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DO SHOCKS HAVE PERMANENT OR TRANSITORY EFFECTS ON CONTAINER TRAFFIC IN TURKISH PORTS?

***Abdullah AÇIK*[1]**

Abstract

Container ports are one of the most important parts of the supply chain. Due to high investment and operating costs, the structure and predictability of current and future demands are very important. To investigate this structure, this study aims to determine whether the shocks to the export and import container quantities handled in Turkish ports are temporary or permanent. Both standard unit root tests and unit root tests with structural breaks were applied to export and import container amounts. According to the results, when the structural breaks are considered, it has been determined that both export and import container quantities are stationary. This situation shows that the effects of the shocks to the container traffic are temporary, the applied policies lose their effect in a short time and the future container traffic can be predicted using historical data.

Keywords*: Unit Root Test, Structural Breaks, Container Traffic, Policy Effectiveness*

ŞOKLARIN TÜRK LİMANLARINDAKİ KONTEYNER TRAFİĞİ ÜZERİNDEKİ ETKİSİ KALICI MIDIR GEÇİCİ MİDİR?

Öz

Konteyner limanları, tedarik zincirinin en önemli parçalarından biridir. Yüksek yatırım ve işletme maliyetleri nedeniyle, mevcut ve gelecekteki taleplerin yapısı ve öngörülebilirliği çok önemlidir. Bu yapıyı incelemek için bu çalışma, Türkiye limanlarında elleçlenen ihracat ve ithal konteyner miktarlarına yönelik şokların geçici mi yoksa kalıcı mı olduğunu belirlemeyi amaçlamaktadır. İthal ve ihraç konteyner miktarlarına hem standart birim kök testleri hem de yapısal kırılmalı birim kök testleri uygulanmıştır. Sonuçlara göre yapısal kırılmalar göz önüne alındığında hem ihraç hem de ithal konteyner miktarlarının durağan oldukları tespit edilmiştir. Bu durum, şokların konteyner trafiğine olan etkilerinin geçici olduğunu, uygulanan politikaların kısa sürede etkisini yitirdiğini ve geçmiş veriler kullanılarak gelecekteki konteyner trafiğinin tahmin edilebileceğini göstermektedir.

Anahtar Kelimeler: *Birim Kök Testi, Yapısal Kırılma, Konteyner Trafiği, Politika Etkinliği*

[1] *Dr., Dokuz Eylül University, Maritime Faculty, Department of Maritime Business Administration, abdullah.acik@deu.edu.tr, orcid.org/0000-0003-4542-9831*

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1. Introduction

Maritime transport has a supply chain consisting of many components (Sys and Vanelslander, 2020:262). Although the main players look like ports and ships, there are also a lot of players involved in providing services to these main players through vertical relationships (Leal et al., 2011:530). In this respect, with an effect that we can call the multiplier effect, the changes in the cargo traffic can make its effect felt in many different sectors. Due to this effect, providing a sustainable transportation network for policymakers is important for both the national economy and transport security. At this point, determining whether the policies applied to maintain and develop international trade are effective is important in terms of shaping the policies in the next process. One way to determine the impact of policies is to examine the impact of the shocks contained in the series. However, in the literature, the lack of a study examining the impact of policies on maritime transport is outstanding.

In this study, we aimed to investigate whether the shocks in the amount of exported and imported containers are permanent or temporary. Determining whether the effects of shocks on container shipping are permanent or temporary is of different importance for policymakers, port managers, port users, liner shipping companies, other service providers, and entrepreneurs interested in foreign trade. We aimed to use unit root tests to detect the impact of the shocks. Using these tests, it has been examined whether the shocks are temporary or permanent in many different research areas in the literature. We performed our analyzes using both standard unit root tests and unit root tests that take into account the structural breaks in the series. The reason for this is to consider the possible effect of structural breaks in the series on the unit root test results. The unit root in container volumes indicates that the shocks to the series are permanent and their effects continue in the long run. In addition, if the shock is permanent, this shock may be transmitted to other related sectors. On the other hand, if container trade volumes are stationary, it shows that the shocks to the series are temporary and the series returns to the trends when the shock effect loses. As a result of our research, it has been determined that shocks in container trade are temporary, lose their effects after a while, and the policies implemented have temporary effects. For this reason, it has been revealed that shocks in container trade do not spread to other relevant sectors and future data can be predicted using historical data.

