeria and found a negative relationship between maritime transport and GDP and industrial production. Therefore, they mentioned that the government should take economic and political measures regarding maritime transport. Also in Nigeria, Lloyd et al. (2019) studied the effects of maritime transport on the economy. Due to the lack of necessary technological investments and the poor management of ports and resources, the impact of the seaway on the Nigerian economy was found to be weak. According to Jacks and Pendakur's (2010) study on the historical development of the effects of maritime transport on global trade, sea freight prices affect maritime transportation. They also found no evidence that maritime transport was the most important force influencing foreign trade in the late 19th century. Liang and Zhao (2009) conducted a Granger causality analysis for the effects of maritime transport on GDP and employment numbers and found that the development of maritime transport depends on the development of GDP ratios as well as industrial production and employment. Navarro et al. (2010) examined the statistical link between maritime transport and foreign trade in Spain and determined that maritime transport will be strengthened with the new database proposed for foreign trade.

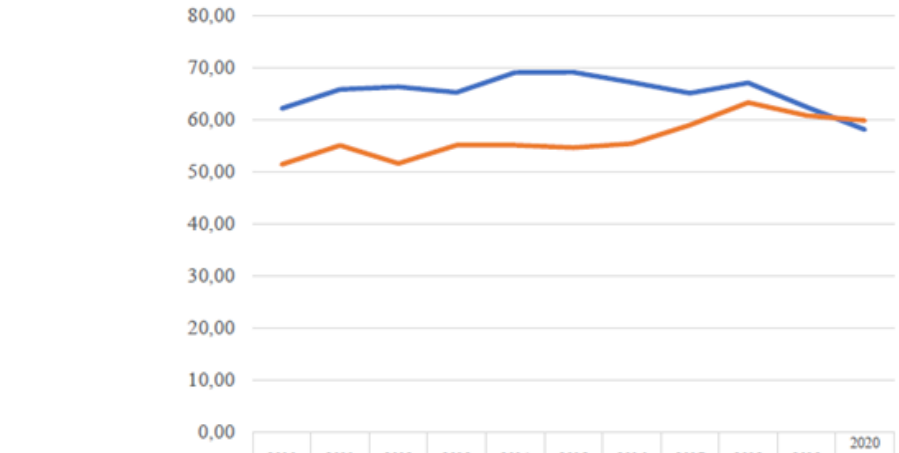
According to Emeç (2021), maritime exports positively affect the industrial production index, container handling amount, and oil price volatility in the long run. However, maritime exports, exchange rates, and Baltic Dry Freight Index affect the variables negatively. Tari et al. (2019) found that Hopa Port will make significant contributions to maritime transport and the country's economy. Gülmez et al. (2018) examined relations based on the total amount and cargo groups of cargoes in maritime exports and imports, the loading-unloading tonnage of ships, foreign trade regions, and ports. As a result of the analysis, the most imported product according to 2016 data is iron from the Americas.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Dry cargo ship	500	496	489	473	447	390	379	353	323	298
Bulk Carrier	106	115	115	109	102	85	80	64	64	56
Container	70	70	72	72	74	78	72	75	70	57
liquid gas tanker	223	221	214	213	196	194	190	184	184	178
Total number of fleets	899	902	890	867	819	747	721	676	641	589
Total DWT	8.645.351	9.629.262	10.125.938	9.083.826	8.912.159	8.433.007	8.124.944	7.794.224	7.254.724	6.506.656

Image 1. Turkish Maritime Merchant Ships (UTIKAD, 2020).

Since Turkey is surrounded by seas on three sides and is at the junction of the Asian and European continents, it is an important logistics top in international trade. However, while these advantages are used very well, the data in Image 1 shows that the situation is not getting better. The number of ships of 150 gross tonnages and above shows a decreasing trend from 2010 to 2019 in the number of general cargo dry cargo ships. For bulk carriers, it decreased from 106 to 56 between 2010-2019. Container ships increased from 70 in 2010 to 57 in 2019. Liquid gas tankers decreased from 223 to 178 in the same years. Accordingly, the total DWT (deadweight tonnage) amount decreased from 8645351 to 6506656. The total number of ships decreased by 34% from 2010 to 2019 (UTIKAD, 2020: 123).



