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The Impact of Freight Rates on Pirate Attacks

Navlun Oranlarının Deniz Haydutluğu Saldırılarına Etkisi

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Kadir Emrah ERGİNER[1], Abdullah AÇIK[1,*], Özgür YILDIZ[1]

[1]*Dokuz Eylül University, Maritime Faculty, İzmir,*
ORCID No: https://orcid.org/0000-0003-4542-9831

ABSTRACT

The aim of this study is to determine whether freight levels in dry bulk and tanker markets have an impact on pirate attacks. The sample included in the study consists of monthly bulk and tanker freight indices and annual attack values between 2008 and 2018 periods. Annual attack values due to data constraint have been converted to monthly data by cubic transformation in order to carry out the analyzes more accurately. The results reveal that freight rates are the causes of pirate attacks, freight rates significantly affect pirate attacks on both bulk ships and tanker ships in a positive way, and freight rate changes in the bulk market explain the attacks more. This results indicate that increased freight revenues are more motivating for pirates to attack.

Keywords: Pirate attacks, Freight rate, Tanker shipping, Dry bulk shipping.

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*Corresponding Author
E-mail: abdullah.acik@deu.edu.tr

ÖZET

Bu çalışmanın amacı kuru dökme ve tanker piyasalarındaki navlun seviyelerinin deniz haydutluğu saldırılarına etkisinin olup olmadığının tespit edilmesidir. Çalışmadaki örneklem 2008 ve 2018 dönemleri arasını kapsayan aylık dökme ve tanker navlun endekslerinden ve yıllık korsan saldırısı değerlerinden oluşmaktadır. Deniz haydutluğu değişkeni analizleri daha isabetli şekilde yürütebilmek için kübik dönüşüm ile aylık veriye dönüştürülmüştür. Sonuçlar navlun oranlarının deniz haydutluğu saldırılarının nedeni olduğunu, navlun seviyelerindeki değişmelerin hem dökme gemilerinde hem de tanker gemilerindeki deniz haydutluğu saldırılarını anlamlı bir şekilde pozitif yönde etkilediğini ve dökme piyasasındaki navlun değişimlerinin deniz haydutluğu saldırılarını daha fazla açıkladığını göstermektedir. Bu sonuçlar, artan navlun gelirlerinin deniz haydutlarını saldırmaları için daha fazla motive ettiğine işaret etmektedir.

Anahtar sözcükler: Deniz haydutluğu saldırısı, Navlun oranı, Tanker taşımacılığı, Kuru yük taşımacılığı

1. INTRODUCTION

Piracy, by taking advantage of the lack of authority for private individuals to gain financial income without any connection to any state, is to say that in areas where the maritime trade is intense, the ships and the personnel present in the ship are attacked and seized. It is observed that maritime piracy causes great damages to the international trade of the states, especially when it is considered that most of the international trade transportation is carried out by sea. The cost of the maritime piracy to the maritime sector amounts to $1-16 billion (IMB 2003-2013). These attacks affect economically, exporters, importers, shipowners or operators (carriers), insurance companies and, consequently, the end consumer. As the attacks increase in the transported regions, insurance premiums increase. Each delay of the ships increases the costs and prolonged port periods impose costs on the carrier. Due to these increasing costs, there is a compulsory increase in freight rates as well.

The aim of this study is to test whether the pirate attacks on ships are affected by freight rates in the market. Increased freight revenues may also lead to an increase in the amount of ransom that ships or cargo owners are willing to pay since the daily charter rates of ships in the live freight market conditions are very high. Therefore, the confiscation of the ship may cause loss of large profits or may bring large costs. As a result of the econometric analysis carried out for the period between 2008 and 2018, freight indices have been found to be Granger cause of pirate attacks and there are positive relationships between pirate attacks and freight levels both in the dry bulk market and in the crude oil market. Although the study does not seem to make a concrete contribution to the actors in a practical and managerial way, it makes an important contribution to the literature with an econometric verification of the clear theoretical relationship.

