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Impact of Commodity Price on Freight Market Considering the 2008 Crisis: An Investigation of Iron Ore Price and Capesize Shipping Rates

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Abstract

This study investigated the asymmetric causality from iron ore price to freight market through Capesize rates by considering the possible impact of the 2008 global economic crisis. The study used a monthly data set of 233 observations covering the period between January 2000 and June 2019. According to the structural break tests, a break was detected in June 2008 and the analyses were performed for two separate periods as pre-crisis and post-crisis in addition to the whole period. The results for the whole period revealed that positive shocks in iron ore price caused negative shocks in freight rate and negative shocks caused both negative and positive shocks. In the pre-crisis period, positive shocks in the iron ore prices caused positive shocks in the freight rates. In the post-crisis period, negative shocks in the ore prices caused both negative and positive shocks in freight rates. These results suggested that the impact of commodity prices on the freight market before and after the crisis might vary.

1. Introduction

Dry bulk transportation plays an important role in the global economy. It enables the delivery of randomly distributed resources worldwide in large quantities and cost-effective to the needed areas (Dai et al., 2015, Lun and Quaddus, 2009). The main cargoes that are transported by this mode are iron ore, coal, grain, alumina/bauxite, and phosphate, which are also known as five major bulks and constitute the basic raw materials to several industries.

The market structure of the bulk market is defined as a perfect competition by many researchers since there are no entry barriers (except large capital requirements), there are many buyers (shippers) and sellers (shipowners), and the price in the market is clear for everyone to follow (Lun and Quaddus, 2009). Entrepreneurs who want to take advantage of the increased income when freight is raised, make new orders and increase the carrying capacity in the market due to the ease of entry and exit. When new ships enter the market, freight tends to fall again. Similarly, when freight falls, old ships with high costs are sent to the demolition, causing a reduced carrying capacity, and consequently, this situation causes freight rates to rise again. However, unlike other markets, the construction process factor, which prevents immediate delivery of the ship in ship orders, causes large fluctuations in freight. Since the shipbuilding process lasts for nearly 2 years, ship supply is inelastic in the short run (Başer and Açık, 2018). As this mechanism consequently causes increases and decreases in freight rates eventually, the freight market is described as mean-reverting in the literature (Tvedt, 2003).

Dry bulk transportation may be divided into three submarkets such as Capesize, Panamax, and Handysize (Jing et al., 2008). These types of ships vary in size, and each specializes in particular cargoes. For instance, 70%-80% of iron ore is transported by Capesize ships, 10%-20% is transported by Panamax ships, 10% is transported by Handymax ships; 30%-40% of coal is transported by Capesize ships, 40%-50% is transported by Panamax ships, 10%-20% is transported by Handymax ships; 0%-5% of grain is transported by Capesize ships, 40%-50% is transported by Panamax ships, 45%-55% is transported by Handymax ships (Chen et al., 2014). Since most of the iron ore commodity is transported by Capesize vessels, it is inevitable that there will be a relationship between the price of iron ore and the freight of this ship type. There are several studies on this topic from various angles: economic spillover effect (Kavussanos et al., 2010, Kavussanos et al., 2014: Angelopoulos et al., 2020; Açık and

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Başer, 2021) and linear causality relationship (Yu et al., 2007; Chou et al., 2015; Tsioumas and Papadimitriou, 2018). These studies have obtained several significant results, but no study examining the issue from a nonlinear perspective and considering the possible differentiation in pre- and post-crisis interaction has not been found in the literature. In this regard, we provide an original contribution by examining the possible relationship in two periods (pre-crisis and post-crisis) by considering possible nonlinear structures.

To determine the possible break that was caused by the 2008 global economic crisis, unit root tests with one structural break have been implemented to the data. The results have revealed that there was a break in the date of July 2008 at both level and trend. Then, three analyses have been conducted for the whole period, pre-crisis period, and post-crisis period and possible differentiation in the relationship between commodity prices and freight rates have been examined. The results for the whole period have revealed that positive shocks in iron ore prices cause negative shocks and negative shocks cause both negative and positive shocks. Second, the results for the pre-crisis period have indicated that positive shocks in iron ore prices are causes of positive shocks in freight rates. Thirdly, the results for the post-crisis period have shown that negative shocks in the ore prices are causes of both negative and positive shocks in freight rates. These results have indicated that the 2008 global crisis has caused a break in the Capesize freight market and that the impact of the commodity market has been different before and after the crisis.