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020 quarter
Seaway import (%)	62,16	65,85	66,31	65,28	69,11	69,14	67,22	65,10	67,09	62,47	58,10
Seaway export (%)	51,41	55,05	51,57	55,10	55,11	54,64	55,39	58,99	63,31	60,82	59,86

Image 2. Value-based export and import share of maritime transport in Turkey (UTIKAD, 2020).

In terms of Turkey's exports and imports, maritime transport value is given in Image 2. Although the share of exports in maritime transport decreased for a while between 2011 and 2012, it tends to increase until 2018. However, there is a downward trend since 2018. Although the share of imports in maritime

transportation increased slightly between 2010-2011 and 2013-2015, it started to decrease as of 2015 (UTIKAD, 2020: 125).

Construction Industry

The construction sector is one of the most important economic dynamics of Turkey. There are more than 200 different sectors connected to this sector. A wide variety of products are used in the creation of structures such as houses, roads, bridges, and dams. To deliver these products to the desired destination, international sea transportation is used as well as domestic transportation (Yavuz, 2019: 2).

The construction sector is one of the locomotive sectors in terms of the sub-sectors in the production process and the country's economy. Accordingly, the improvement in the construction sector leads to an improvement in GDP ratios, while on the contrary, it leads to a decrease in GDP ratios (Çınar, 2018; Alper, 2018).

The most important step regarding the construction sector in Turkey was taken after the proclamation of the Republic. Until the years 1950-1960, the most orientation in the sector was seen in infrastructure, construction, and zoning. With the establishment of State Highways and State Hydraulic Works, investments in the sector increased rapidly (Türkeş, 2018: 3).

75% of the construction sector investments in Turkey are residences. The gradual growth of the country's population and changes in the family structure increase the demand for housing. After the 2001 economic crisis, there was an upward acceleration in demand after the abundance of liquidity and the low level of credit perpetrators (Akil, 2019: 73).

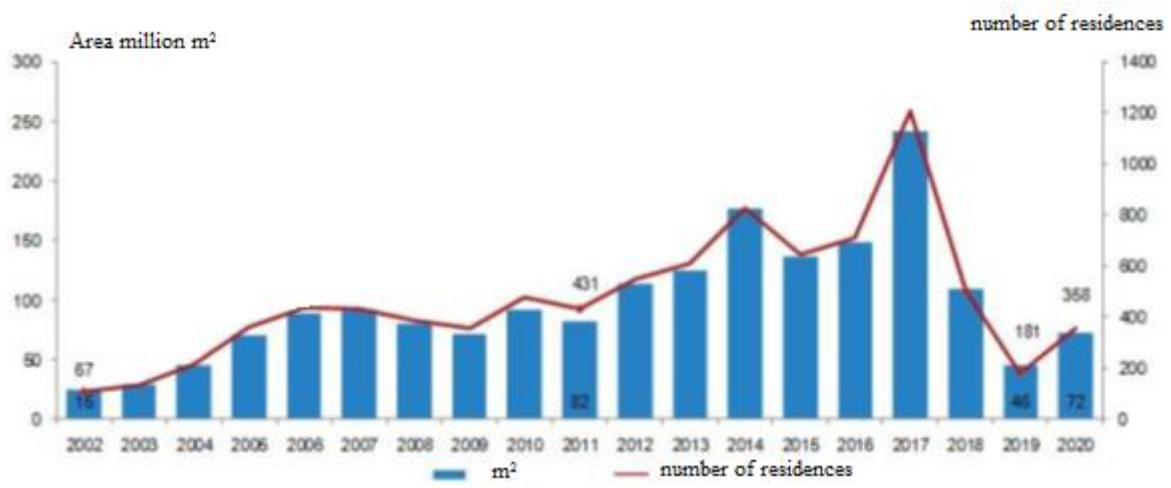


Image 3. Surface area and the number of flats according to the building permit in Turkey (TSI, 2021).

The area and the number of flats in Turkey between 2002-2020 are given in Image 3. Although the numbers have decreased between some years (2007-2009, 2010-2011, and 2014-2015), there is a general increasing trend between 2002-2017. However, after 2017, there was a sudden decrease and it recovered somewhat until 2020.

Dataset and Methodology

In this section, the datasets related to Granger causality analyses and the methodologies in the application are mentioned.

