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ROLE OF INTEREST RATES ON FLEET CAPACITY ADJUSTMENT DECISIONS OF SHIPOWNERS

Gemi Sahiplerinin Filo Kapasitesi Ayarlama Kararlarında Faiz Oranlarının Rolü

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Keywords:
Interest Rate, Ship Investment, Demolition.

JEL Codes:
E43, F62, R41.

Abstract

The aim of this study is to empirically examine the impact of real interest rate on global fleet adjustment processes by modelling new orders and demolitions. The data set used consists of 34 annual observations and covers the years between 1985 and 2018. According to the results, the freight rate has a positive impact on amount of new ship orders and a negative impact on amount of ships scrapped, while the real interest rate has a negative impact on both amount of new ship orders and ships scrapped. The impact of freight rate on new ship orders and demolitions is clear whereas the impact of the real interest rate may be explained by two reasons. Increasing capital costs due to increasing interest rates may cause decrease in both new orders and demolitions as ordering new ships becomes more expensive. The second one may be related to expectations of ship investors to gain more revenue by evaluating their capitals on higher interest rates instead of ordering new ships. Therefore, it is important to limit negative impact of high interest rates by various policies so that maritime transport sector can contribute to economic growth by facilitating trade with sustainable costs.

Anahtar Kelimeler:
Faiz Oranı, Gemi Yatırımı, Gemi Hurdası.

JEL Kodları:
E43, F62, R41.

Özet

Bu çalışmanın amacı reel faiz oranının küresel filo ayarlama sürecine olan etkisini yeni siparişleri ve hurdaya gönderimleri modelleyerek ampirik olarak test etmektir. Kullanılan veri seti 1985 ve 2018 yılları arasını kapsamaktadır ve yıllık bazda 34 gözlemden oluşmaktadır. Elde edilen sonuçlara göre navlun oranı yeni gemi sipariş miktarını pozitif ve söküme gönderilen gemi miktarını negatif etkilerken reel faiz oranı hem yeni sipariş miktarını hem de söküme gönderilen gemi miktarını negatif olarak etkilemektedir. Navlun oranının yeni siparişlerde ve söküme gönderimlerde etkisi açık iken faiz oranının negatif etkisi iki şekilde açıklanabilir. Yükselen faiz oranı nedeniyle artan sermaye maliyetleri yeni gemi siparişlerinin daha pahalı olmasına neden olduğu için yeni siparişlerde ve söküme gönderimlerde azalışa neden oluyor olabilir. İkinci nedeni ise gemi yatırımcılarının sermayelerini daha fazla gelir elde etmek için yeni gemi sipariş etmek yerine yüksek faiz oranlarında değerlendirmeleriyle ilgili olabilir. Bu nedenle, deniz taşımacılığı sektörünün sürdürülebilir maliyetlerle ticareti kolaylaştırarak ekonomik büyümeye katkı sunabilmesi için yüksek faiz oranlarının negatif etkisinin çeşitli politikalarla sınırlandırılması önem arz etmektedir.

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1. Introduction

The maritime market is classically composed of four close markets, which are the freight market, the new building market, the second-hand market and the demolition market (Stopford, 2009, p. 177). As the maritime market has a derived demand structure (Branch, 2012, p. 1), it is immediately affected by the developments in the world economy and becomes a very risky market (Erol and Dursun, 2016). This impact is primarily reflected in the freight market and then spreads to other maritime markets. The traditional supply-demand model that describes the mechanism of the freight market was developed by Koopmans (1939). According to this model, freight rates decrease when ship supply exceeds demand and freight increases when ship demand exceeds ship supply. In fact, ship supply is inelastic in the short run (Glen and Christy, 2010, p. 380) as the ship market has a "time-to-build" effect due to shipbuilding time (Başer and Açık, 2018). This leads to an inability to increase the carrying capacity at a point where the rate of increase in demand is high and to cause an excessive increase in freight rates.