In the second section, a brief literature review is presented. In the third section, information about the method used is given. In the fourth section, the dataset used is investigated and analysis is conducted. In the last section, the findings are presented and recommendations for future studies are presented.

2. Literature Review

The interaction between freight rates and commodity prices has been of interest to many researchers in the literature. The main reason for this interest is that the prices of commodities are shaped according to the demand and supply balance (Radetzki, 2008:58). The changes in the prices of commodities show that there are also changes in the supply and demand sides in the market. Since demand structure in maritime transport is derived (Ma, 2020:3), changes in commodity trade are probably reflected in freight rates. In addition, the fact that the supply is inelastic in the short-run (Koopmans, 1939) in maritime transport causes sudden demand changes to reflect rapidly on freight levels in the market. Besides, non-demand changes in freight rates can affect the prices of commodities and final products. In the research conducted by Chou et al. (2015), the causality relationship between the Baltic Capesize Index (BCI) and the Asian Steel Index (ASI) was examined. As it is known, Capesize vessels are used extensively for iron ore transportation. Therefore, changes in freight rates are likely to affect steel prices. According to the results obtained from the research, the BCI variable has been determined as a leading indicator of the ASI variable. The current situation in freights affects the price of steel in the next 2 periods.

There is also probably a relationship between transported raw materials and dry bulk freight rates. As indicated by Chen et al. (2014), some ships specialize in transporting some raw materials. In this respect, the relationship between commodity prices and freight rates may differ according to the ship type. Accordingly, in the study by Tsioumas and Papadimitriou (2018), they found a mutual interaction between the BCI variable and iron ore and coal prices. On the other hand, they found a significant relationship from wheat price to the Baltic Panamax Index (BPI) variable. A similar research question was investigated by Açık and İnce (2019), taking nonlinear structures into consideration. The researchers considered the BCI, BPI, and Baltic Handysize Index (BHI) indices in the dry bulk market as representative of freight rates. They dealt with iron ore, coal, and wheat commodities, which are heavily transported in the market as the type of cargo. According to the results they obtained by applying asymmetric causality analysis, they determined that the effects of shocks in commodity prices on freight rates differ by ship type.

The interaction between dry bulk freight rates and commodity prices has also been the subject of some studies in terms of information flow. In the research conducted by Angelopoulos et al. (2020), the relationship between freight rates and commodity prices was examined in terms of information flow in dry and liquid bulk markets. According to the results, increases in the prices of dry bulk cargo cause an increase in freight rates in the market. This situation can be shown as evidence that the prices of the cargoes carry information about their demands. Increasing prices due to increasing demand may also cause an increase in freight rates. Because when demand for a commodity increases, it can cause an increase in prices. On the other hand, researchers found that the increase in the prices of petroleum products caused a decrease in tanker freight rates. This situation may be related to the fact that the demand for oil is in a different mechanism than dry bulk cargo or the prices are under the control of limited producers. They found that the prices of dry bulk cargoes are leading for freight in the relevant markets.

In terms of the flow of information, the relationship between dry bulk freight rates has also been examined by Açık and Başer (2021). The relationship between the spot freight rates of Capesize, Panamax, Handymax, and the prices of iron ore, coal, and wheat, which are the 3 main cargo types in the market, is analyzed on an agent-based view. The researchers thought that the use of spot freight would be a better indicator than using a freight index. Because while freight indices use time charter averages in the market whose changes are slow, spot freights have a more dynamic structure. In their results, the researchers found that there was mostly a flow of information from commodity prices to freight rates, while the situation in wheat was two-sided. The main reason for this result is that wheat prices are closely related to oil prices. The volatility in the oil price is spreading to the wheat price. Since oil is also the main cost item in the freight of ships, it is acceptable to have volatility spread from freight to the price of wheat. In addition, the relationship between commodity prices and freight rates can be seen in future derivative markets. Based on this research question, Kavussanos et al. (2010) investigated in Panamax market, and Kavussanos et al. (2014) investigated in Capesize, Panamax, and Supramax markets. According to the general results obtained, the information flow is mostly from commodity price to freight rates in the derivative markets.