Data Set

In recent years, there has been great progress in the analysis of temporal data sets. Inappropriate analysis results were obtained due to the emergence of spurious regression problems in classical regression analyses based on the least-squares method. Engle and Granger (1987) developed the cointegration method to prevent artificial swelling in the analyzes and to make the results more reliable. In the method, long-term relationships are determined by adapting the series for data whose mean and variance differ over time (Yenisu, 2019: 1184).

If Granger causality can be estimated with the temporal data of the Y variable and the data of the X variable, it means that there is a causal relationship between the X variable and the Y variable. This causality can be from X to Y as well as from Y to X (Takım, 2010: 326).

To determine the best equation to be established between the series, it is necessary to determine the stationarity of the data. The variance (σ2), mean (μ), and covariance (γk) of stationary series do not change over time. If the series is stationary without any difference, it means stationary at level I(0). If $\Delta Yt=Yt-Yt-1$ becomes stationary after taking the first difference of the Yt series, the series is said to be stationary at the 1st difference or as I(1). In series that are not stationary at the first difference, $\Delta 2Yt=\Delta Yt-\Delta Yt-1$ series that become stationary after taking the 2nd difference are expressed as stationary at the 2nd difference or I(2). To perform a long-term Granger causality test analysis between the data, the stationarity levels between the series must be equal. Depending on these, the formulas are given below (Uçak et al. 2018, s. 204 Team, 2010: 326).

$E(Yt) = \mu$ average (1)

$Var(Yt) = E(Yt - \mu)2 = \sigma 2$ variance (2)

$Cov(Yt - Yt+k) = \gamma k$ covariance (for all t's and $k \neq 0$) (3)

Granger causality tests were used to determine the cointegration relations between the temporal series that are the subject of the research. Bidirectional Granger causality test formulas are given below. The a, b, c, and d in the formula represent the appropriate lag length, and e and n represent the error terms (Granger, 1969: 431). Two-way (from X to Y and Y to X) Granger cointegration correlation tests were conducted as dependent and independent data (X and Y variables) of maritime export and import, GDP, and construction sector data.

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + e_t \quad (4)$$

$$Y_t = \sum_{j=1}^{m} c_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + n_t \quad (5)$$

Granger causality analysis is based on the VAR model. Vector autoregression (VAR) is an econometric model that gives the evolution and interdependence between multivariate time series while generalizing one-variable AR models. All variable parameters in VAR are handled symmetrically, with an equation for each variable describing the evolution of the variable depending on the lags of the variable itself and the lags of all other variables in the model. The lag lengths in the VAR model are important because they affect the reliability of the model. Information criteria such as Schwartz and Akaike are used in the selection of lag lengths (Güzel and Şekeroğlu, 2021: 1125).

Methodology

To determine the relations between GDP in Turkey and the maritime foreign trade and construction sector, the data between 2013 and 2021 are used. The data were obtained from the Turkish Statistical Institute on 15.02.2022 and analyzed with the EViews 12 package program. To determine the analysis method, the stationarity levels of the temporal series were determined. Unit root statistical analyzes were performed to determine the stationarity of the series. Since I (0) was not stationary without taking the difference, the analysis was repeated by taking the 1st difference and it was stationary. Granger causality analysis method was preferred because unit root statistics results of all series became stationary at the I (1) level.

As the limitations of the research, the data of the study cover the years between 2013 and 2021, EViews 12 package program was used for analyzing the data.

Findings

Unit root statistical analysis was performed to determine the stationarity levels of maritime exports, maritime imports, GDP, and construction sector data. The Schwartz Information Criterion (SIC) is used to determine the stationarity levels in the series.

Augmented Dickey-Fuller (ADF) test statistical results between series are given in Table 1. First, the series was analyzed at the I(0) level, and the analysis was repeated after taking the 1st difference since it was not stationary. As a result of the analysis after taking the first difference, the ADF values were respectively (-7.993.095, -5.427.036, -12.242.480, and -13.630.360) test critical values of 1% (-4.252.879, -4.252.879, - Since 4.273.277 and -4.273.277) are small in absolute value, and the probability values (0.0000 and 0.0005) are less than 5%, the series are stationary at the 1st level.