If freight rates are too high, ship owners who wish to make more use of existing profitable freight rates aim to increase their carrying capacity by ordering new ships. In addition, old and obsolete ships with high operational costs can carry out their transportation activities profitably at high freight rates. After a certain period of time that changes from cycle to cycle, the ordered ships also enter the market and the excess capacity begin to form (Stopford, 2010, p. 249). Add to this the economic slowdown, freight rates are reduced and old ships with high costs cannot find cargo and are sent to the demolition (Taylor, 1976). Freights return to their average levels with reduced carrying capacity, and because of this structure the freight market is defined as mean-reverting (Adland and Cullinane, 2006). Therefore, when freight revenues increase, there is an increase in new ordered ships and a decrease in demolished ships, and vice versa (Açık and Başer, 2017; Buxton, 1991; Karlis and Polemis, 2016; Knapp, Kumar and Remijn, 2008).

This classical view is seen as inadequate because of the idea that the interaction is only within the maritime markets since it considers economic growth as the main impressive factor. There are other external factors affecting ship owners' or investors' decisions regarding the fleet, and one of the most important is interest rates (Karakitsos and Varnavides, 2014, p. 3). Interest rates are seen as the determinant of investments by Keynes, but if the expected profit from the investment is too high, it loses its dominance (Arnold, 2010, p. 205). As the costs of ships which are referred to as maritime investments are very high, interest rates can be decisive as alternative investment instrument. Therefore, the rates may be considered to be effective in asset gathering (ordering new ship) and in asset disposing (sending demolition) decisions of the owners. In this context, this study aims to examine the maritime market from a macroeconomic approach by examining the effect of interest rates on new order and demolition amounts. Since the possible effects of freight revenues on both new orders and demolition tonnages are already obvious, freight rate variable is included in the models as control variable and the effect of interest rate is tried to be revealed.

In the second section of the study, related literature is reviewed and our study is positioned by considering its contribution. In the third section of the study, the method used in the study is introduced. After the results of the analyzes are presented in the fourth section, evaluations are made in the last section.

2. Literature Review

Since the scope of the study examines the fleet adjustment decisions, it is considered appropriate to mention the studies related to demolition and new building in the literature. Firstly, we started to examine the literature on ship demolition market and evaluate the market from various angles. In the ship demolition literature, the subjects such as demolished ship tonnage, ship demolition prices and the relationship between these prices and other sectors are examined. There are also studies examining the environmental impacts of the shipbreaking industry in the world. In the first study we want to mention, the relationship between freight rates and the amount of ships sent to the demolition was investigated (Açık and Başer, 2017). The authors tested the impact of changes in the level of freight rates in market on the amount of ships sent to the demolition and assumed that when freight rates fall, the number of ships sent to the demolition will increase as old ships are unable to meet their operational expenses and their owners' expectations about future revenues reduce. In addition, when freight levels increase, the number of ships dismantled will decrease as even old ships can cover their operational expenses and make profit. This indicates that ship owners' decisions to demolish their ships vary according to market conditions, and in one study this conclusion was reached by researchers (Yin and Fan, 2018). In addition, it was found that the ships that were demolished before and after the 2008 crisis were differentiated, majority of the demolished ships belong to developed countries before the crisis while majority of the ships belong to developing countries after the crisis. These results can be interpreted as developed countries' anticipating the crisis and reducing their risks thanks to their knowledge accumulation. A complementary study was done by the same researchers and the relationship between the freight rate and demolition price was investigated (Açık and Başer, 2018a). The researchers examined whether the situation in the maritime transportation market is reflected in ship demolition prices based on two assumptions. Firstly, when the freight market revives, the price of demolition offered by ship dismantling centers to the owners will increase in order to attract ships as even old and obsolete ships are operational in the market. Secondly, since the recovery in the freight market is also a sign of economic recovery, demand for steel will increase and this will have a positive impact on demolition prices. In this context, the expected positive relationship between the variables was tested by the researchers and significant results were obtained. When the findings were evaluated together with the previous study, it can be concluded that decreasing the number of ships dismantled due to high freight leads to higher demolition prices. In an older study, the relationship between freight levels, demolition prices in five different countries and the probability of being demolished in these countries was examined using a very large sample (Knapp et al., 2008). As a result of the study, there was a negative relationship between freight rates and the probability of being demolished in any of these countries, while a positive relationship was found between demolition prices and this probability. The increase in demolition probability was also verified in another study (Alizadeh, Strandenes and Thanopoulou, 2016). Increase in scrap steel prices increases the probability of demolition for the vessel. The results of all these studies are consistent with each other and clearly draw the framework from angle of freight market.

