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Research Article

The impact of economic activities in US on container freight rates: An application on China-USA route

ABD ekonomisinin kontayner navlun oranları üzerine etkisi: Çin-Amerika rotasında bir uygulama

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Abstract

Container shipping is a crucial transportation method for manufactured consumer goods. Seaborne trade and container shipping is highly affected by various factors. Global economic growth, international trade, demand-supply balance in the container shipping market affect the container shipping industry. The global economy is the most critical demand factor. Supply in container shipping is container fleet capacity which is inelastic, and the market cannot respond to sudden demand changes. Therefore, changes on the demand side can rapidly impact freight. This study aims to empirically examine the effect of changes in demand on container shipping freight rates. In the analysis, the impact of the changes in the GDP of the USA, the world's largest economy, on the container freights between the USA and China was examined by the regression analysis method. The research results have determined that the relationship between the variables is positive when the structural breaks are taken into account, and a 1% change in GDP causes a 3.17% change in freight rates. It was also determined that there was a structural break in the model after 2020 Q1 with COVID-19. The findings show how sensitive maritime transport is too large economies and how big this situation poses.

Keywords: Economic Growth, Seaborne Trade, Container Shipping, Freight Rates

Jell Codes: L09, C05, O04

Öz

Konteyner taşımacılığı, dünyanın üretilen tüketim malları için çok önemli bir taşımacılık çeşididir. Deniz yoluyla yapılan ticaret ve dolayısıyla konteyner taşımacılığı çeşitli faktörlerden oldukça etkilenir. Küresel ekonomik büyüme, uluslararası ticaret, konteyner taşımacılığı pazarındaki arz-talep dengesi, konteyner taşımacılığı sektörünü etkileyen faktörlerden bazılarıdır. Küresel ekonomi en önemli talep faktörüdür. Konteyner taşımacılığında arz, esnek olmayan konteyner filosu kapasitesidir ve piyasa ani talep değişikliklerine cevap veremez. Ancak talep tarafındaki değişikler navlun oranları üzerinde ani etkiler yapabilir. Bu çalışmanın amacı, talepteki değişimlerin konteyner taşımacılığı navlun oranları üzerindeki etkisini ampirik olarak incelemektir. Analizde, dünyanın en büyük ekonomisi olan ABD'nin GSYİH'sindeki değişimin ABD ile Çin arasındaki konteyner navlun oranlarına etkisi regresyon analizi yöntemi ile incelenmiştir. Araştırma sonuçlarında, yapısal kırılmalar dikkate alındığında değişkenler arasındaki ilişkinin pozitif olduğu ve GSYİH'deki %1'lik bir değişimin navlun oranlarında %3,17'lik bir değişime neden olduğu tespit edilmiştir. COVİD-19'un da etkisiyle 2020 1. çeyrek sonrasında modelde yapısal kırılma olduğu da belirlenmiştir.

Anahtar Kelimeler: Dünya Ekonomisi, Ekonomik Büyüme, Deniz Ticareti, Konteynır Taşımacılığı, Navlun Fiyatları

Jell Kodları: L09, C05, O04

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Introduction

The globalization of the world economy, the cross-border production and consumption relations, and the advantages offered by sea transport played a role in this increase. These advantages can be counted as cheaper sea routes than air, land and railways, less pollution to the environment, lower energy consumption, and the ability to transport large quantities of products such as raw materials at once and safely. Therefore, transporting goods by sea is an essential participant in international trade. Furthermore, maritime transport is the most effective way to transport goods over long distances in terms of costs and environmental impact. Furthermore, the maritime business is essential for the development of economic activities, as international trade requires ships to transport cargo from places of production to areas of consumption. Therefore, shipping plays a vital role in world trade and the economy. Nowadays, although a certain amount of the world trade is transported by truck, rail, aeroplane etc. most is carried by ships. It was estimated that 90 per cent of world trade goods in the volume are shipped by the sea (Ma, 2004: 11).

In maritime transport, specific cargo and ship types are developed. Products such as iron ore, coal, grain constitute dry cargo and are subject to dry bulk cargo transportation. Liquid bulk shipping includes crude oil, petroleum products and gas. In container transportation, which enables the vehicle of different products together and easier to transfer, the loads are transported in large-sized crates made according to international standards. Ships are also classified according to the type of cargo they carry, such as dry cargo, liquid cargo (tanker), container, bulk cargo ships, and Ro-Ro vessels that provide wheeled vehicles (UNCTAD, 2018). Freight is the fee paid by the cargo owner and earned by the shipowner for the execution of all these transportation activities. The interaction of the two parties forms the freight market, and the equilibrium price fluctuates according to some conditions (Alizadeh & Nomikos, 2009:46).