In the second section of the study, general information about piracy activities in the world is presented. After introducing the method used in the study in the third section, the data set used is examined and the analyzes are applied in the fourth section. In the last section, the findings are discussed and general evaluations are made.

2. PIRACY IN THE WORLD

At least 6,000 pirate attacks have been reported to merchant ships over the past three decades since the 1990s (Mejia et al., 2013:1). Piracy is a low-risky and good-paying criminal activity. It is generally thought that poverty triggers these activities, but this remains a bit simple. Commonly, piracy activities are organized and dominated by gangsters who see piracy as a business in most regions (Murphy, 2013:8). The regions where these activities are intense are shown in Figure 1. It presents positions of the attacks in the world according to the stages of them in 2018. Most of the attacks have occurred around the African continent and South-East Asia region.
The reason for piracy activities to be observed mostly in these less developed countries can be explained by the low employment opportunities in these regions, but this inference is very optimistic. As mentioned earlier, these activities are carried out by professional gangs since they can earn much more than legal employment conditions and this constitutes their motivation (Hallwood and Miceli, 2015:20). Usually 7 factors allow the development of piracy activities; legal and jurisdictional weakness, favorable geography, conflict and disorder, under-funded law enforcement/inadequate security, permissive political environments, cultural acceptability, promise of reward (Murphy, 2013:12).
Even the only part of piracy activities in Somalia costs billions of dollars to the world maritime sector. These costs are due to the fact that ships necessarily change their routes to Cape of Good Hope for an additional 20 days, raised insurance costs up to $ 20,000 per trip, increased chartering costs due to reduced ship capacity in the market due to longer distances, and increased inventory costs due to longer stay at sea. Furthermore, owners of ships that are taken hostage pay ransom amounts ranging from $ 500,000 to $ 5.5 million (Hallwood and Miceli, 2015:5). For all these reasons, the costs of pirate attacks, which are seen as a means of living for some small groups, reach to enormous amounts in international trade.

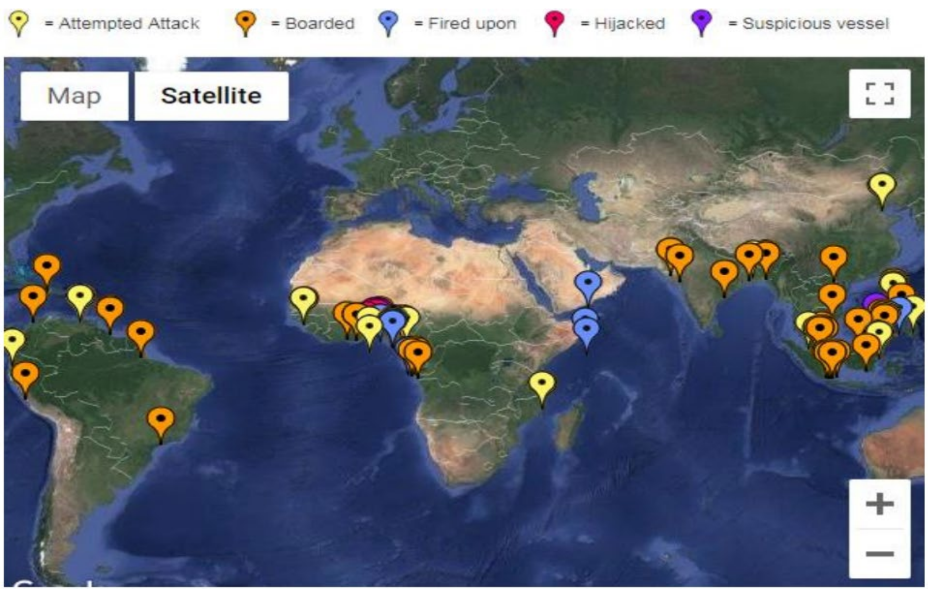

Figure 1. Attacks around the World in 2018 (ICC, 2019).