In the first study about the mechanism of ship demolition prices, impact of currency exchange rates on demolition prices was investigated (Karlis, Polemis, and Georgakis, 2016). The authors formed different models for different types of ships in major demolition countries and reached detailed results. In their results, the exchange rates of some countries had a significant effect on all types of ships, while in some countries they have had a significant effect only ships of different sizes. They also validated the mechanism and importance of exchange rates in international trade for the demolition market. In another price related study, it was tested whether the efficient market hypothesis is valid for ship demolition prices (Açık and Başer, 2018b). Prices in five major ship demolition countries which are Bangladesh, China, India, Pakistan and Turkey were analyzed individually and weak-form efficiency were tested. As a result, they reached the conclusion that prices do not move randomly and that prices can be estimated by using historical price information and it is possible to make profit with technical strategies. This situation can be explained by the fact that demolition prices are affected by both the maritime sector and the steel sector and therefore cannot act independently. In addition, since demolition areas in the world are limited, the prices may be affected by each other. In another study, based on this research question, researchers tested the volatility spillover between demolition prices in these five countries (Açık and Başer, 2019). As a result of the analysis, it was found that there are volatility spillovers from Turkish demolition prices to almost all other countries' demolition prices. This shows that they follow the information coming from each other in price setting and this prevents them from being in an effective market structure.

In one of the studies examining the interaction of ship demolition market with other sectors, the causality relationship between steel prices and ship demolition prices was tested (Tunç and Açık, 2019). This relationship is inevitable considering the relationship between general scrap prices and metal prices, and price and volatility spreads between these markets (Xiarchosa and Fletcherb, 2009). According to the results of the analysis applied, the panel causality result was reached from steel prices to ship demolition prices. However, the opposite causality could not be determined, and it is an explainable conclusion that the demolition market cannot influence the overall prices due to its very small size in the steel market. These findings confirm that steel prices are one of the main price determinants for demolition prices. The general scrap market is also very large alongside the ship demolition market therefore the ship market is probably affected by the developments in the general market. This research question is examined in a study by using causality analysis between ship demolition market and general scrap market (Kagkarakis, Merikas and Merika, 2016). As a result of the study, one-way causality relationship was determined from general scrap prices to ship scrap prices. These results indicate that ship demolition prices have a weak determinant power over general scrap prices in line with the previous study. One of the most important customers of the steel sector is the construction sector, which is likely to be affected by the ship demolition market. In a study conducted on this research question, the impact of Turkish ship demolition prices on construction costs in Turkey examined (Açık and Baran, 2019) and it was found that positive shocks in ship demolition prices cause positive shock in the construction costs. This suggests that the ship demolition market may be effective in the costs of steel users, albeit its small size in the market.

Ship demolition sector comes to the fore with the environmental damage, because the ships built in the past are mostly built using harmful ingredients. In addition, the remains of the cargo carried by the ship's type pose a serious risk for the environment. But still some ship demolition facilities can provide a sustainable commercial environment by taking necessary precautions. In this context, improvements of demolition yards were investigated in a study through Aliağa shipbreaking yards (Neşer, Ünsalan, Tekoğul and Stuer-Lauridsen, 2008). The authors stated that Aliağa demolition yards became a suitable shipyard with appropriate regulations and legal frameworks and could serve more ships. However, in some countries, the situation is not very pleasant. The impact of ship breaking industry on coastal environment of Bangladesh was investigated in a study (Hossain, Fakhruddin, Chowdhury and Gan, 2016). They found that ship demolition activities in the country has significant unfavorable impact on environment and social life. The authors stated that the management practices and plans that are not suitable for this situation caused these results, and they also stated that urgent measures can be taken and thus a sustainable sector may be formed. These harmful consequences of ship demolition activities were expressed more strikingly in another study (Choi, Kelley, Murphy and Thangamani, 2016). The authors stated that substandard ship demolition caused irreversible damages to the environment. They also stated that some businesses ignore important issues such as labor and environmental safety with commercial concerns whose basis was formed by the financial concerns of these businesses. However, the authors stated that profitable commercial activities can be carried out with some suggestions even when ship demolition standards are increased.