In this study, unlike the literature, we determined whether a break in the global economy changed the relationship between commodity prices and freight rates. Due to the historical peaks in dry bulk freight rates before 2008, the interaction may have differentiated in the future due to the excess ships ordered after the crisis. In this respect, it is thought that our study offers an original approach to the literature.

3. Methodology

In this study, the asymmetric causality test developed by Hatemi-J (2012a) is used, which is a nonlinear method and investigates the relationship between variables by distinguishing the shocks they include as negative and positive. Therefore, 4 different combinations of relationships are probably obtained; (i) from positive shocks to positive shocks, (ii) from positive shocks to negative shocks; (iii) from negative shocks to negative shocks, (iv) from negative shocks to the positive shocks. Considering the possible different impacts of positive and negative shocks (Hatemi-j, 2012b), the method can be said to be very useful since agents in a market may react differently according to the type of shock (Hatemi-J, 2012a). Furthermore, the series does not have to have a normal distribution in the analysis, and this is a great advantage when considering the structures of financial series subject to too many shocks and unexpected events (Bildirici and Turkmen, 2015).

The method investigates the possible asymmetric causalities by using cumulative sums of positive and negative shocks (Tugcu and Topcu, 2018). Therefore, the causal effects of positive and negative ones can be distinguished (Shahbaz et al., 2017). The bootstrap simulation method is used to consider an autoregressive conditional heteroscedasticity effect (Tugcu et al., 2012) and obtains accurate critical values by this technique (Hatemi-J and Uddin, 2012).

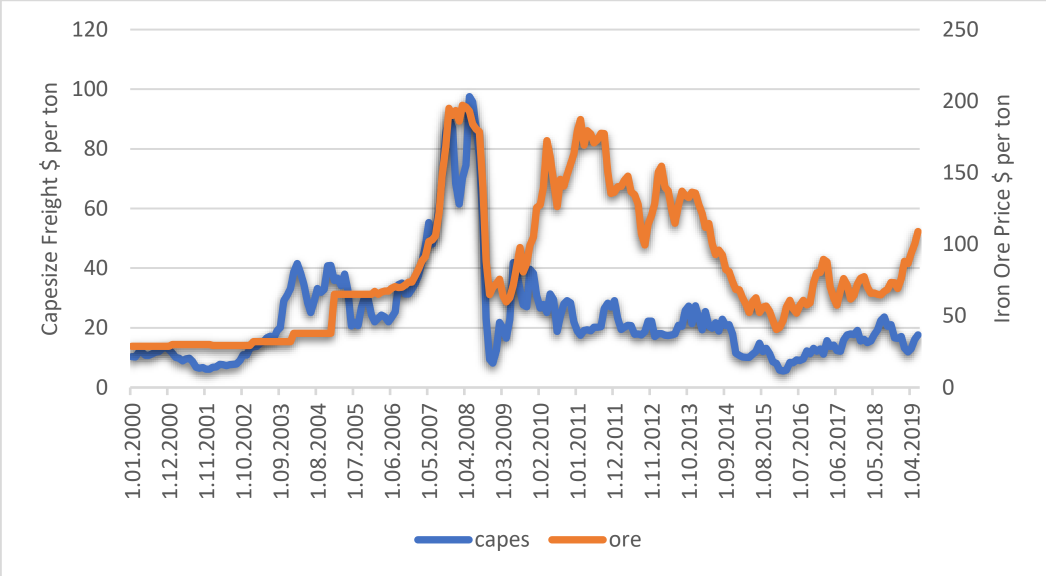
Because the asymmetric causality method includes Toda and Yamamoto (1995) process, the series does not have to be stationary, but the appropriate integration degree needs to be determined (Umar and Dahalan, 2016). Unit root tests are performed to check the condition of the series and if there is any non-stationary series, the maximum difference taking value to make it stationary is added to unrestricted VAR equations (Hatemi-J and Uddin, 2012).

4. Findings

We used a monthly data set of 233 observations covering the period between January 2000 and June 2019. Capesize freight rate variable was obtained from Bloomberg Data Platform (2019) on 20 June 2019. It represents the freight rate per ton from Tubarau (Brazil) to Qingdao (China). This route was chosen because it is one of the most intensive iron ore seaborne trade routes. The arithmetic average of the daily freight rates was taken to match the data and converted into monthly values because the price of iron ore consists of monthly observations. The iron ore price represents the general iron ore price per ton published by Worldbank (2019).