3. METHODOLOGY

Various statistical methods are used to examine the econometric relationships between variables. These methods differ according to the theory grounded on, the dataset used and the objectives to be achieved. One of the simplest and most common of these methods is regression analysis, which helps to explain the functional relationship between the variables (Chatterjee and Hadi, 2015:1).
The types of the regression analysis are also very wide and varies according to the purpose of use. The most commonly used type is the multiple regression model and is expressed as (1);

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i + \varepsilon \quad (1)$$

In this model Y is the dependent variable, X_1, X_2, $X_3, \ldots$, X_i are the set of independent (explanatory) variables and ε is residuals from the model (Gordon, 2015:5). Since the model includes more than one explanatory variables, it is called multiple regression model (Allen, 2004:4). If the model is developed with only one explanatory variable, it is called simple regression model (Gaurav, 2011:3). When the model is estimated, it becomes possible to determine whether the independent variables explain the dependent variable or to what extent. *Bs* are the most important outcomes of the models since they indicate a direction and strength of the statistical relationships between dependent and independent variables individually (Esquerdo and Welc, 2018:2). In other words, they help to define degree of reaction of the dependent variable in response to one unit change in the independent variable (Archdeacon, 1994:148).
When the model is estimated, the significance of the model and variables should be checked firstly. In addition, several diagnostics tests should be carried out even if the model has significant outcomes. These tests are applied to the residues of the model and are used to verify the validity of some assumptions. These 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). When these assumptions are met, the model is considered to be reliable and valid (Menard, 2002:5). However, if the desired results cannot be achieved in any of them, corrections are applied to re-calculate standard errors and therefore the results become interpretable.
Implementing causality tests before regression models are important for the correct design of the models, as using one variable, which is the cause of another variable, as a dependent variable may lead to misleading results. The most widely used method of causality tests has been developed by Granger (1969). This method deals with whether a variable's historical values can explain the current and future values of the other variable (Yu et al., 2015). For instance, when we consider X as a dependent variable Y as an independent variable, if X is better explained by the historical values of Y than its own historical values, Y is expressed as the Granger cause of X (Dura et al., 2017). In this study, first of all, the causality tests among the variables are applied to examine the endogeneity and exogeneity, and then the models are tested.

4. RESULTS AND FINDINGS

Descriptive statistics of the dataset used in the study are presented in Table 1. The period covered is between 2008 and 2018. 132 observations of monthly frequency of Baltic Dry Index (BDI) and Baltic Dirty Tanker Index (BDTI) have been obtained, however only annual data on pirate attacks have been reached. Therefore, the annual data has been converted to monthly frequency data using cubic transformation and this limitation has been tried to be overcome.
Since high frequency data on pirate attacks

could not be found, the annual frequency data has been divided into monthly frequencies using cubic transformation and used in the analyzes. The movements of the data before and after the transformation are shown in Figure 2. Thanks to cubic transformation, the transition between the years is softer and a more realistic process is obtained.

Table 1. Descriptive Statistics of the Variables

	BDI	BDTI	BULK ATT.	TANKER ATT.
Mean	1819	822	67.8	30
Median	1177	762	59	30
Maximum	11440	1993	109	61
Minimum	317	474	38	13
Std.Dev.	1896	271	22.8	14.3
Skewness	3.01	2.25	0.58	0.67
Kurtosis	12.5	9.0	2.09	2.71
Jarque-Bera	696	316	1.0	0.88
Probability	0.00	0.00	0.60	0.64
Observations	132	132	11	11

Source: Investing, 2019; ICC, 2019.