General topics in port literature are evaluated in the second section of the study. In this way, it is aimed to draw a framework for our research. In the next sections, the method and data set we use are introduced. After the results of the analysis are presented, final evaluations are made in the last section.

2. Literature Review

No studies have been found in studies on the port that examine the structure of the shocks in the port traffic. For this reason, making a general evaluation of the studies conducted specifically for ports may be useful in drawing the framework of the subject. Studies on ports generally consist of studies

examining port efficiency and performance (e.g., Ateş et al., 2013; Ateş and Esmer, 2014; Güner, 2015a; Güner, 2015b; Sağlam et al., 2018; Bucak et al., 2020), factors affecting cargo traffic at ports (e.g. Chou et al., 2008; Lättilä and Hilmola, 2012; Akar and Esmer, 2015; Chi and Cheng, 2016; Kim, 2016; Kim, 2017; Tsai and Huang, 2017; Gosasang et al., 2018; Açık, 2019; Açık et al., 2019a; Açık et al., 2019b; Erginer et al., 2019; Açık, 2020) and the relations of ports with their users (e.g. Sağlam and Karataş Çetin, 2018).

Each of these studies is important for understanding the ports and developing suitable policies. However, since the subject of our research is the shocks that the cargo traffic in ports is exposed to, it would be more reasonable to consider studies examining the factors affecting port cargo traffic. One of the most important factors affecting port traffic is the changes in exchange rates. The exchange rate, which is one of the most important macro variables, has a significant function in international trade as it determines the relative price of products in countries relative to other countries. Goods in countries where the currency is relatively worthless may be cheap to other countries, resulting in more exports than that country. Therefore, many empirical studies (e.g., Lättilä and Hilmola, 2012; Chi and Cheng, 2016; Tsai and Huang, 2017; Kim, 2017; Açık et al., 2019a) have investigated the effect of exchange rates on port cargo traffic and found significant results.

Various tools are used to measure the production made in the country as a result of the demand for domestic goods. The most basic tool is the industrial production level in the country. Especially in countries with relatively worthless exchange rates, the production sector works export-oriented. In addition, most of the developing countries use imported intermediate goods in their production activities. This situation causes an increase in imports while the demand for the goods of the country increases. In this case, the level of industrial production is another important macroeconomic variable that affects port traffic for countries. Because of this importance, it has been discussed in many studies in the literature (e.g., Chou et al., 2008; Lättilä and Hilmola, 2012; Tsai and Huang, 2017; Gosasang et al., 2018; Açık et al., 2019b; Erginer et al., 2019), and empirically significant results have been obtained. Also, there is an increase in the welfare level of the country with the effect of production and trade within the country. For this reason, the effect of GPD on port traffic has been also analyzed in several studies (e.g., Chou et al., 2008; Lättilä and Hilmola, 2012; Akar and Esmer, 2015; Tsai and Huang, 2017), and significant results have been obtained.

Due to the derived nature of maritime trade, the goods must be demanded so that business can be done in the maritime industry. The more demand for goods, the more cargo traffic will be in the ports. In this respect, the population of the region, which is one of the factors affecting the regional demand for goods, was used to examine the demand for ports and significant results were obtained in the literature (e.g., Chou et al., 2008; Akar and Esmer, 2015). Another issue that can be associated with the population is the uncertainty within the country. Individuals tend to consume less when uncertainty increases, and when uncertainty decreases, they tend to consume more. In this respect, the impact of uncertainty within the country on port cargo traffic has been examined in the

literature (e.g., Açık, 2020), and it has been found that increased uncertainty causes a decrease in port cargo traffic.

Since transport costs are added to the price of the final product, they have a great impact on the demand for the related product. Therefore, as the transportation cost increases, the demand for the product may decrease. The issue of shipping in ports is about loading containers on ships and sending them to their destinations. At this point, since the share of the freight costs of the ships is higher than other cost items, the change in freight rates may affect the demand for goods and therefore the container traffic at ports. This research question has also been examined in the literature (e.g., Kim, 2016; Açık, 2019), and it has been determined that the volatility in ship freights significantly affects the cargo flow at ports.