Fluctuations in container freight rates depend on the supply and demand balance. It is said that container fleet capacity, which is considered to be supplied, depends on the profits of the shipowner. An increase in this profit is observed when the demand is increased so freight rates. In container shipping, this demand is affected mainly by the world economy and international trade since container ships carry finished goods in the economy. Since the growth rates highly influence the freight rates in container shipping in the world economy, this research aims to find and explain a relationship between freight rates and the economic growth of the USA economy. This study uses a similar study to the container market, which was previously done for the dry bulk market (Başer & Açık, 2019). Although maritime transport is logically about moving cargo from one point to another, it has different markets for different cargo types. These markets may differ from each other in terms of features (Ma, 2020:302). Therefore, the results obtained in the dry bulk market and the results obtained in the container market may differ. The dry bulk market deals mainly with transporting raw materials, while the container market deals with transporting finished products. In the general literature, the relationship between economic growth and freight rates has been analyzed with statistical methods for maritime transport (e.g. Chi, 2016; Park, J. S., Seo, Y. J., & Ha, M. H., 2019; Akbulaev & Bayramli, 2020; Michail, 2020; Özer, M., Canbay, Ş., & Kırca, M., 2020; Şeker, 2020), road transport (e.g. Kveiborg & Fosgerau, 2007; Alises, A., Vassallo, J. M., & Guzmán, A. F., 2014), air transport (e.g. Marazzo M, Scherre R, Fernandes E., 2010; Brida J.G., Rodriguez-Brinidis, M.A., Lanzilotta, B. & Rodriguez-Collazo, S., 2016), rail transport (e.g. Kulshreshtha M, Nag B, Kulshreshtha M., 2001; Maparu & Mazumder, 2017; Khan & Khan, 2020) and general transport (e.g. Beyzatlar, M.A., Karacal, M. & Yetkiner, H., 2014; Benali & Feki, 2020; Ma, Y., Zhu, J., Gu, G., & Chen, K., 2020; Wang, H., Han, J., Su, M., Wan, S., & Zhang, Z., 2021), and significant results have been obtained. Of course, there are numerous valuable studies in this literature, but we have only pointed out some of them. In these studies, some relationships were determined from transportation to economic growth, while others from economic development to vehicle. In addition, there have been studies that have determined that the relations are two-way. This situation results in line with the supply-led and demand-led growth explanations of a trade using transport facilities. While some studies applied their analyses to a single country, others applied their analyses on a panel data set. To further individualize the impact, we have found it appropriate to examine the effects of economic activities on transportation by considering trade between the world's two largest economies. In this direction, we aimed to empirically determine the USA's gross domestic product (GDP) impact on freight rates, based on the container freights between the USA, the world's largest economy, and China, the world's largest exporter. Theoretically, a positive relationship can be expected. Maritime transport has a derived demand structure (Theotokas, 2018:84). The demand for goods, which increases with production, is mainly met by naval transportation. However, this situation may be different for the container market, which has a monopolistic market structure in the short term (Ma, 2020:304). According to the analysis applied on the freights on the Shanghai-New York route, it has been

determined that the GDP of the USA is very effective on the freights of the route, and a 1% change in GPD causes a 3.17% change in freight rates. This shows that container freights are also highly dependent on macroeconomic indicators despite having a monopolistic structure. In addition, structural break tests determined two break dates in the model. The first one is in 2015 Q3, and the second one is 2020 Q1. With these results, it has been revealed that market structure and economic growths are very effective in forming freights.

The second part of the study presents brief information about international container transportation. The third part explains the basic formation philosophy of freight rates. The data set and method used in the study are introduced in the fourth part. After the results obtained from the analyzes are presented in the fifth part, the findings are evaluated in the last detail.