The graphical representation of the variables used in the study is presented in Figure 1. The big structural break in the maritime sector is seen obviously in the figure. In addition to the decelerating demand during this period, the increase in ship supply caused the freight to hit bottom. Therefore, the freight market's interaction with commodity prices may differ before and after the crisis. Increased commodity prices after the crisis may point to increased demand, but freight rates have failed to react positively, as rising ship orders due to the incredible earnings before the crisis generates a huge ship surplus in the market.

Figure 1. Graphical display of variables.



Reference: Bloomberg (2019); Worldbank (2019).

Descriptive statistics are important indicators related to the structures of the data, which are presented in Table 1 as return forms. The table presents descriptive statistics for both the whole period and the periods divided according to the test results in Table 2. Considering the high kurtosis values, it is also possible to obtain information from skewness values about the type of shock that the variables are mostly exposed to in the period in which they are handled. For example, Capesize freight rates were more exposed to negative shocks, while iron ore prices were exposed to positive shocks in the whole period. This situation is similar in the first period between January 2000 and July 2008. In the second period between August 2008 and June 2019, both variables were mostly exposed to negative shocks (news).

When the distributions of variables are examined, the normal distribution indicates linearity, whereas the opposite indicates non-linearity. When the Jarque-Bera statistics, which test the distributions are investigated, it is seen that the null of normal distribution hypothesis is rejected in all variables. This finding can be interpreted as a sign that the variables contain nonlinear structures.

Table 1. Descriptive statistics of the return series.

	Cap	Ore	Cap 1	Ore 1	Cap2	Ore 2
Mean	0.002	0.005	0.020	0.017	-0.011	-0.003
Median	0.007	0.000	0.030	0.000	-0.002	0.005
Maximum	0.607	0.539	0.371	0.539	0.607	0.212
Minimum	-0.893	-0.454	-0.459	-0.047	-0.893	-0.454
Std.Dev.	0.17	0.090	0.122	0.065	0.20	0.10
Skewness	-0.83	0.10	-0.36	5.56	-0.71	-0.73
Kurtosis	8.47	10.5	4.84	41.6	7.14	4.71
Jarque-Bera	317	553	16.7	6867	104	27.4
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Observations	233	233	102	102	130	130

Reference: Bloomberg (2019); Worldbank (2019).

The period of possible breaks in Capesize freight rates can also be spotted by examining the graph. However, statistical support for this break is important for the reliability of the research. In this direction, one-break unit root tests proposed by Zivot and Andrews (1992) and Lee and Strazicich (2013) are applied to Capesize freight data by using GAUSS 19 statistical software and the results are presented in Table 2. These tests make it possible to detect both break in level and break in level and trend. The obtained results revealed that there is a significant break in the level and trend according to both ZA and LS tests. When this break is taken into consideration, the series becomes stationary. The one break ADF test indicates July 2008 as a break date, while the one break LM test indicates August 2008 as a break date. Considering these results, July 2008 is accepted as the break point and the dataset is divided into pre-crisis and post-crisis periods.

Table 2. Unit root tests with structural breaks(*).

Test Items	Break in Level Capesize	Break in Level and Trend Capesize
	One break ADF test (Zivot & Andrews, 1992)	
ADF Stat	-3.75	-4.75**
Break Date	July 2002	July 2008
Fraction	0.13	0.44
Lag	9	9
	One break LM test (Lee & Strazicich, 2013)	
LM Stat	-2.54	-4.40*
Break Date	September 2008	August 2008
Fraction	0.44	0.44
Lag	9	9

(*) ZA (1992) Break in Level CVs: -5.34 for ***1%, -4.80 for **5%, -4.58 for *10%. ZA (1992) Break in Level and Trend CVs: -5.05 for ***1%, -4.50 for **5%, -4.18 for *10%. LS (2013) Break in Level CVs: -4.23 for ***1%, -3.56 for **5%, -3.21 for *10%. LS (2013) Break in Level and Trend CVs: -5.05 for ***1%, -4.50 for **5%, -4.18 for *10%.

The graph drawn on the basis of the determined break date is presented in Figure 2. Thanks to the trend lines inserted in the figure, the differentiation between two periods can be clearly seen. While there is an increasing trend in the pre-crisis period, there is a decreasing trend in the post-crisis period. There is also a major level break in the date of the crisis.