Table 1. Stability Levels of Series According to ADF Unit Root Test Statistics Results

		Maritime Export			Maritime Import			GDP			Construction Industry		
		t-Statistic	Prob.*	Stability	t-Statistic	Prob.*	Stability	t-Statistic	Prob.*	Stability	t-Statistic	Prob.*	Stability
Augmented Dickey-Fuller test statistic		-7.933.095	0.0000	I(1)	-5.427.036	0.0005	I(1)	-12.242.480	0.0000	I(1)	-13.630.360	0.0000	I(1)
Test critical values	1% level	-4.252.879			-4.252.879			-4.273.277			-4.273.277		
	5% level	-3.548.490			-3.548.490			-3.557.759			-3.557.759		
	10% level	-3.207.094			-3.207.094			-3.212.361			-3.212.361		

Appropriate lag lengths in the VAR models established between the variables before proceeding with the Granger analysis are shown in Table 2. According to the information criteria and error values in the VAR models established between GDP - maritime export, maritime import - GDP, maritime export - seaway import, maritime export - construction sector, and maritime import - construction sector, the appropriate delay length was determined as 3. Unlike these, the appropriate lag length in the VAR model established between GDP and the construction sector was determined as 4.

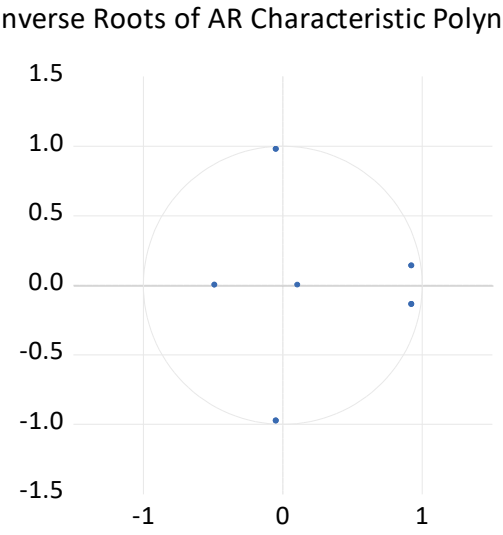
Table 2. Latency Lengths of Established VAR Models

Models	Lag	LogL	LR	FPE	AIC	SC	HQ
GDP Export	0	-1175.107	NA	3.29e+28	71.33983	71.43053	71.37035
	1	-1152.182	41.68295	1.05e+28	70.19283	70.46492	70.28438
	2	-1145.401	11.50669	8.88e+27	70.02430	70.47779	70.17688

	3	-1126.089	30.43051*	3.54e+27*	69.09632*	69.73120*	69.30994*
	0	-1185.281	NA	6.10e+28	71.95645	72.04715	71.98697
Import	1	-1158.797	48.15265	1.56e+28	70.59379	70.86588	70.68534
GDP	2	-1156.170	4.459297	1.70e+28	70.67695	71.13044	70.82953
	3	-1133.031	36.46081*	5.39e+27*	69.51703*	70.15192*	69.73065*
	0	-1135.715	NA	2.61e+28	71.10718	71.19878	71.13754
	1	-1117.704	32.64458	1.09e+28	70.23150	70.50633	70.32260
GDP	2	-1108.358	15.77085	7.82e+27	69.89740	70.35544	70.04922
Construct.	3	-1095.291	20.41821	4.48e+27	69.33067	69.97193	69.54323
	4	-1079.204	23.12418*	2.14e+27*	68.57527*	69.39974*	68.84856*
	0	-1103.051	NA	4.18e+26	66.97276	67.06346	67.00328
Export	1	-1064.942	69.28899	5.29e+25	64.90555	65.17765	64.99710
Import	2	-1061.954	5.069929	5.65e+25	64.96691	65.42040	65.11949
	3	-1049.142	20.18834*	3.34e+25*	64.43286*	65.06774*	64.64648*
	0	-1096.016	NA	2.73e+26	66.54645	66.63714	66.57696
Export	1	-1075.499	37.30474	1.00e+26	65.54538	65.81747	65.63693
Construct.	2	-1067.599	13.40480	7.95e+25	65.30906	65.76255	65.46164
	3	-1054.523	20.60506*	4.63e+25*	64.75898*	65.39386*	64.97260*
	0	-1094.976	NA	2.56e+26	66.48339	66.57409	66.51391
Import	1	-1075.309	35.75816	9.92e+25	65.53388	65.80597*	65.62543
Construct.	2	-1073.162	3.643306	1.11e+26	65.64618	66.09967	65.79877
	3	-1064.399	13.80819*	8.42e+25*	65.35752*	65.99240	65.57114*