The literature on newbuilding ships generally consists of studies examining new building prices, ordered ship tonnage and delivered ship tonnage. The first study, which we want to mention from the shipbuilding literature, examines the relationship between new building prices and freight rates (Xu, Yip and Liu, 2011). The researchers examined whether there is a causality between these two variables and whether they can move together in the long run with panel data analysis. As a result of the research, they found a positive relationship from freight rates to new building prices. They also found that freight rates are more sensitive to market changes than new building prices. Since the shipbuilding process takes a certain period of time, it is likely that situation of the market will not be known at the end of that period, making it less volatile. In another study on new building prices, the volatility of prices and the factors affecting this volatility were examined (Dai, Hu, Chen and Zheng, 2015). The researchers found that the most important factor positively affecting the volatility of new building prices was the volatility in freight prices. They also found that the volatility in second-hand ship prices, exchange rates and shipbuilding costs was also very impressive on new building prices.

The relationship between freight rates and shipbuilding orders was investigated in a study specifically in the Korean shipbuilding industry (Kim and Park, 2017). In the study, the researchers examined the causality relationship between freight rates represented by ClarkSea Index and ordered ship tonnage, and found a one-way causality relationship from the freight rates to the amount of ordered tonnage in Korean industry. The paper examined the subject from behavioral theory in economics, and found consistency of the relationship with the overconfidence hypothesis. Inspired by the fact that shipbuilding time can vary between 1-3 years (Karakitsos and Varnavides, 2014, p. 14), a study examining the relationship between the delivered tonnage and freight rates has taken place in the literature (Başer and Açık, 2018). The researchers modeled the relationship between freight rates and delivered ship tonnage and found the relationship between them to be 2 years delayed and positive. This shows that today's order is affected by today's freight rates and there is a delayed relationship since the ordered ship is delivered after an average of 2 years.

Our study is very similar to the papers related to the demolition tonnage (Açık and Başer, 2017) and new order ship tonnage (Başer and Açık, 2018; Kim and Park, 2017). In the mentioned similar studies, freight rates constituted the main research question and the maritime market was assumed to have a closed mechanism from the global world, however, in this study freight is added as a control variable and an important macroeconomic variable is added to the models. Thus, the maritime market, which is generally handled independently from macro variables, is also approached from a macro point of view. Therefore, the main focus of the study is to reveal the effect of interest rate on both new order and demolition tonnages. It is hoped that more consistent results will be achieved by including cost and alternative revenue options for ship investors by including interest rates in the models as a mix of both. In addition, considering the possible structural breaks in the models is thought to increase the contribution of the study. In this respect, the study empirically addresses the issue and plays a complementary role in previous studies and is thought to have made an original contribution.

3. Methodology

In this study, regression analysis is used to determine the relationship between variables. Regression analysis provides a simple method to examine the functional relationship between variables (Chatterjee and Hadi, 2015, p. 1) in order to obtain information about statistical and theoretical relationships. There are many types of regression models and they vary according to the intended use. The type used in this study is a linear regression model and can be shown as follows (1);

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

In this model Y is the dependent variable, X_1 is the independent (explanatory) variable and ε is residuals (Gordon, 2015, p. 5). Since the model is developed with one independent variable, it is called simple regression model (Gaurav, 2011, p. 3). The set of independent variables may be more than one such as X_1, X_2, $X_3, \ldots, X_i$, and these kind of models is called multiple regression models (Allen, 2004, p. 4). The multiple regression model can be expressed as (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 becomes possible to determine whether the dependent variable is explained by independent variables. In addition, the extent to which the dependent variable is influenced by the independent variables is determined. This is achieved by the β coefficients in the model. These coefficients allow us to understand in which direction the effect of the independent variable is and how much influence it has individually (Esquerdo and Welc, 2018, p. 2). Thus, it can be determined how much one unit change in each independent variable causes a change in the dependent variable (Archdeacon, 1994, p. 148).