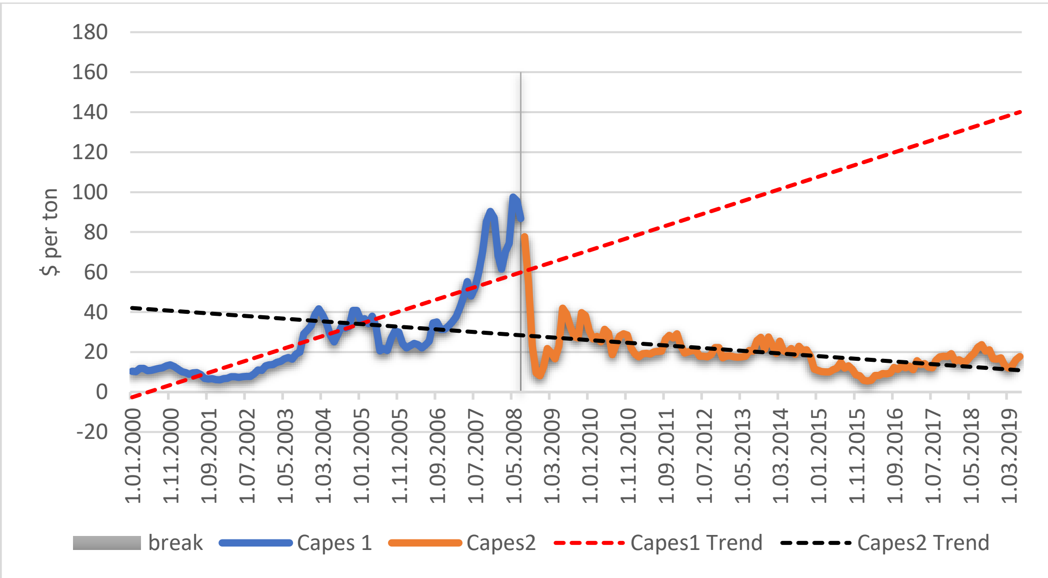


Figure 2. Break date and trends of different periods.

To apply the asymmetric causality test used in the study, the series does not have to be stationary, but the maximum integration degree should be known. To determine this value, augmented Dickey-Fuller (1979) and Phillips-Perron (1988) tests were applied to the series by using EViews 10 econometric software, and results are presented in Table 3. According to the results of the analysis for the whole sample, the Capesize variable is stationary at the level and the ore variable becomes stationary when the first difference is taken. In the pre-crisis period, both variables contain unit root at the level and it is necessary to take the first differences in the variables to make them stationary. Finally, in the post-crisis period, only the Capesize variable is stationary at the level. When all these results are evaluated, the maximum integration degree is determined as one in all three periods (whole, pre-crisis, post-crisis) analyzed.

Table 3. Unit roots tests of the variables(*).

	Variable	Level		First Difference	
		Intercept	Trend and Intercept	Intercept	Trend and Intercept
ADF	Iron Ore	-1.88	-1.95	-11.03***	-11.02***
	Capesize	-3.04**	-3.06	-11.69***	-11.68***
PP	Iron Ore	-1.70	-1.70	-10.86***	-10.84***
	Capesize	-2.59*	-2.54	-11.32***	-11.31***
ADF	Iron Ore P1	1.23	-1.42	-8.87***	-9.15***
	Capesize P1	-0.56	-2.33	-7.61***	-7.62***
PP	Iron Ore P1	1.13	-1.51	-8.91***	-9.15***
	Capesize P1	-0.21	-2.00	-7.51***	-7.44***
ADF	Iron Ore P2	-1.48	-1.69	-9.33***	-9.27***
	Capesize P2	-4.02***	-4.05	-8.93***	-8.93***
PP	Iron Ore P2	-2.17	-1.95	-7.67***	-7.66***
	Capesize P2	-4.02***	-4.05	-10.02***	-10.20***

(*) Whole Sample CVs -3.45 for ***1%, -2.87 for **5%, -2.57 for *10% at Intercept. -3.99 for ***1%, -3.42 for **5%, -3.13 for *10% at Trend and Intercept. P1 CVs -3.49 for ***1%, -2.88 for **5%, -2.58 for *10% at Intercept. -4.05 for ***1%, -3.45 for **5%, -3.15 for *10% at Trend and Intercept. P2 CVs -3.48 for ***1%, -2.88 for **5%, -2.57 for *10% at Intercept. -4.03 for ***1%, -3.44 for **5%, -3.14 for *10% at Trend and Intercept.