Container trade in the world

Transport of goods by sea is an essential participant in international trade. Maritime transport is the most effective way to transport goods over long distances in terms of costs and environmental impact. The maritime business is essential for the development of economic activities, as international trade requires ships to transport cargo from places of production to areas of consumption. Adam Smith, the father of the economy, saw shipping as a low-cost transport source that could open up markets. Smith mentioned that "as using water carriage, a more extensive market is opened to every sort of industry… it is upon the sea-coast that industry of every kind naturally begins to subdivide and improve itself" (Smith, 1776). Shipping plays a vital role in world trade and the economy. Today, a certain amount of world trade is truck, rail, plane, etc. Although it is transported by ship, most are made by ship. It was estimated that 90 per cent of world trade goods by volume were shipped by sea. (Ma, 2004:11).

The container shipping industry consists of shipping companies transporting containerized goods overseas via regular liner services as a core activity. Liner service is "a fleet of ships, with a common ownership or management, which provide a fixed service, at regular intervals, between named ports, and offer transport to any goods in the catchment area served by those ports and ready for transit by their sailing dates" (Stopford 1997:343). Container liner services are focused explicitly on transporting a limited range of standardized unit loads: the twenty-foot dry - cargo container or TEU and the forty-foot dry - cargo container or FEU. Occasionally, slightly diverging container units are also loaded on container vessels, such as high cube containers, tank and open-top containers and 45 - foot containers. The diversity in unit loads in the container shipping industry is low due to the need for uniformity when stacking containers below and on the deck of specialized container vessels.

The maritime industry experienced so many changes more than during the previous 2000 years; however, canals, railroads and steamships came together in a global transportation network in the 19th century. The technology of steamships has allowed ship owners to provide scheduled service. Service of the cargo ship was flexible to carry a mixture of products, semi-products, small amounts of bulk cargoes, passengers etc. In addition to this, it was a slow and demanding process to load and unload available shipments as bulk cargo to ships. At the end of the 1950s, the cost of 60-75% of carriage of cargoes via sea route was done at the port. Today, in favour of containerization, this cost was reduced to 37% of carriage of cargoes via sea route. Malcolm McLean from the USA, a businessman owner of a lorry company, led container transportation to view in the 1950s. He bought Pan Atlantic Tanker Company and customized its ships for carrying containers in 1955. On 26th April 1956, he got the 1st container transportation started from New Jersey to Houston. A while later, He renamed his company Sea-LAND. He got the 1st transatlantic container transportation from his new-built terminal in New Jersey to McLean's new trailer terminal in Rotterdam. Using containerization coming into view, intermodal transport of international commerce started a revolution. Containerization of sea route transportation has drawn attention because of the shortening duration of port operations. By comparing services, the port duration of a container vessel was reduced to only 17% of a bulk cargo ship's port duration. Besides the shortening of the port period, container transportation has changed how shipping companies work. ''Door to door'' service has become an essential part of container transportation services. The need to manage the land or seasides of the transportation has promoted improving intermodal transport.

Meanwhile, containerization has caused consolidation, so the shipping industry became the most intensive sector, and this will be examined in more detail in the next stage. Lastly, because container ships cannot be transferred between lines and bulk cargoes, the tramp transportation market has disappeared for the vessels that carry containerised cargoes. Small bulk carriers, open/close bulk carriers, parcel tankers, car carriers, MPP vessels and heavy-lifting vessels have started working in this market. In addition to its effects on the maritime industry, it had a more substantial impact on the world

economy. Containerization made transportation fast, trustable and cheap between various territories. In 2004, putting 4000 video recorder devices in a container has reduced freight costs to 83 cents per unit from the Far East to Europe. As a result, distance and cost of transportation have become less critical subjects in the production industry (Fan, 2011).

The globalization of the world economy, the cross-border production and consumption relations, and the advantages offered by sea transport played a role in this increase. These advantages can be counted as cheaper sea routes than air, land and railways, less pollution to the environment, lower energy consumption, and the ability to transport large quantities of products such as raw materials at once and safely. In maritime transport, specific cargo and ship types are developed. Products such as iron ore, coal, grain constitute dry cargo and are subject to dry bulk cargo transportation. Liquid bulk shipping includes crude oil, petroleum products and gas. In container transportation, which enables the vehicle of different products together and easier to transfer, the loads are transported in large-sized crates made according to international standards. Ships are also classified according to the type of cargo they carry, such as dry cargo, liquid cargo (tanker), container, bulk cargo ships, and Ro-Ro vessels that provide wheeled vehicles. The change in the distribution of merchant ships according to their load types shows that container ships are the fastest-growing group among them (Table 1). Container transportation, which has become widespread since the 1960s, has been developing due to good cargo protection, allowing different loads, fast handling, and easier integration with road and rail. In this direction, container transportation shows very rapid development globally (UNCTAD, 2018).