All the variables we have mentioned so far consist of economic and macro variables. These variables certainly have an effect on the cargo traffic in the ports. However, the port preferences of ship owners and shippers can also be effective in port traffic (e.g., Lee et al., 2010; Tran, 2011; Ng et al., 2013; Hsu et al., 2020), as is peculiar to container transportation. Shipowners can make long or short-term agreements with some ports under certain conditions and this agreement means regular cargo traffic for the relevant container port. However, the termination of the agreement also means a decrease in cargo traffic for the old port. Since we apply the analysis for the total container traffic in Turkey, the port choice decisions of the ship owners and shippers do not affect our results in this study. However, they should be taken into account in other studies involving heterogeneity between ports. On the other hand, the decisions of global liner companies to select a different country as a transshipment port may also significantly affect the port traffic in related country. In order to minimize this effect, we have removed the transit containers at Turkish ports from our data.

So far, we have examined the general literature on ports and the factors affecting the cargo traffic in ports. Now, it will be useful to consider in which areas the method we selected in our study is used for similar purposes in the literature. Unit root tests are widely used in the literature to determine whether shocks are temporary or permanent. The investigated areas in these studies are tourist expenditures and inflow (e.g. Narayan, 2005; Lean and Smyth, 2009; Baig and Hussain, 2020; Yucel, 2020), stock prices (e.g. Narayan, 2008), oil prices (e.g. Narayan et al., 2008), energy consumption (e.g. Shahbaz et al., 2014; Öztürk and Aslan, 2014; Yilanci and Tunali, 2014; Lean and Smyth, 2014; Gozgor, 2016), price bubbles (e.g. Malhotra and Maloo, 2014), outputs of the countries (e.g. Guloglu and Ivrendi, 2008; Suresh, 2016), economic growth of the countries (e.g. Aly and Strazicich, 2011), exchange rates (e.g. Narayan and Prasad, 2008), unemployment rates (e.g. Khraief et al., 2020), inflation rates (e.g. Lee and Chang, 2008), ecological footprint (e.g. Ulucak and Lin, 2017), air passenger traffic (e.g. Njegovan, 2006).

As can be seen from the studies, unit root tests were used not only for economic variables but also for determining the effects of shocks for variables from many different areas. In this study, we chose this method to analyze the container

traffic in Turkish ports and we aimed to make an original contribution to the port literature by applying our analysis. The lack of a similar study increases our motivation for the originality of our study.

3. Methodology and Data

Testing the unit root hypothesis is an important method for determining whether the effects of shocks on a variable are permanent or temporary (Narayan, 2005). In the study, unit root tests were used to determine whether the shocks were permanent or temporary, as in many studies in the literature. The fact that the series contains a unit root, in other words, being I (1) shows that shocks have permanent effects. The fact that the series is stationary, in other words being I (0) shows that shocks have temporary effects (Davis, 2008:146). Policies applied in cases where permanent shocks are prevalent may be effective, but otherwise lose their effect in the long term, as stationary series tend to revert to their average trends.

For this research, we first used the standard unit root tests, which are augmented Dickey-Fuller (Dickey and Fuller, 1969) and KPSS (Kwiatkowski et al., 1992) tests. Then, we used the same unit root tests that take into account possible structural breaks in the series, considering that the breaks in the series may affect the unit root results. These unit root tests are one break ADF test (Zivot and Andrews, 1992), two breaks ADF test (Narayan and Popp, 2010), and two breaks KPSS test (CiS and Sanso, 2007). Since these methods are very common and used widely, no space is spent in this section to explain the mathematical forms of each.

By using these tests, we aimed to test whether the impact of shocks on export and import cargo quantities in Turkish ports is permanent or temporary. If the series is determined as I (0), it means that shocks are temporary, while if the series is determined as I (1), it means that effects of shocks are permanent. Analyzes were applied using the GAUSS econometrics analysis software. The dataset consists of 193 monthly observations and covers the dates between January 2004 and January 2020. The unit of the data is the Twenty-foot Equivalent Unit (TEU), which is a standard measurement unit used to define the amount of container transportation. The dataset was obtained from the website of the Ministry of Transport and Infrastructure (2021). The data includes monthly exported and imported container amounts in Turkish ports. Transit and cabotage container cargoes are excluded from these variables.

Descriptive statistics for the variables are presented in Table 1. When the average values of raw data are analyzed, it is seen that imported container cargoes are more than exported containers. This situation is already reflected in Turkey's current account balance and serve our country is a long-term deficit. For example, the average ratio of export/import coverage ratio between 2015 and 2019 is 75.2%, which can be considered as a low rate (TSI, 2021). When the log-differenced return variables are analyzed, it is seen that the average return of both variables is positive. They followed an increasing course on average in the period under consideration. Therefore, as can be understood from the skewness values, the effect of positive shocks was more effective than others.