Since the asymmetric causality test developed by Hatemi-J (2012a) is a nonlinear method, the variables must have nonlinear structures to obtain healthy results. First, the models that give the lowest Akaike Information Criterion (AIC) value for each variable are determined. Then, the models are estimated and the residues of the models are separated to distinguish stochastic structures from the deterministic structures. Then, the obtained residues of the models are tested by ARCH LM (Engle, 1982) and BDS Independence (Brock et al., 1987) tests using EViews 10. The optimum models are as follows: ARMA (0, 1) with -2.05 AIC value for iron ore, ARMA (4, 8) with -0.77 AIC value for Capesize, ARMA (0, 0) with -2.58 AIC value for iron ore P1, ARMA (6, 9) with -1.48 AIC value for Capesize P1, ARMA (0, 1) with -1.79 AIC value for iron ore P2, and ARMA (9, 8) with -0.54 AIC value for Capesize P2. BDS Independence test results that are implemented to the residuals of these models are presented in Table 4. The null hypothesis of the test indicates linearity and rejection of the null hypothesis indicates nonlinearity. According to the BDS independence test results, the null of linearity hypothesis is rejected for all variables except for Capesize P1.

Table 4. BDS independence test results(*).

Dimension	Capesize	Ore	Cap P1	Ore P1	Cap P2	Ore P2
2	0.016***	0.023***	-0.009	0.053***	0.023***	0.015***
3	0.028***	0.042***	-0.017	0.067***	0.032***	0.028***
4	0.038***	0.067***	-0.014	0.103***	0.037***	0.040***
5	0.041***	0.081***	-0.006	0.116***	0.031**	0.045***
6	0.0382***	0.084***	-0.002	0.096***	0.025*	0.047***

(*).Null of Linearity Rejected at ***1%, **5%, *10%.

We have also applied ARCH LM test as a supportive method in order to investigate linearities of the variables. The null hypothesis of this test indicates linearity of the related variable. The test is applied for lags of 1, 2, 4, 8, and the results are presented in Table 5. According to the results, null of linearity is rejected for all variables at least one lag except for iron ore P2. The results of both test reveal that all variables have nonlinear structures, and then the asymmetric causality test is applied by using GAUSS 19.

Table 5. ARCH LM test results(*).

Lag	Capesize	Ore	Cap P1	Ore P1	Cap P2	Ore P2
1	44.069***	7.237***	1.634	0.005	13.834***	7.030***
2	22.879***	3.593**	1.316	0.009	8.787***	0.946
4	11.833***	1.770	3.443**	0.017	0.810	0.546
8	6.126***	0.852	2.898***	0.026	1.093	1.041

(*).Null of Linearity Rejected at ***1%, **5%, *10%.

First, analysis is performed for the whole sample, which covers the periods between January 2000 and June 2019, and the results are presented in Table 6. The letter "O" refers to Iron ore price while the letter "C" refers to

Capesize freight rate. The maximum number of lags is selected as 5, the maximum degree of integration is selected as one, and the information criterion is selected as AICc, which is a kind of AIC that is used in small-sized samples. According to the results of the analysis, which covers the whole sample, 3 significant causal relationships have been determined; (i) from positive shocks to negative shocks, (ii) from negative shocks to negative shocks, and (iii) from negative shocks to positive shocks.

Table 6. Asymmetric causality test results for the whole sample(*).

		O^+C^+	O^+C^-	O^-C^-	O^-C^+
Optimal Lag; VAR(p)		1	5	3	5
Additional Lags		1	1	1	1
Test Stat (MWALD)		0.20	12.1	54.5	35.5
Asym. chi-sq. p-value		0.65	0.03**	0.00***	0.00***
Critical Val.	1%	8.83	16.5	13.4	17.3
	5%	4.83	12.0	8.85	12.6
	10%	2.90	9.80	6.77	10.0

(*) Significance levels ***1%, **5%, *10%.