Following the estimation process, several diagnostics tests should be applied to the residuals of the model in order to control several assumptions, which are (i) the conditional mean of ε is zero, (ii) coefficient constancy which reveals that both β and ε are fixed over the sample period, (iii) serial independence in the disturbances of ε, and (iv) a distributional assumption of normality for ε (Pagan and Hall, 1983). These assumptions are important for the validity and reliability of the model (Menard, 2002, p. 5) and are expected to be achieved. However, if some of these cannot be achieved, several correction methods should be applied so that the standard errors can be recalculated in order to be interpreted confidingly.

4. Findings

The data set used consists of 34 annual observations and covers the years between 1985 and 2018. Descriptive statistics of the data used in the study are presented in Table 1 both in raw form and in logarithmic form. Since the real interest rate is already a percentage value, no logarithm is taken again.

Some assumptions were applied in the study due to data constraint. While the ORDER variable and DEMO variables are global measures for all ship types, the BDI variable is an index that includes freight levels in the dry bulk market. ORDERS variable indicates the total gross tonnage of ships ordered to the shipyards to be built in the related year. DEMO variable indicates the total dwt tonnage of ships sent to the demolition yards to be scrapped. Baltic Dry Index variable is an index representing the freight levels in the dry bulk market. The BDI variable represents the price of the global maritime transport (Geman, 2008, p. 181), which is a cost indicator for shippers and a revenue indicator for transporters. With this feature, it stands out as a factor affecting the foreign trade of countries (Eryüzlü, 2019) and has a structure covering all other sub-indices (Zeren and Kahramer, 2019). Finally, the RINT variable is the real interest rate obtained by subtracting the inflation rate from the nominal interest rate in the United States.

Logarithmic series are used in econometric analysis since in this way series can show better distributional characteristics (Shahbaz, Van Hoang, Mahalik and Roubaud, 2017). For instance, after this process, the distribution of the ORDER variable evolves to the normal distribution as seen in Table 1.

Table 1. Descriptive Statistics of the Variables

	ORDERS (Thousand GT)	DEMO Thousand DWT)	BDI (Index)	RINT (%)	Ln ORD.	Ln DEM.	Ln BDI
Mean	46310.5	22259.7	1893.4	0.99	17.4	16.67	7.35
Median	35040.0	23700	1353.7	0.77	17.3	16.97	7.21
Maximum	164830	50300	7070.2	4.86	18.9	17.73	8.86
Minimum	11840	2350	673.12	-3.03	16.2	14.66	6.51
Std. Dev.	34384.6	13006	1492.6	2.17	0.70	0.80	0.58
Skewness	1.45	0.17	2.23	0.07	0.16	-0.88	1.02
Kurtosis	5.22	2.13	7.51	1.83	2.08	2.72	3.55
Jarque-Bera	19.02	1.23	57.2	1.94	1.34	4.53	6.41
Probability	0.00	0.53	0.00	0.37	0.50	0.10	0.04
Observations	34	34	34	34	34	34	34

Sources: Athenian Shipbrokers, 2019; Bloomberg, 2019; FED, 2019, SAJ, 2019.

The first step that should be taken when studying with time series is to apply the unit root test to the series in order to avoid possible spurious regression issues. Two of the most common methods for this procedure are the augmented Dickey-Fuller (Dickey and Fuller, 1979) and Kwiatkowski-Phillips-Schmidt-Shin tests (Kwiatkowski, Phillips, Schmidt and Shin, 1992). The results of the implemented test are presented in Table 2. ADF test is used as unit root test and KPSS test is used as stationarity test. Therefore, the null hypothesis of the ADF test points to the unit root whereas the null hypothesis of the KPSS test points to stationarity. KPSS test is used as a complementary test to the first test. According to the results, while unit root is rejected in at least one option in ADF test, stationarity cannot be rejected in all options in KPSS test. This indicates that all series used in the study are I (0) and therefore, there is no need for difference taking operations for the further analysis.