Notes: * is the lag length selected according to the information criteria. LR: "Sequentially modified LR test statistic (each test at 5% level)"; FPE: "Final Prediction Error; AIC: Akaike Information Criteria; SC: Schwarz Information Criteria"; HQ: "Hannan-Quinn Knowledge Criteria"

Image 4. Stability of VAR (3) Model Established Between GDP-Seaway Exports



The inverse roots of the autoregressive characteristic polynomial of the VAR (3) model established between GDP and seaway exports remain within the unit circle. In this respect, it means that the established model is Image (Image 4). The reverse roots of the characteristic polynomial of the stationarity of the other established models are included in the appendices.

The stationarity of the VAR (3) models established for the series was also evaluated with the Jarque-Bera test results, apart from the one shown in Table 3. In addition, it is shown in Image 3 by analyzing whether there is autocorrelation in the models. Since the probability values of the Jarque-Bera tests of the models (0.8935, 0.5836, 0.8931, 0.2600, and 0.6480) are greater than 5%, it means that the established VAR (3) models provide the assumption of normality. Considering the autocorrelation LM test results in VAR (3) models, since the probability values (0.1175, 0.1504, 0.7224, 0.1946, and 0.4772) at the 3rd crossing length are greater than 5%, there is no autocorrelation in the established models. In addition, since the probability value of the Jarque-Bera tests (0.3752) and the autocorrelation LM test result (0.3633) in the VAR (4) model established between the GDP and the construction sector are greater than 5%, it means that the series is stationary and there is no autocorrelation between them. Thus, there is no harm in making Granger causality analysis related to the established models.

Table 3. Jarque-Bera and Autocorrelation LM Test Results

Models	Jarque-Bera (Joint)	Prob.	Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
GDP Export	1.104954	0.8935	1	11.68484	4	0.0199	3.245834	(4, 46.0)	0.0199
			2	6.977353	4	0.1371	1.840458	(4, 46.0)	0.1373
			3	7.375315	4	0.1173	1.953895	(4, 46.0)	0.1175
			4	2.899800	4	0.5747	0.731871	(4, 46.0)	0.5749
Import GDP	2.847841	0.5836	1	14.21686	4	0.0066	4.062023	(4, 46.0)	0.0067
			2	7.275300	4	0.1220	1.925295	(4, 46.0)	0.1222
			3	6.740694	4	0.1502	1.773453	(4, 46.0)	0.1504
			4	1.018081	4	0.9070	0.251822	(4, 46.0)	0.9071
GDP Construct	4.234667	0.3752	1	6.793528	4	0.1472	1.802140	(4, 40.0)	0.1475
			2	13.80626	8	0.0870	1.911442	(8, 36.0)	0.0885
			3	15.05408	12	0.2385	1.338944	(12, 32.0)	0.2458
			4	17.65057	16	0.3448	1.147701	(16, 28.0)	0.3633
			5	22.65965	20	0.3058	1.184472	(20, 24.0)	0.3428
Export Import	1.107387	0.8931	1	5.829056	4	0.2123	1.518475	(4, 46.0)	0.2125
			2	2.637516	4	0.6202	0.663801	(4, 46.0)	0.6203
			3	2.073476	4	0.7222	0.518697	(4, 46.0)	0.7224
			4	0.534749	4	0.9700	0.131590	(4, 46.0)	0.9700
Export Construct	5.277694	0.2600	1	11.62950	4	0.0203	3.189678	(4, 52.0)	0.0204
			2	3.293703	4	0.5099	0.833521	(4, 52.0)	0.5101
			3	6.064208	4	0.1944	1.575884	(4, 52.0)	0.1946

			4	13.11764	4	0.0107	3.702285	(4, 46.0)	0.0108
Import			1	11.29883	4	0.0234	3.088985	(4, 52.0)	0.0235
Construc	2.481309	0.6480	2	7.578164	4	0.1083	1.998251	(4, 52.0)	0.1084
t			3	3.505158	4	0.4771	0.888823	(4, 52.0)	0.4772
			4	19.53093	4	0.0006	5.924872	(4, 46.0)	0.0006