Table 1: Distribution of merchant ships according to their load types by years, (DWT percent)

Type of Ship	1980	2018
Tanker	49,70%	29,20%
Dry Bulk Carrier	27,20%	42,50%
General Cargo	17,00%	3,90%
Container Carrier	1,60%	13,10%
Others	4,50%	11,30%

Source: UNCTAD (2018).

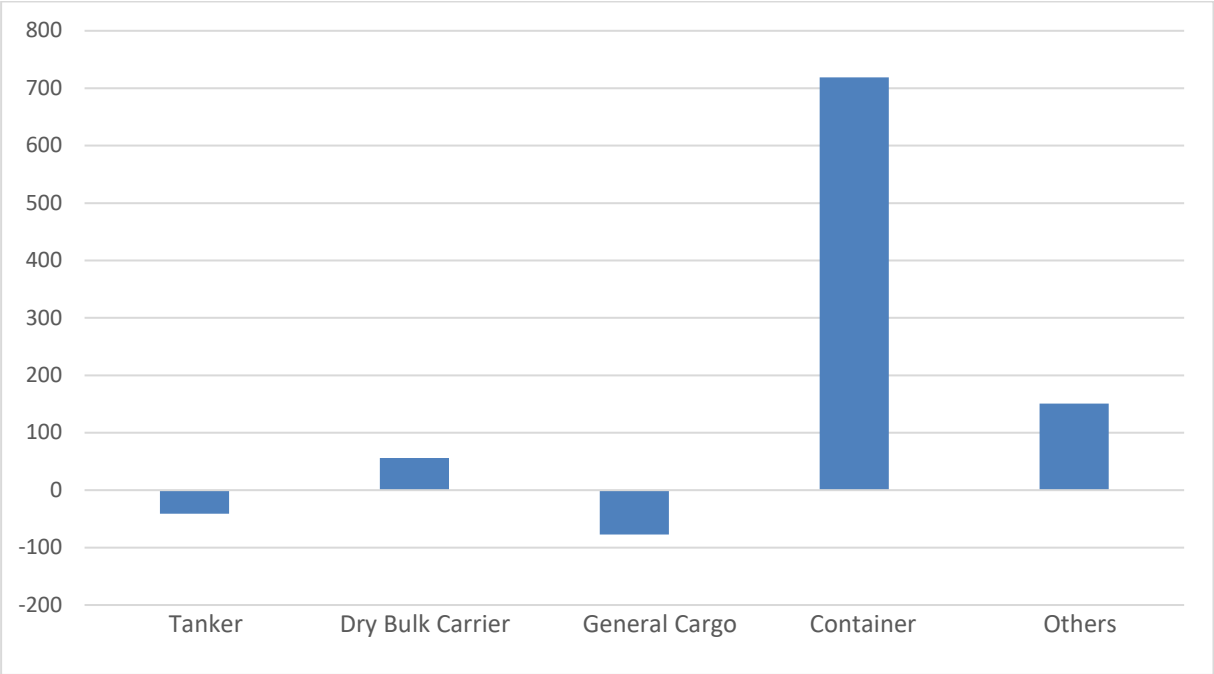

Figure 1: Percentage Change of Transport by Ship Types in World Trade, DWT, 1980-2018

Source: UNCTAD (2018).

The change in the share of ship types in maritime transport between 1980 and 2018 indicates a decrease in tankers and general cargo ships, whereas dry bulk and container transport has increased. Container transportation displayed the most significant increase in these trends with 719% (Figure 1). Container ships, which had only 1.6% in 1980, increased their share to 13.10% in 2018. This shows us the trend expressed as containerization (UNCTAD, 2018).

Container shipping routes can be categorized into three main groups: (1) East-West trades, which circle the globe in the Northern Hemisphere linking the major industrial centres of North America, Western Europe and Asia; (2) North-South trades articulating around significant production and consumption centres of Europe, Asia and North America, and linking these centres with developing countries in the Southern Hemisphere; and (3) intraregional trades operating in shorter hauls and with smaller ships. Asia-North America container shipping route has the most volume among all other top trade routes, 26,527,000 TEU containers, as shown in Table 2.