Table 2. ADF Unit Root Test Results

		Level			
		Intercept	**Trend and Intercept**	**None**	**Conclusion**
ADF	Orders	-2.527966	-3.484212**	0.705880	I(0)
	Demolition	-1.957494	-3.252959*	-0.164627	I(0)
	BDI	-2.700290*	-2.901115	0.025163	I(0)
	Interest	-2.202195	-3.156731	-2.318003**	I(0)
KPSS	Orders	0.609821***	0.170795***	x	I(0)
	Demolition	0.295107*	0.063283*	x	I(0)
	BDI	0.148304*	0.116202*	x	I(0)
	Interest	0.652695***	0.051709*	x	I(0)

CVs for ADF= Intercept; -3.646342 for ***1%, -2.954021 for **5%, -2.615817 for *10%, Trend and Intercept; -4.262735 for ***1%, -3.552973 for **5%, -3.209642 for *10%, None: -2.641672 for ***1%, -1.952066 for **5%, -1.610400 for *10%. Akaike Information Criteria is used in lag selection. Cvs for KPSS= Intercept; 0.739000 for ***1%, 0.463000 for for **5%, 0.347000 for *10%, Trend and Intercept; 0.216000 for ***1%, 0.146000 for for **5%, 0.119000 for *10%. Barlett Kernel spectral estimation method and Newey-West Bandwidth selection are used.

In order to obtain preliminary information about the direction of the relationship between the series and to evaluate their suitability for regression analysis, correlation analysis is applied to the stationary series and the results are presented in Table 3. Pearson's correlation method is applied since most of the variables have normal distribution characteristics.

Table 3. Correlation between the Variables

	Demo	**Orders**	**BDI**	**Interest**
Demo	1			
Orders	0.07 (0.68)	1		
BDI	-0.49 (0.00***)	0.60 (0.00***)	1	
Interest	-0.38 (0.02**)	-0.57 (0.00***)	-0.23 (0.18)	1

The dependent variables that are intended to be used in two separate models are ORDER and DEMO. The remaining variables are used as independent variables in both models. Firstly, when the ORDER variable is examined in terms of its correlation with other ones, the results reveal that it has a medium degree significant positive correlation between BDI and medium degree significant negative correlation between RINT. According to these results, the freight rates and the quantity of ships ordered are moving in the same direction, while interest rates and the quantity of ships ordered are moving in opposite direction. Secondly, when the DEMO variable is examined, the results reveal that it has medium degree significant negative correlations between BDI and RINT. In other words, the amount of ships sent to the demolition moves in the opposite direction to the freight rates and the interest rates. On the other hand, there is no any significant correlations between independent variables of the dataset. The results obtained support the theoretical foundations of the study, however the correlation analysis only provides information about the direction and strength of the relationship. It is not able to give information about the mechanisms between the variables, thus regression modeling is applied in the further process.

The first developed model is based on the ORDER variable, which is defined as a dependent variable, and BDI and RINT variables are independent ones. The theoretical results expected to be obtained after the estimation are that the new ship orders are positively affected by BDI variable and negatively affected by RINT variable, since the BDI represents the income level in the market while RINT represents the investment cost in the market. Then the model is estimated as presented in (3).

$$lnORDERS_t = ln\beta_1 + \beta_2 lnBDI_t + \beta_3 lnRINT_t + \varepsilon_t \tag{3}$$

The estimated regression results are presented in Table 4 as Model A. According to the results obtained in the model, all variables used in the model are significant. The model is significant as a whole according to the F statistic showing the significance of the complete model. Adjusted R square value reveals that the explanatory power of the model is determined as 53%. The coefficients obtained from the model are positive in the BDI variable and negative in the RINT variable as expected. However, as a result of the tests applied to the residuals of the model, autocorrelation problems in residues has been determined. Therefore, HAC (Newey-West) method has been implemented in order to calculate better t-statistics. The t-statistics presented in Model A part are recalculated ones, and all variables are significant, which also supports to interpretability of the coefficients. In addition to this results, Quandt-Andrews unknown breakpoint test is applied to the model. In this way, it is aimed to make the model healthier by compensating the loss of information caused by the possible breakages. The results of the breakpoint test are presented in Table 5, and the tests has spotted a break date in 1997. Based on this result, a dummy variable has been generated by giving a value of 1 from 1997 to 2018, and the model has been re-estimated with the dummy one.