Granger causality tests were applied to the established VAR models and the results are shown in Table 4. The causality values of the results may also change according to the positions of each variable. Granger causality was found in the case of probability values less than 5% between the related series, but not in the opposite case. Since the probability values (0.0005, 0.0416, and 0.0000) are less than 5%, there is a Granger causality relationship between GDP and maritime exports, maritime imports, and the construction industry. While maritime exports are the Granger cause of GDP and maritime imports (0.0208 and 0.0208), the construction industry (0.1106) is not. Maritime imports are not the Granger cause of GDP, maritime exports, and construction sectors (0.6718, 0.6829, and 0.1802). While the construction sector is the Granger cause of maritime exports (0.0004), it is not the cause of GDP and maritime imports (0.0736 and 0.8980).

Table 4. Granger Causality Test of VAR Models

Excluded	Chi-sq	df	Prob.	**Results**
GDP → Export	17.75375	3	0.0005	GDP is the cause of maritime export
GDP → Construction	9.929690	4	0.0416	GDP is the cause of Constr. İnd
GDP → Import	22.56890	3	0.0000	GDP is the cause of Maritime import
Export → GDP	9.755524	3	0.0208	Maritime export is the cause of GDP
Export → Import	11.33462	3	0.0208	Mar. Export is the cause of Mar. import
Export → Construction	4.403409	2	0.1106	Mar. export is not the cause of Constr. ind.
Import → GDP	1.545728	3	0.6718	Maritime import is not the cause of GDP
Import → Export	1.497292	3	0.6829	Mar. import is not the cause of Mar. export
Import → Construction	3.427232	2	0.1802	Mar. import is not the cause of Constr. İnd.
Construction → GDP	8.542549	4	0.0736	Constr. İnd. is not the cause of GDP
Construction → Export	15.53841	2	0.0004	Constr. İnd. is the cause of Mar. export
Construction → Import	0.215156	2	0.8980	Constr. İnd. is not the cause of Mar. import

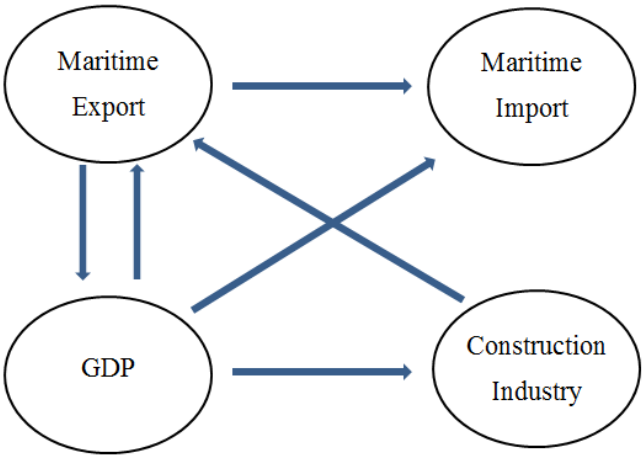


Image 5. Aspects of Granger Causality Relationships Between Variables

There is a bidirectional Granger causality relationship between GDP and maritime exports, and a unidirectional Granger causality relationship between maritime imports and the construction industry. There is a Granger causality relationship only for maritime exports from the construction sector, but not for other variables from maritime imports (Image 5).

Results and Discussion

Although many types of transport are used in international trade, maritime transport is one of the most important actors. Especially in some intercontinental transportation, maritime transportation is the only alternative. It is necessary to give due importance to maritime transport, which can affect the economic conditions of the countries. Since Turkey is surrounded by seas on three sides and due to its geopolitical location, maritime transport increases the importance of the country in terms of politics, economy, and trade.

This study is carried out by Granger causality relationships between GDP and maritime exports, maritime imports, and the construction sector. There is a bidirectional Granger causality relationship on the GDP of maritime exports. These results are similar to Emeç (2021), Tunalı and Akarçay (2018), Osadume et al. (2020) and Prandeka and Zarkos (2014). However, the results differ from Usta and Sari (2021), Igberi and Ogunniyi (2013), and Lloyd et al. (2019). Usta and Sarı (2021) could not establish a long-term relationship between maritime exports and economic growth in their study. Igberi and Ogunniyi (2013) and Lloyd et al. (2019) reported that maritime transport does not affect economic growth in their research in Nigeria.