Table 2. Top Trade Routes (TEU Shipped), 2017

Route	West Bound	East Bound	North Bound	South Bound	Total
Asia-North America	7,490,000	19,482,000	N/A	N/A	26,572,000
Asia-North Europe	9,924,000	5,139,000	N/A	N/A	15,063,000
Asia-Mediterranean	5,504,000	2,409,000	N/A	N/A	7,913,000
Asia-Middle East	3,304,000	1,400,000	N/A	N/A	4,704,000
North Europe-North America	3,284,000	2,120,000	N/A	N/A	5,404,000
Asia-East Coast South America	N/A	N/A	730,000	1,344,000	2,074,000
North Europe/ Mediterranean – East Coast South America	N/A	N/A	830,000	850,000	1,680,000
North Europe/ Mediterranean – East Coast South America	N/A	N/A	794,000	474,000	1,268,000

Source: World Shipping Council (2017)

Of course, as in all maritime markets, the most crucial factor affecting cargo density on routes is freight rates. Freights determine both the ship owners' profitability and the cargo owners' costs. The amount of the service offered is determined according to the freight rates in the market. In this respect, it is vital to examine how freights are formed.

Formation of freight rates

In maritime transport, freight rates are the price paid by the shipper to maritime shipping companies for the transport service. Fluctuations for freight rates depend on the supply and demand balance in the market. If the supply exceeds demand, freight rates fall, but if the demand exceeds supply, freight rates rise (Stopford 2009:136). In container shipping, fluctuations for freight rates depend on how demand for container transportation services and pool which is container fleet capacity are balanced (Cowie, 2009:14). This demand will increase with increasing of international trade. This demand is also dependent on the cost of transportation of containers (Açık, 2019). Container fleet capacity changes with the new building ships and scrapping. Since the container shipping industry is considerably new and the lifetime of the early container vessel is usually 30 years, the scrapping activity has just started. The average proportion of demolition to the world container fleet capacity was only 0.593% from 1994 to 2007. Thus, the effect of scrapping can be ignored on the container fleet capacity. New ship orders will increase with the high profit by shipowners. This happens when there is a high demand in the market, so freight rates are also high (Başer & Açık, 2018). But the building of a new ship takes up to two years so, the supply is slow. On the other hand, changes in the demand are fast since it is affected by mostly the world economy and the world economy can go up and down dramatically in a short time. If the delivery of new container ships results in higher supply capacity than in demand, the freight rates will fall. This will cause very few new ship orders, but the demand will keep increasing the supply when the demand is high. As a result, the decreasing of freight rates will accelerate. This will end when demand exceeds the supply (Luo et al., 2009).

As a result, the basis of shipping markets is the freight market. Other maritime markets are affected by developments in this market. In addition, although they appear in a separate structure (Strandenes, 2012), they all interact with each other (Karakitsos & Varnavides, 2014). Many factors affect freights positively, such as slow growth of maritime transport capacity, congestion in ports, climatic conditions, and strikes (Chistè & Van Vuuren, 2014). But the most critical factor necessary for freight to climb positively is the economy's growth (Randers & Göluke, 2007). Therefore, in this study, we aimed to empirically test the effect of economic activities on container freight, which is thought to represent the current economic conjuncture better, as it is used to transport final products. The method and data set we used in this direction are examined in the next section.

Methodology and data

Our research applied regression analysis to determine the relationships between the variables. Regression analysis is a standard method used to detect theoretical and statistical relationships between variables (Chatterjee & Hadi, 2015: 1). There are many types of regression analysis with different valuable functions. We preferred to use the linear regression model in our study. The linear simple regression model can be represented as in Equation 1:

$$Y = \beta_0 + \beta_1 X_1 + \varepsilon \quad (1)$$

In this model, Y represents the dependent variable, X_1 means the independent variable, and ε represents the residuals (Gordon, 2015:5). Since this model consists of a single independent variable, this model is called a simple regression model (Gaurav, 2011: 3). However, in some models, the number of independent variables may be more than one. Models containing more than one independent variable of this kind are called multiple regression models (Allen, 2004: 4). The multiple regression model can be represented as in Equation 2:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i + \varepsilon \quad (2)$$

After the model is estimated, it can be determined whether the independent variables explain the dependent variable and how much. In addition, how much the changes in each independent variable affect the dependent variable can be determined by the β coefficients (Esquerdo and Welc, 2018: 2). Thus, it is determined how much a one-unit change in each independent variable affects the independent variable (Archdeacon, 1994:148).