Table 4. Orders Regression Results

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
MODEL A	C	13.12992	1.281560	10.24526	0.0000
	BDI	0.602362	0.164463	3.662599	0.0009
	Interest	-0.150367	0.046541	-3.230852	0.0029
	R-squared	0.566912	**F-statistic**		20.28948
	Adjusted R-squared	0.538971	**Prob (F-statistic)**		0.000002
	Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
MODEL B	C	13.12150	1.099341	11.93579	0.0000
	BDI	0.519585	0.146558	3.545242	0.0013
	Interest	-0.052090	0.028943	-1.799748	0.0820
	Dummy	0.802680	0.128522	6.245485	0.0000
	R-squared	0.764650	**F-statistic**		32.48995
	Adjusted R-squared	0.741115	**Prob (F-statistic)**		0.000000

The results of the new model are presented in Model B in Table 4. According to the model, RINT variable is insignificant, and the model includes heteroscedasticity problem. Therefore, the model is re-estimated by Huber-White-Hinkley method, and t-statistics are recalculated. Thus, the RINT variable also becomes significant. In the new model, the F statistic and R-squared values are also increased, making the model better. As for the interpretation of the coefficients, dummy variable indicates that an increase of 80% occurred in 1997 regardless of the effect of independent variables, which has caused a level shift in the model. According to the coefficient of the BDI variable, a 1% increase in freight rates results in a 0.52% increase in the ordered tonnage of ship, or vice versa. On the other hand, 1 unit (1%) increase in the interest rates decreases the ordered tonnage of ships by 0.05%. Eventually, this model successfully explains 74% of the changes in the amount of ship order.

The results of the Quandt-Andrews unknown breakpoint test for DEMO and ORDERS models are presented in Table 5. The null hypothesis of this test indicates that there is no break. According to the results of the test, the null hypotheses are rejected for both of the models. The structure of the ORDER model has been broken down in 1997 and the structure of the DEMO model has been broken down in 1993.

Table 5. Quandt-Andrews Unknown Breakpoint Test

Statistic	Demo (1993)		Orders (1997)	
	Value	Prob.	Value	Prob.
Maximum LR F-statistic	21.2	0.00	8.03	0.00
Maximum Wald F-statistic	63.7	0.00	24.09	0.00
Exp LR F-statistic	8.08	0.00	2.35	0.00
Exp Wald F-statistic	28.9	0.07	9.13	0.00
Ave LR F-statistic	4.33	0.00	3.88	0.00
Ave Wald F-statistic	13.00	0.00	11.64	0.00

The second developed model is based on the DEMO variable, and the independent variables are BDI and RINT as in the former model. According to the expected results in this model theoretically, the tonnage sent to the demolition should be negatively affected from both the BDI variable and the RINT variable. When the freight rates increase, the shipowners continue to operate instead of dismantling their ships. Also, when the interest rate increases, the cost of ordering a new ship increases and the shipowners refrain from sending their ships to dismantling. Then the model is developed and estimated as (4).

$$lnDEMO_t = ln\beta_1 + \beta_2 lnBDI_t + \beta_3 lnRINT_t + \varepsilon_t \quad (4)$$