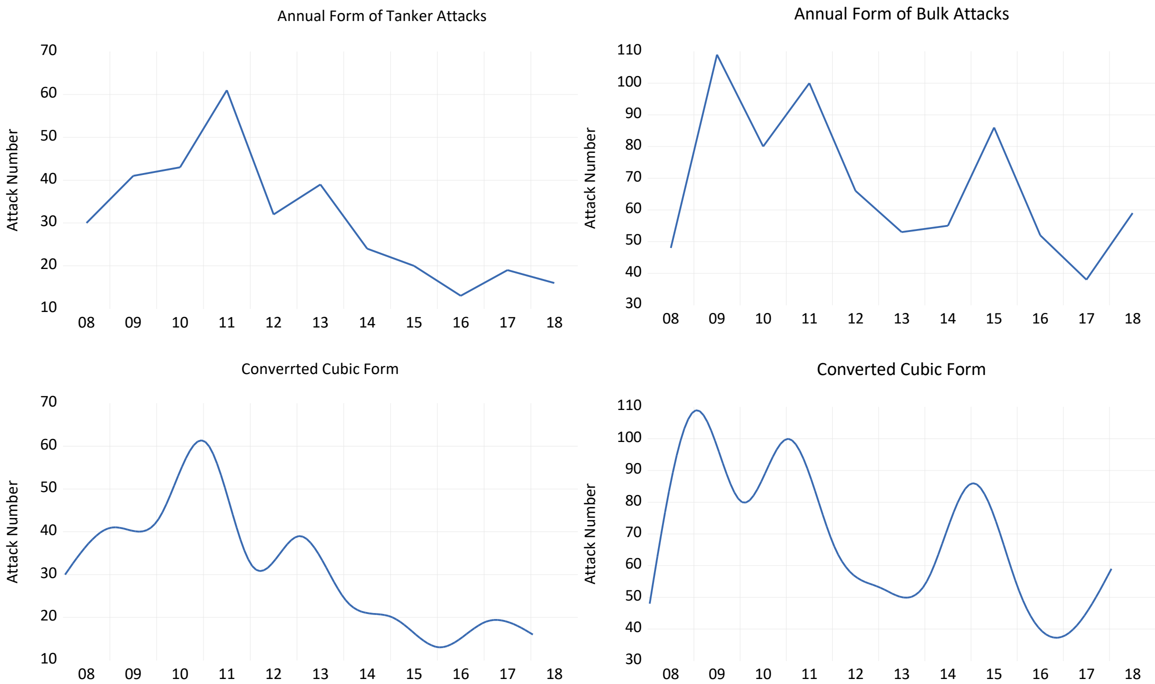

Figure 2. Annual Data and Converted Monthly Data

The variables used in the study have been converted to logarithmic form, thus the discrete data became continuous and the processability of the data has been increased. Also, since the relationship between the variables is examined by time series analysis, it is very important that the variables used are stationary. For this purpose, augmented Dickey-Fuller (Dickey and Fuller, 1979) unit root test has been applied to all variables (See Appendix 1 for the results). According to the results of the analysis, both BDI and BDTI variables are stationary at the level, whereas pirate attack variables become stationary when the first differences are taken. Therefore, the first differenced pirate attacks variables have been used in the analysis.

In order to develop the regression models correctly in the study, it is important to determine the causality direction between the variables. The reason is that while the study aims to examine the impact of freight rates on pirate attacks, theoretically, pirate attacks also affect freight rates by increasing insurance costs, bunker consumptions, etc. Therefore, the causality relationships between the variables have been examined by Granger method and the results are presented in Table 2. The most appropriate lags for the models have been determined as 4 according to Schwarz and Hannan-Quinn criteria (See Appendix 2 and Appendix 3 for lag selection results). According to the results obtained the null hypotheses of no causalities are rejected as freights are causal factors for pirate attacks in both dry bulk and tanker sectors. This implies that the impact of pirate attacks on freights are statistically insignificant and that the established regression models are correctly designed.