After the regression is estimated, the reliability and validity of the model are checked by applying some tests to the model's residuals. These assumptions are the absence of heteroscedasticity and autocorrelation in residuals and the normal distribution of residuals (Pagan and Hall, 1983). If some of these assumptions cannot be met, the standard errors of the variables are recalculated by applying some correction methods.

The logarithmic simple linear regression models we used in our research are presented in Equations 3. The vital aspect of logarithmic regression is that the coefficient of the independent variable shows the elasticity of the dependent variable relative to the independent variable. Thus, it can be determined how much the dependent variable has changed considering the percentage change in the independent variable (Gujarati, 2004: 176).

$$lnFreight_t = ln\beta_1 + \beta_2 lnGDP_t + \varepsilon_t \quad (3)$$

The dataset covers the 2011 Q3 and 2021 Q1 and consists of 38 quarterly observations. The term of the Freight variable is Shanghai to New York quarterly freight rate in dollars for 20 TEU container transportation obtained from Bloomberg (2021). The Shanghai to New York container shipping route is chosen for this research because this route is in the Asia-North America container shipping route with the most volume among other major container shipping routes. In addition, the fact that it is the route between the world's largest economy and the largest exporter increases the possibility of obtaining significant results in the analysis. Term of GDP is USA quarterly real GDP billions of dollars chained to 2012 dollars obtained from Fred (2021). Descriptive statistics for raw and return data are presented in Table 3.

Table 3. Descriptive Statistics of the Data Set

	FREIGHT	GDP	RFRE	RGDP
Mean	3131.30	4406.35	0.018	0.004
Median	3059.80	4400.61	0.037	0.006
Maximum	6573.90	4910.16	0.346	0.080
Minimum	1656.20	3969.69	-0.352	-0.087
Std. Dev.	918.55	272.91	0.187	0.020
Skewness	1.45	0.01	-0.23	-1.13
Kurtosis	6.52	1.82	2.10	17.39
Jarque-Bera	34.06	2.24	1.59	336.41
Probability	0.000	0.326	0.450	0.000
Observations	39	39	38	38

Source: Bloomberg (2021); Fred (2021).

The graphical representation of the freight rate and GDP values in our study is presented in Figure 2. In general, it can be said that there is a positive relationship for some periods. Still, the structural breaks experienced by the freight variable make this relationship insignificant in some other periods. Considering this situation related to the structural breaks in the analysis is essential for the validity of the results. In 2015, there was a major structural break in the freight variable, and a decrease was observed. In 2020, the level and trend were experienced, and a significant increase was observed.

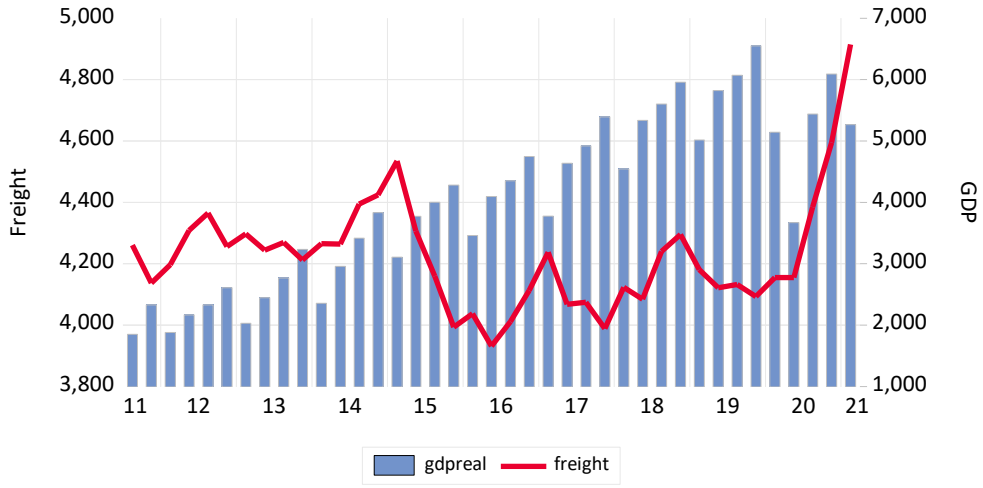

Figure 2. Graphical Display of the Variables

Source: Bloomberg (2021); Fred (2021).