In this study, different from the others, the development of GDP is affected by maritime exports, maritime imports, and the construction sector, but there is no relationship between maritime imports and other parameters. In addition, only maritime exports affect the development of the construction sector (Table 4). However, while there is a strong relationship between GDP and maritime exports and imports, there is a weak relationship with the construction sector. In addition, there is a strong relationship between the construction industry and maritime exports (Image 5). This means that the products in the building sector are evaluated in domestic and export markets.

In addition, the reasons for the lack of a Granger causality relationship between maritime imports and GDP, maritime exports, and construction sectors may be as follows. Products imported by sea are mainly products for consumption, which may mean that transit regimes are used less frequently. In addition,

the emphasis is on other products rather than the products of the construction sector in maritime imports. In addition, it means that other types of transportation can be used more than maritime transportation in the import of construction sector products.

Although there have been decreases in the number of ships and DWT capacities used in maritime transport in Turkey in recent years, it means that economic growth is largely dependent on maritime exports and imports and the construction sector. If maritime transport continues to decline, the economy will be greatly affected, as is the case with scientific research in Nigeria, and a decrease in the welfare level of the country may occur.

In future studies, the effects of other transportation modes on GDP, industrial production, the construction sector, and other sectors can be investigated. In this study, the areas where causal relationships cannot be established can be examined by investigating the relationships with other transportation types.

Conflict of interest

There is no potential conflict of interest in this study.

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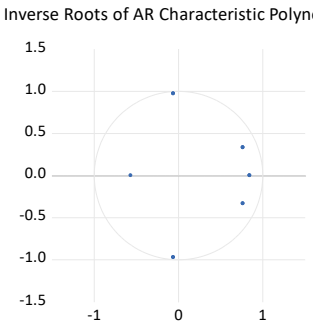
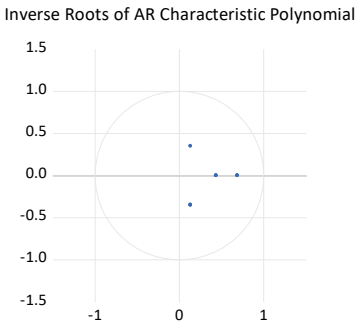
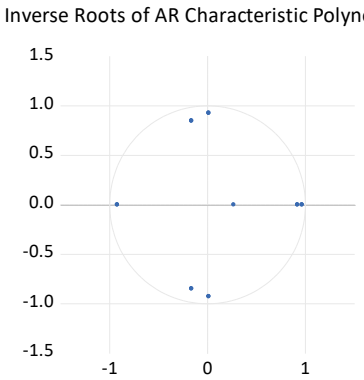
Appendices

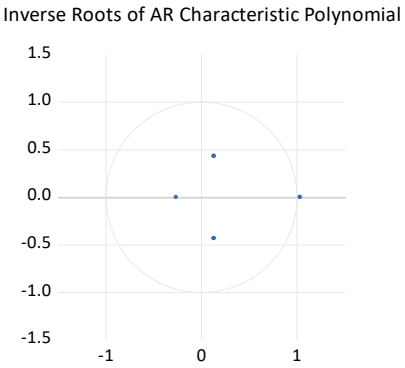




Appendix 1. Stability of GDP-Import VAR (3)

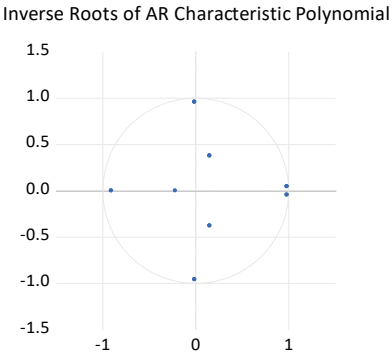


Appendix 2. Stability of Import – Const. VAR (3)



Appendix 3. Stability of GDP – Const. VAR (4)

Appendix 4. Stability of Export– Import VAR (3)



Appendix 5. Stability of Export– Const. VAR (3)