The model estimated in the regression analysis is basically as follows (2); the number of pirate attacks on tanker and bulk carriers are dependent variable, and the freight indices in the tanker and bulk shipping markets are independent variables. Both models have been estimated by ordinary least squares method (OLS).

$$lnATTACK_t = ln\beta_0 + \beta_1 lnFREIGHT_t + \varepsilon_t \quad (2)$$

Both of the estimated models have been obtained as significant as a whole according to F statistics, and independent variables also significantly explain changes in the dependent variables according to t-statistics. However, heteroscedasticity, autocorrelation and non-normal distribution problems have been determined in both models as a result of the several robustness tests applied to the residues of the models. Therefore, the models have been re-estimated by applying HAC (Newey-West) correction and standard errors have been recalculated, and the new results are presented in Table 3. According to the results obtained, both models are significant as a whole, and independent variables are also significant. Considering the bulk ship model, positive changes in the BDI variable positively affect pirate attacks. 100% change in freight rates causes about 3% change in pirate attacks. However, the change in freight rates can account for 25% of the change in pirate attacks. This may be due to data-related constraints, or factors other than freight rates may be more influential. On the other hand, explanatory power of the tanker ship model is much lower. Positive changes in the BDTI variable also positively affect pirate attacks. The coefficient of the freight is almost the same as the previous model (0.029), but the explanatory power of the model is as low as 5%. This can likewise be interpreted as factors other than freight rate being more influential in pirate attacks.

Table 2. Granger Causality Tests

H_0	Chi-sq.	Df.	Prob.
BDI does not Granger cause Bulk Attack	8.00	4	0.09
Bulk Attack does not Granger cause BDI	2.33	4	0.67
BDTI does not Granger cause Tanker Attack	7.92	4	0.09
Tanker Attack does not Granger cause BDTI	0.70	4	0.95

Table 3. Regression Estimation Results

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
BULK SHIP MODEL	C	-0.2058	0.0691	-2.9756	0.00
	BDI	0.0288	0.0098	2.9359	0.00
	R-squared	0.25	**F-statistic**		41.2
	Adjusted R-squared	0.25	**Prob (F-statistic)**		0.00
	Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
TANKER SHIP MODEL	C	-0.2004	0.0939	-2.1322	0.03
	BDTI	0.0292	0.0138	2.1176	0.03
	R-squared	0.05	**F-statistic**		7.38
	Adjusted R-squared	0.05	**Prob (F-statistic)**		0.00

5. CONCLUSIONS

Although pirate attacks are mainly caused by lack of security and poverty in the underdeveloped countries, it is seen that the people who have recently been involved in pirate attacks are equipped with modern equipment and they do this professionally. On the other hand, the attacked companies generally submit to the wishes of the pirates, taking into account both the safety of personnel and the costs of detaining the ship. Thus, pirates make the equipment they use more modern by generated income.

Freight levels of ships usually follow an upward trend for two reasons; (i) demand related increase; (ii) cost related increase. The increase in demand is mainly due to the inelasticity of ship supply in the short run. This is due to the fact that the ordered ships to the shipyards have not been able to enter the market at the requested time due to a certain period of time for building. Therefore, high freight rates have high profit margins, and the ship's inability to do business for any reason causes large revenue losses. Increases due to the cost are usually caused by increases in fuel prices since the fuel costs are one of the largest expense items of ships. Whatever the reason is, the last thing the ship owner wants is for her ship to be unable to do business, and the pirates turn it into an opportunity and aim for extraordinary gains. In this context, it is possible that there is a relationship between freight levels and number of piracy attacks. Although this relationship is clear verbally, no study has been found in the related literature which tests this relationship statistically. This lack in the literature forms the motivation of this study and it is aimed to gain a new perspective to the literature with an empirical approach.