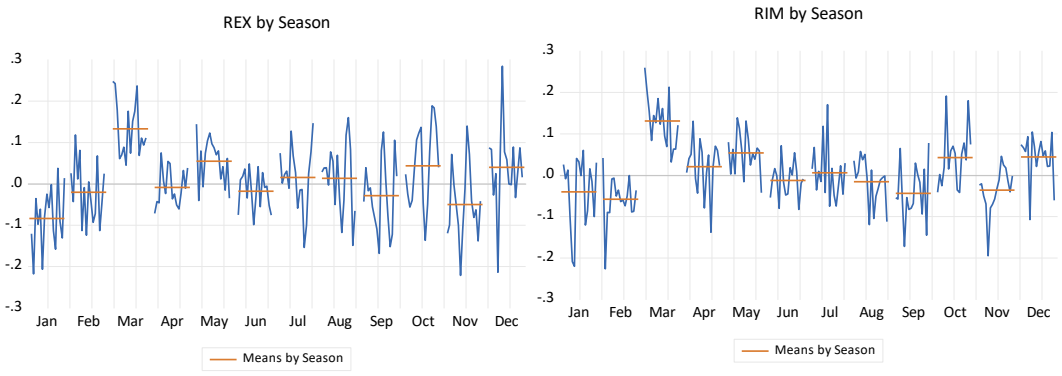
Table 1: Descriptive Statistics

	Export	Import	R_Export	R_Import
Mean	238570.6	241631.6	0.007529	0.007750
Median	233496.0	237200.5	0.005628	0.008478
Maximum	412770.7	404159.0	0.284530	0.260113
Minimum	95442.50	88393.00	-0.221450	-0.226108
Std. Dev.	78796.00	80207.95	0.092452	0.080136
Skewness	0.264142	0.112662	0.118228	0.021507
Kurtosis	2.160523	2.012211	3.111653	3.706023
Jarque-Bera	7.911434	8.254747	0.547019	4.002547
Prob.	0.019145	0.016125	0.760705	0.135163
Obs.	193	193	192	192

Source: (MTI, 2021).

Since our data consists of monthly data, it must be seasonally adjusted. Quarterly and monthly data often exhibit cyclical movements, and these cyclical movements should be removed in order to obtain consistent and accurate results. For this, seasonally adjusted series were obtained by using TRAMO/SEATS application of econometric software. Figure 1 shows the average of the return series according to seasonal months. As can be seen from this graph, there are significant seasonal effects in both of the variables. Especially in March, both export and import variables enter an increasing trend. In January and November, there is a great decrease in exports. Similar examples can be reproduced, and these examples demonstrate the presence of seasonal effects. Therefore, it is of great importance to purify these seasonal effects from the variables.

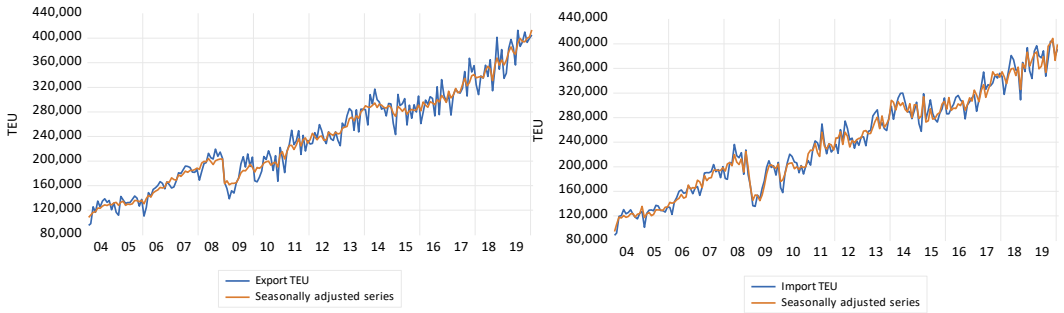
Figure 1: Seasonality Patterns of the Data



Source: (MTI, 2021).