Results

First, since GDP and freight variables are quarterly data, we adjusted for seasonal effects using the TRAMO/SEATS function of EViews software. Then, the logarithms of the series were used while performing the analyses. In this way, the distribution properties of the series become better. In time series analysis, the fact that the variables contain unit root may cause erroneous and biased results. Because the shocks of the variables are permanent, it may prevent the analyzes from giving accurate results. In this direction, augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski et al., 1992) tests were applied to the freight and GDP variables, and the results are presented in Table 4. The null hypothesis of the ADF test is that the series contains a unit root. According to the results obtained, while the null hypothesis is rejected for the freight variable at level, it cannot be dismissed for the GDP variable. The null hypothesis of the KPSS test is that the series is stationary. Therefore, the null hypothesis could not be rejected for the freight and GDP variables according to the results obtained. In this case, it was decided that both variables were I (0) based on the KPSS test results. The fact that the series is stationary indicates that the effects of the shocks they receive are temporary. Thus, they tend to return to the mean in the long run.

Table 4: Unit Root and Stationarity Test Results

		Level		
		Intercept	**Intercept and Trend**	**Conclusion**
ADF	Freight	-2.338	-2.139	I(1)
	GDP	-1.403	-3.472*	I(0)
KPSS	Freight	0.158*	0.150***	I(0)
	GDP	0.728*	0.145**	I(0)

ADF CVs: -3.626 for %1***, -2.945 for %5** , -2.611 for %10* at Intercept, -4.243 for %1***, -3.544 for %5**, -3.204 for %10* at Intercept and Trend. KPSS CVs: 0.739 for %1***, 0.463 for %5**, 0.347 for %10* at Intercept, 0.216 for %1***, 0.146 for %5**, 0.119 for %10* at Intercept and Trend.

Then, using the series, the model in Equation 3 was estimated using the ordinary least squares method, and the results are presented in Table 6. According to the results obtained, the model and the independent variable are insignificant. Therefore, the model's explanatory power also takes a value close to 0. At this point, the undeniable effect of the demand generated by the American economy could not be determined. The relationship between the variables is not linear or breaks in the series. Breaks in the series disrupt the linearity of the series, making it difficult to determine the significant relationships with linear methods. Accordingly, the multiple breakpoint test was applied to the model to test the model's possible breaks, and the results are presented in Table 5. The used test shows structural breaks in the model in 2015 Q3 and 2020 Q1. The break-in Q3 2015 is probably related to fuel prices. The oil price, which is the quarterly average of daily expenses, decreased from 60 dollars in 2015 Q2 to 35 dollars in 2016 Q1 (Investing, 2021), which means a nearly 42% decrease in a relatively short time. Since fuel price is one of the most significant cost items for maritime transport, freight rates may have been reduced. The break-in of Q1 2020 was due to the trade imbalance caused by the impact of COVID-19. As shown in Figure 2, the freights entered an increasing trend and climbed to high levels quickly. Then, the regression equation was estimated with the dummy variables generated by putting the value of 1 from these dates on.

Table 5: Multiple Breakpoint Test

Break Test	**F-statistic**	**Scaled F-statistic**	**Critical Value****
0 vs. 1*	10.560	21.121	11.47
1 vs. 2*	11.100	22.201	12.95
2 vs. 3	2.132	4.264	14.03
Break Dates	Break 1:	2015 Q3	
	Break 2:	2020 Q1	

*Significant at the 0.05 level. **Bai-Perron (Econometric Journal, 2003) critical values.

The estimated regression results with dummy variables are presented in Table 6. According to the F test, the model is significant as a whole. According to the adjusted R square value, the model's explanatory power is nearly 60%. In addition, our GDP independent variable and our two dummy variables have statistically significant effects on freight rates. According to the Ljung-Box Q (Ljung and Box, 1979) test, the null of no autocorrelation in the model's residuals is rejected according to the ARCH (Engle, 1982) test the null hypothesis of homoscedasticity could not be dismissed. In this case, HAC (Newey and West, 1987) covariance estimator was applied to recalculate the standard errors, and new results are presented in the column with dummies robust. According to the recalculated probability values, the model and all independent variables are significant at a 1% confidence level. The coefficient of the GDP variable is 3,17, and accordingly, a 1% change in GDP causes a 3,17% change in freight rates. The coefficient of 2015 Q3 Dummy is -0.646, which indicates a 47.5% decrease $(100 \times (e^{\beta_2} - 1))$ in freight after that date, regardless of changes in GDP. The coefficient of 2020 Q1 Dummy is 0.412, which indicates a 51% increase $(100 \times (e^{\beta_3} - 1))$ in freight rates after this date, regardless of changes in GDP.