In the study, two separate models have established and tested for dry bulk and tanker freight markets. The Baltic Dry Index for the bulk market and the Baltic Dirty Tanker Index for the tanker market are used as freight indicators in the markets. Pirate attacks have been converted from annual frequency to monthly frequency for both markets and included in the analysis. Firstly, Granger causality tests have been applied among the variables to determine the characteristics of endogeneity and exogeneity and it has been confirmed that freight rates are the determinants of pirate attacks. Later, according to the regression models established for both markets as pirate attacks are dependent variables, it has been found that changes in the freight rates significantly explain changes in the number of pirate attacks. 100% increase in freight rates causes a nearly %3 increase piracy attacks. The explanatory powers of the models are relatively low, but both models established are significant. This can be thought to be caused by a constraint from the data set.

Although the results of the study do not provide any practical and managerial implications for the actors in the market, they provide an original contribution to the literature by statistically testing that piracy is affected by freight levels in the market. What can be said in general is that the cost

of pirate attacks is very high for the maritime sector due to factors such as extending the route distances of ships, reducing the available tonnage in the market and increasing insurance costs. On the contrary, the reason for perpetrators who are engaged in pirate activities is not low labor opportunities in their countries, conversely they are attracted by the high returns of piracy. In this context, contributing to the development of job opportunities in countries with high piracy may not be able to reduce piracy activities. Instead, it is considered beneficial to increase the protective measures for the protection of merchant ships in a sustainable manner.
The biggest limitation of this study is related to the dataset since only annual data on pirate attacks could be obtained by ship type since 2008. If a higher frequency data set covering a longer period can be obtained, healthier analyzes can be performed, and thus better results can be obtained.

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APPENDIXES

Appendix 1. Unit Root Test Results

	Level			First Difference		
	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None
BDI	-2.87*	-3.01	-0.75	-9.97***	-10.00***	-9.99***
BDTI	-3.26**	-3.12	-0.09	-12.20***	-12.23***	-12.25***
Bulker Attack	-2.01	-2.37	-0.31	-3.81***	-3.73**	-3.82***
Tanker Attack	-0.05	-2.49	-1.33	-3.79***	-3.98**	-3.56***

CVs for Intercept: -3.47***, -2.88**, -2.57*. CVs for Trend and Intercept: -4.02***, -3.44**, -3.14*. CVs for None: -2.58***, -1.94**, -1.61*

Appendix 2. Lag Length Selection Criteria for Bulk Ship Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	136.7102	NA	0.000309	-2.405539	-2.356994	-2.385843
1	404.3376	520.9176	2.79e-06	-7.113171	-6.967537	-7.054083
2	624.5888	420.8371	5.87e-08	-10.97480	-10.73208	-10.87632
3	695.6571	133.2531	1.77e-08	-12.17245	-11.83264	-12.03458
4	706.7844	20.46623	1.56e-08	-12.29972	-11.86282*	-12.12246*
5	711.1565	7.885448	1.55e-08*	-12.30637*	-11.77238	-12.08971
6	712.5629	2.486299	1.63e-08	-12.26005	-11.62897	-12.00400
7	713.5939	1.785757	1.72e-08	-12.20703	-11.47886	-11.91159
8	721.7936	13.91032*	1.60e-08	-12.28203	-11.45677	-11.94720

Appendix 3. Lag Length Selection Criteria for Tanker Ship Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	251.0241	NA	4.02e-05	-4.446859	-4.398314	-4.427163
1	460.9141	408.5360	1.02e-06	-8.123467	-7.977833	-8.064379
2	658.4713	377.4753	3.21e-08	-11.57984	-11.33712	-11.48136
3	726.6800	127.8913	1.02e-08	-12.72643	-12.38662	-12.58856
4	739.6771	23.90541*	8.68e-09*	-12.88709*	-12.45019*	-12.70983*
5	741.9683	4.132287	8.95e-09	-12.85658	-12.32259	-12.63992
6	742.5246	0.983419	9.53e-09	-12.79508	-12.16400	-12.53903
7	746.4078	6.726362	9.56e-09	-12.79300	-12.06483	-12.49756
8	749.6351	5.474841	9.71e-09	-12.77920	-11.95394	-12.44436