Figure 2 presents both raw data and seasonally adjusted data. As can be seen, fluctuations are less involved in the adjusted data. When the situation regarding the course of the data is analyzed, it is seen that there are breaks in the series in some periods. For example, after the 2008 global economic crisis, there has been a decline in container traffic in Turkish ports. In the following processes, an increasing trend was entered again and previous levels were exceeded. Similarly, it can be said that there was a break at the level in 2014 as well. Therefore, tests that take into account structural breaks may be more beneficial.

Figure 2: Raw and Seasonally Adjusted Data



Source: (MTI, 2021).

In the next section, our analyzes were applied over the methods and data set we mentioned here, and our results were presented.

4. Results

We used the logarithmic series in our analysis because this increases the processability of the data and better distribution properties can be obtained. In the study, firstly, Augmented Dickey-Fuller (Dickey and Fuller, 1969) and KPSS (Kwiatkowski et al., 1992) tests, which are the standard unit root tests, were applied and the results are presented in Table 2. The null hypothesis of the ADF test indicates that the series contains a unit root. In this case, rejecting the null hypothesis can be interpreted as the shocks in the series are temporary. The results revealed that the null hypothesis cannot be rejected for the Import variable. For the export variable, the null hypothesis can be rejected in the intercept & trend state. In this case, shocks in the export variable are permanent while shocks in the import variable are temporary. On the other hand, in the KPSS test, which is applied to support the first unit root test, the null hypothesis indicates that the series is stationary. The rejection of the null hypothesis can be interpreted as the shocks in the series are permanent. The results revealed that the null hypothesis is accepted in the intercept & trend state for both export and import variables. This situation shows that the shocks in both export and import variables are temporary. However, as seen in Figure 2, there may be some breaks in the series. Therefore, the application of unit root tests, which also take into account structural breaks, may be important to obtain valid results.

Table 2: Results of the ADF and KPSS Tests

	Intercept	Intercept & Trend	Decision
Augmented Dickey-Fuller (1969)			
Export	-0.712	-2.526	H0 Accepted
Import	-1.323	-4.000**	H0 Rejected
(Kwiatkowski et al., 1992)			
Export	1.673	0.133**	H0 Accepted
Import	1.649	0.169***	H0 Accepted

Notes: Null of unit root is rejected at *10%, **5%, ***1%. Null of stationary is accepted at *90%, **95%, ***99%. Bartlett Kernel and Newey West are used.

We also applied the versions of the ADF and KPSS tests that take into account the breaks in order to take into account the possible breaks in the series, which can be seen in Figure 1. These tests are one break ADF test (Zivot and Andrews, 1992), two breaks ADF test (Narayan and Popp, 2010), and two breaks KPSS test (CiS and Sanso, 2007), and the results are presented in Table 3. According to the results of the single break ADF test, the unit root null hypothesis is accepted for the export variable and rejected when the breaks in both the level and the trend are taken into account for the import variable. Level and trend break date for the import variable is determined as 09.2008, which is the time where the 2008 global economic crisis occurred. ADF test with two breaks results reveals that the unit root null hypotheses are rejected for both of the variables. The level break dates for the export variable are 10.2008 and 02.2014, while level and trend break dates are 10.2008 and 10.2014. The level break dates for the import variable are 09.2008 and 02.2015, while level and trend break dates are 09.2008 and 08.2014. Especially former dates for both variables corresponds to the global economic crisis. KPSS test with two breaks tests results reveals that the null of stationarity hypotheses are accepted both for the export and import variables. The level break and level and trend break dates for the export variable are the same and correspond to 12.2004 and 11.2008. The level break dates for the import variable are 08.2006 and 11.2008, while level and trend break dates are 12.2004 and 11.2008. According to the general results obtained, considering the breaks in the series, both series are stationary and I (0). This shows that the shocks in the series are temporary and the series returns to average in the long run.

Table 3: Unit Root Test with Structural Breaks

Test Items	Mod A Export	Mod C Export	Decision	Mod A Import	Mod C Import	Decision
	One break ADF test (Zivot and Andrews, 1992)					
ADF Stat	-3.604	-4.191	H0 Accepted	-4.444	-5.465**	H0 Rejected
Break Date	12.2005	10.2008		11.2005	09.2008	
Fraction	0.12	0.30		0.11	0.29	
Lag	3	3		1	1	
	Two breaks ADF test (Narayan and Popp, 2010)					
ADF Stat	-6.842***	-8.883***	H0 Rejected	-7.258***	-9.149***	H0 Rejected
Break Dates	10.2008, 02.2015	10.2008, 10.2014		09.2008, 02.2015	09.2008, 08.2014	
Fractions	0.30, 0.69	0.30, 0.67		0.29, 0.69	0.29, 0.66	
Lag	3	3		1	1	
	Two breaks KPSS test (CiS and Sanso, 2007)					
KPSS Test	0.100***	0.026*	H0 Accepted	0.117***	0.028*	H0 Accepted
Break Dates	11.2008, 12.2004	11.2008, 12.2004		08.2006, 11.2008	11.2008, 12.2004	
Fractions	0.30, 0.68	0.30, 0.68		0.16, 0.30	0.30, 0.68	