The estimated regression results are presented in Table 6 as Model A. According to the results obtained in the model, all variables used in the model are significant. The model is significant as a whole according to the F statistic, and adjusted R square value reveals that the explanatory power of the model is determined as 46%. The coefficients of both the BDI and the RINT variables are negative as expected. However, according to tests that show the usability of the model and applied to residuals, there are both heteroscedasticity and autocorrelation problems in the model. Accordingly, the model is re-estimated using the HAC (Newey-West) method and the new t-statistics are calculated. The newly obtained results are presented in Model A of Table 6, and according to these results all variables are significant. However, as in the former model, Quandt-Andrews unknown breakpoint test is also applied to prevent an ineffectiveness due to possible break points in the model. According to the results of the break point test presented in Table 5, there is a break in the current model in 1993. Therefore, from 1993 to the end of the data period, a dummy variable is generated with a value of 1, then the model re-estimated. All variables in the new model are significant, but both heteroscedasticity and autocorrelation problems are detected in the residuals of the model. Therefore, new t-statistics are calculated by estimating the model with HAC (Newey-West) method. The results of the newly estimated model are presented in Model B of Table 6. All independent variables are significant according to the last version of the model and the coefficients are at the interpretable point. According to the results obtained, there has been a break in the model in 1993 regardless of the changes in the independent variables, and the amount of ships sent to the demolition has increased by 92%. The coefficient of the BDI variable indicates a 1% increase in freight rates resulting in a reduction of 0.95% in the amount of ship sent to the demolition. The coefficient of the RINT variable indicates that a 1-unit (1%) increase in interest rates led to a 0.09% decrease in the amount of ship sending to the demolition. And finally, the explanatory power of the model is determined as 63%.

Table 6. Demolition Regression Results

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
MODEL A	C	23.12377	0.925350	24.98923	0.0000
	BDI	-0.851392	0.130428	-6.527695	0.0000
	Interest	-0.194168	0.065994	-2.942217	0.0061
	R-squared	0.501200	**F-statistic**		15.57457
	Adjusted R-squared	0.469019	**Prob (F-statistic)**		0.000021
	Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
MODEL B	C	23.08986	1.096187	21.06380	0.0000
	BDI	-0.956235	0.152767	-6.259427	0.0000
	Interest	-0.099265	0.033959	-2.923121	0.0065
	Dummy	0.928984	0.325161	2.856999	0.0077
	R-squared	0.666631	**F-statistic**		19.99675
	Adjusted R-squared	0.633294	**Prob (F-statistic)**		0.000000

5. Conclusion

In this study, the contemporary perspective developed by Karakitsos and Varnavides (2014) is tested empirically by adding interest rate, which is one of the most important the macro factor affecting the world economy, to the classical models that explain the maritime markets through their interactions among themselves. As a result of the study, it was found that interest rate negatively affects both of the new order tonnage and the demolition tonnage. This can be explained by the decrease in new investments and the hold of old ships due to the increase in the financial costs of both new construction and second hand ship prices. Moreover, it may seem more profitable to invest capital in interest than invest in a new ship. It is also possible to argue that high interest rates have a negative effect on total world trade which is the source of the derived demand for maritime transportation. On the other hand, the decrease in interest rates positively affects both the new order and the demolition amounts as it reduces financial costs. The shipowners tend to place new orders, and get the aged vessels which have high operation and insurance expenses scrapped. The low interest rates may also be triggering freight increase through fueling a growth in world trade volume.

The study is considered to be one of the first in terms of analyzing the impact of interest rate on maritime assets by including the rate as a variable in the model. Rising interest rates negatively affect both new ship orders and shipowners' disposal of their old ships. This may prevent the provision of a sustainable transport service to developing world trade, both at an affordable price and within a broad network. This is because the transport costs of new ships are lower and since the transport costs of the non-renewable and age-old fleet are high, the cost of international trade will be also high. As the development of transportation infrastructure in supply-led models facilitates commercial activities, it has a positive impact on economic growth. Since one of the most important actors of the intercontinental trade network is maritime transport, the availability of this transport network can be achieved through sustainable fleet growth. As this growth can be achieved with appropriate capital cost, sustainable interest policies are important for the maritime market as well as the global economy.

Data availability can be shown as a main limitation of the study. While the freight indicator of the dry bulk market is used, the other new building and demolition data consist of all kind of ships. It is possible that more reliable results can be achieved if data specific to the dry bulk market are available. Supplying the model with market and ship type specific data might produce more reliable results. Finally, the events in the dates of 1993 and 1997 that lead to breaks in the structures of the models can be examined in more detail.

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