Second, the analysis is performed for the pre-crisis period, which covers the period between January 2000 and July 2008 and consists of 103 monthly observations. According to the results obtained, there is only one causal relationship from positive shocks to positive shocks.

Table 7. Asymmetric causality test results for pre-crisis period(*).

		O^+C^+	O^+C^-	O^-C^-	O^-C^+
Optimal Lag; VAR(p)		3	1	1	1
Additional Lags		1	1	1	1
Test Stat (MWALD)		7.12	0.17	0.44	0.00
Asym. chi-sq. p-value		0.06*	0.67	0.50	0.99
Critical Val.	1%	13.2	13.3	12.1	12.9
	5%	8.17	3.75	4.09	4.18
	10%	6.41	2.53	2.55	2.61

(*) Significance levels ***1%, **5%, *10%.

Thirdly, the analysis is performed for the post-crisis period, which covers the period between August 2008 and June 2019 and consists of 131 monthly observations. According to the results, two significant causal relationships have been determined; (i) from negative shocks to negative shocks; and (ii) from negative shocks to positive shocks.

Table 8. Asymmetric causality test results for post-crisis period(*).

		O^+C^+	O^+C^-	O^-C^-	O^-C^+
Optimal Lag; VAR(p)		1	3	1	3
Additional Lags		1	1	1	1
Test Stat (MWALD)		0.17	1.09	5.79	11.5
Asym. chi-sq. p-value		0.67	0.77	0.01**	0.00***
Critical Val.	1%	7.78	12.9	7.16	13.7
	5%	4.25	8.73	4.29	8.66
	10%	3.07	6.79	2.84	6.98

(*) Significance levels ***1%, **5%, *10%

5. Conclusion

In this study, first unit root tests which take structural breaks into account have been applied to Capesize freight rates and the crisis date has been determined statistically. A significant break has been detected in both level and trend in 2008. When this break is considered, the series is stationary. July 2008 has been determined as the structural break date and the sample has been divided into two periods as pre-crisis and post-crisis. Then, the linearities of all series have been tested by various methods and it has been determined that all of them have trace(s) of nonlinear structures. Then, the asymmetric causality test has been applied.

When the whole period is considered, it is seen that positive shocks in iron ore price cause negative shocks and negative shocks cause both negative and positive shocks. Considering the big break in the freight market and large fluctuations in commodity prices due to the 2008 global economic crisis in the period under covered, these complex results can be regarded as normal. Due to the structure of the maritime market, the supply is inelastic in the short run and the carrying capacity cannot be increased at the requested time. Because the ship has a certain period of construction and a ship ordered today can enter the market in about 2 years. However, there is uncertainty about what the market will look like when the ship enters the market. In cases where the rate of increase in demand decreases or turns negative if the supply increase rate is high, excessive carrying capacity is formed in the market and freights are bottomed. Indeed, after the crisis in 2008, freight rates saw low levels and remained far from their former glory days. In this respect, it is possible that there may be a differentiation in the pre and post-crisis trends in the freight market. Then, the analysis has been conducted for the pre-crisis period and the causality relationship has been determined only from positive shocks to positive shocks. This situation can be interpreted as the increase in demand-induced price increases positively affect the demand for maritime transport. In the analysis performed for the post-crisis period, causality relationships have been determined from negative shocks to negative shocks, and from negative shocks to positive shocks. The first result may be considered as negative price shocks in ore caused by the decrease in demand have a negative effect on the demand for shipping. The significant causal relationship from negative shocks to positive shocks may be a statistically random relationship. Or it can be interpreted as the decrease in commodity prices is due to political reasons rather than demand, and therefore the increase in demand for transportation might be triggered. In addition, factors affecting freight rates, other than iron ore price, due to the method used were ignored. Among these factors, oil prices undoubtedly have a significant effect on freight rates. In this context, the role of the oil price in the results obtained is also worth examining and it has been determined as a research question for our future studies.

The lack of any studies in the maritime literature, which separates the periods is a major gap and this study is hoped to provide an original contribution to the literature by addressing the issue from this perspective. The main limitation of the study is that the frequency of the obtained iron ore price is monthly. If higher frequency data can be found, the results of the study are considered to be more robust. Also, it would be beneficial to reconsider the relationship with models in which other influential variables such as oil price can be included, in order to broaden the scope of the subject.

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