Notes: Null of unit root is rejected at *10%, **5%, ***1%. Null of stationary is accepted at *90%, **95%, ***99%. Mod A refers to structural break in level, Mod C refers to structural break in both level and trend. AIC max lags 14

The findings we have obtained show that the shocks that are included in both the export and import container quantities in Turkish ports have temporary effects. In addition, we determined that both imported and exported container amounts were subjected to structural breaks in the period under consideration. According to these results, it is revealed that the effects of factors such as exchange rate, industrial production, freight rates, and economic uncertainties on port throughputs are temporary.

This result puts different findings for elements such as ports, policymakers, and port users. First of all, it can be said that the effects of the policies that encourage or restrict trade by policymakers soon disappear, because, in the long run, both imported and exported container volumes tend to return to the average trend. Container traffic can be used as an alternative measurement tool to measure international trade concretely, as monetary values are subject to many inflationary effects. In this respect, different new strategies can be followed to ensure that policies do not lose their effects in the long term. Especially, it is of great importance to developing permanent effective policies aimed at reducing the uncertainty in the country and ensuring stability in exchange rates, since the effect of these factors is felt in the Turkish container ports (e.g., Lättilä and Hilmola, 2012; Chi and Cheng, 2016; Tsai and Huang, 2017; Kim, 2017; Açık et al., 2019a; Açık, 2020).

For ports, the loss of the effects of shocks may be beneficial in reducing uncertainties regarding future demand changes. Because container traffic does

not carry the shocks they are exposed to, it may be possible to predict the possible future demand using historical values. Since the investments of ports are very expensive and time-consuming processes, predicting future traffic can contribute to ports' ability to pursue proactive investment strategies. Having more input than needed may cause a loss of efficiency in ports (e.g., Ateş et al., 2013; Ateş and Esmer, 2014; Güner, 2015a; Güner, 2015b; Sağlam et al., 2018; Bucak et al. 2020) and this may negatively affect competitive advantage by causing an increase in average costs per unit. Otherwise, in case of permanent shocks, they may be exposed to the risk of being unprepared for surprise demand changes and losing competitive power against the competitors. Temporary shocks can provide a similar benefit to service providers in the hinterland of ports. They too must be able to anticipate the demand at ports in terms of preparing their own service equipment and stockpiles. Because in this way, they do not have to bear unnecessary investment and inventory costs.

4.Conclusion

In this study, we have started to investigate the factors affecting the container traffic in Turkish ports by revealing which variables are effective. We then aimed to determine whether the shocks in the amount of containers were temporary or permanent, possibly for reasons arising from these factors. We used unit root tests, which are widely used in the literature, to determine the structures of the shocks. As one of those who dealt with this issue from this perspective for the first time in the literature, we tried to make an original contribution. Besides, in this study, we have also examined the effectiveness of the factors affecting port traffic in a sense, which have been extensively examined in the literature. Our findings show that considering the structural breaks, shocks in both export and imported containers have a temporary effect. The fact that the shocks are temporary means that they lose their effects over time. This situation may also show that the policies towards international trade within the country are not effective and their effects last for a short time. Because the reflections of the policies towards the country's economy will directly reflect on the port sector, which is one of the most important pillars of international trade. Based on our results, future values can also be estimated using historical data. In this case, the elements whose business strategies and business volumes are closely related to port traffic can use applications to estimate the likely future demand amount. Thus, risks arising from uncertainty can be reduced and proactive business planning can be implemented.

In future studies, possible nonlinear structures in the series can be examined and the scope of the analysis can be expanded by using unit root tests suitable for that structure. Because in the globalizing world, crises and volatility are spreading very rapidly and this effect is felt even in the most remote corners of the world. Also, cargo traffics at different ports can be handled separately, because there may be heterogeneity between the ports.

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