Table 6. Regression Estimation Results

Model	Freight	With Dummies	With Dummies Robust
GDP	-0.58 [0.415]	3.171 [0.001]	3.171 [0.000]
2015 Q3 Dummy	-	-0.646 [0.000]	-0.646 [0.000]
2020 Q1 Dummy	-	0.412 [0.000]	0.412 [0.008]
Constant		-18.268 [0.017]	-18.268 [0.009]
F Stat.	0.678 [0.415]	19.72 [0.000]	19.72 [0.000]
R^2	0.018	0.628	0.628
Adjusted R^2	-0.008	0.596	0.596
Auto Correlation	Yes	Yes	-
Heteroscedasticity	Yes	No	-
Wald F Stat.	-	-	25.343 [0.000]

Probability values are included in []

An important limitation of the study is the implementation of analyzes over only one container route. However, if different economies and freight rates can be included in the analysis, more inclusive results can be obtained. In addition, although GDP is the main factor affecting freight rates, other affecting factors such as oil price, ship supply, interest rates can be included in the models to increase the explanatory power of the models.

Discussion and conclusion

In this study, we aimed to determine how the economic situation in the United States of America affects the freight in container transportation with China, based on the derived demand structure of maritime transport. As it is known, the USA is the world's largest economy, and China is the largest exporter. Therefore, the demand from China has a significant impact on the maritime markets (Efes et al., 2019). We aimed to contribute to the literature by applying the similar subject tested for the dry bulk market (Başer & Açık, 2019) to the container market this time. Also, there are many studies (e.g. Chi, 2016; Park et al., 2019; Akbulaev & Bayramli, 2020; Michail, 2020; Özer et al., 2020; Şeker, 2020) in the literature between maritime transport and economic developments and these studies have confirmed that the relationship between the variables is present and robust. In this respect, we determined our research question and applied our analyzes based on a solid theoretical and empirical background. Our results showed that the developments in the USA economy significantly affected the container freight rates. 1% change in GDP causes approximately a 3% change in freight rates. This shows how sensitive maritime transport is to economic developments. The sensitivity of economic activities to maritime transport is one of the common findings in the studies in the literature. In this respect, our study plays a complementary role to previous studies and expands the perspective of relations examined by including a single route application. In addition, as a result of the structural break tests we applied to the model, we detected breaks in the model after the 2015 Q3 and 2020 Q1 periods. The break in the 2015 Q3 period affected the freights negatively. There was a 48% decrease in freight rates regardless of the changes in GDP of the USA. The main reason for this may be the significant drop in oil prices at that time. As it is known, one of the most oversized expense items for maritime transport is fuel (Keupp, 2015:109), and the decrease in fuel costs can reduce freight rates. In addition, there was a slowdown in demand which was 1%increase in container shipping. Supply was increased by %8 in 2015 in container shipping. This supply increase happened due to overinvestment in container fleet capacity, resulting from earlier high profits by shipping companies. Companies ordered mega-ships when the yield was high, but it took three years to build them. When the ships were delivered, the demand was not as high as expected. This unbalances the supply-demand market results in the decline of freight rates. The break in the 2020 Q1 period may have arisen due to the empty container crisis due to world trade, which the impact of COVID-19 has destabilized. Due to the poor circulation of empty containers, the freights demanded by the shipowners rose to relatively high levels. Also, after the slowdown in the first quarter of 2020, an increased demand was quickly observed for container shipping in the following quarters of 2020 and the first quarter of 2021. This high demand resulted from changes in consumption and

shopping patterns affected by the pandemic. This demand included manufactured consumer goods that are primarily moved in shipping containers. This unexpected increase in demand could not meet with a proper supply of container shipping capacity shortage of empty containers caused all-time highs in container freight rates. Empty containers were left in countries where they were unnecessary, and repositioning had not been planned. Manufactured goods are imported more than exported in South American and West African countries. This caused additional costs in container freight rates as returning empty containers to China. In addition, the expected recovery in the world economy after COVID-19 also supported the rise in freight rates. COVID-19 has shown us containers have an essential role in the container shipping market. In times of crisis, the movement of containers to their planned locations may be disrupted. This may cause severe changes in container freight rates. Therefore, the effect of containers on the container shipping market should also be examined. This shows that the container supply chain should not be concentrated in certain countries and that container supply strategy should be developed to relieve the market in times of crisis.

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