Genişletilmiş Özet

Uluslararası ticarette hemen her türlü ürünler denizyolu ile taşınabilmektedir. Bu ürünler arasında birim yük haline getirilmiş olanlar (palet, balya, çuval vb.) olabileceği gibi sıvı ve katı dökme yüklerde olabilmektedir. Dökme yüklerde demir madeni, hububat, orman, zirai vb. ürünler yer almaktadır. Ayrıca işlenmiş veya yarı işlenmiş demir malzemeleri ile yapı sektöründe kullanılan ürünler de taşınabilmektedir. Literatürde yapılan çalışmalar incelendiğinde ağırlıklı olarak denizyolu ihracat ve ithalat ile GSYİH, ekonomi, sanayi üretimi ve dış ticaret aralarındaki ilişkileri içermektedir. Yerli ve yabancı çalışmaların bazılarında, seriler aralarında pozitif ilişki tespit edilirken, bazılarında ilişki tespit edilememiş ve bazı çalışmalarda da negatif ilişki tespit edilmiştir. Denizyolu taşımacılığı ekonomik krizlerden, siyasi politikalardan ve navlun fiyatlarından etkilenebilmektedir. Bu açıdan zaman içerisinde ülke ekonomilerine etkileri de değişebilmektedir. Türkiye'de bu alanlarda yapılan çalışmalar sınırlı sayıda olup, bazı çalışmalarda denizyolu ihracat ve ithalatın GSYİH, ekonomik büyüme ve sanayi üretime üzerine olumlu etkileri bulunurken, bazı alışmalarda ise etkileri bulunamamıştır. Bu çalışmada son yıllara ait veriler kullanılarak GSYİH ile denizyolu dış ticaret arasındaki ilişkilerin yanı sıra farklı bir alan

olan yapı sektörü ile ilişkiler de irdelenmiştir. Yapı sektörü Türkiye'nin en önemli ekonomik dinamiklerinden birisi olması ve altında birçok sektörleri de barındırmasından dolayı ele alınmıştır. Zamansal serilerin her birisi bağımlı ve bağımsız değişken olarak çift yönlü analizler gerçekleştirilmiştir.

Türkiye'deki GSYİH ile denizyolu dış ticaret ve yapı sektörü arasındaki ilişkileri belirlemek için 2013-2021 yılları arasındaki verilerden yararlanılmaktadır. Veriler Türkiye İstatistik Kurumu'ndan (TÜİK) 15.02.2022 tarihinde elde edilmiş ve EViews 12 paket programı ile analiz edilmiştir. Analiz yöntemini belirlemek için zamansal serilerin durağanlık seviyeleri tespit edilmiştir. Serilerin durağanlığın tespiti için birim kök istatistik analizleri yapılmıştır. Serilerin farkı almadan I(0) durağan olmadığı için 1. fark alınarak analiz tekrarlanmış ve durağan olduğu tespit edilmiştir. Tüm serilerin birim kök istatistik sonuçları I (1) seviyesinde durağanlaştığı için Granger nedensellik analiz yöntemi tercih edilmiştir.

Özet olarak bu çalışmada, Türkiye'deki GSYİH ile denizyolu dış ticareti ve yapı sektörü arasındaki nedensellik ilişkiler belirlenmiştir. Araştırmada denizyolu ihracatın GSYİH üzerinde çift yönlü Granger nedensellik ilişki olduğu anlaşılmaktadır. GSYİH'nın gelişimini denizyolu ihracatı, denizyolu ithalatı ve yapı sektörü etkilemektedir, fakat denizyolu ithalatı ile diğer parametreler arasında hiçbir ilişki bulunmamaktadır. Ayrıca yapı sektörünün gelişimini sadece denizyolu ihracatı etkilemektedir. Ayrıca denizyolu ithalatın, GSYİH, denizyolu ihracat ve yapı sektörleri arasında Granger nedensellik ilişkinin olmamasının sebepleri şunlar olabilir. Denizyolu ithalatındaki ürünlerin ağırlıklı tüketim amaçlı olup transit geçiş rejimlerinin daha az kullanıldığı, ithalatta yapı sektörü ürünlerinde başka diğer ürünlere ağırlık verildiği ve diğer taşımacılık türlerinin daha fazla kullanılabildiği anlamına gelebilmektedir.