Capesize markets behavior: Explaining volatility and expectations

Pelagidis, Theodore and Karaoulanis, Ioannis

2021

Capesize markets behavior: Explaining volatility and expectations

Theodore Pelagidis [a,*,1], Ioannis Karaoulanis [b,1]

[a] Dpt. of Maritime studies, University of Piraeus and NR senior fellow, Brookings Institution, US
[b] University of Piraeus, Dpt. of Maritime Studies, Greece

A B S T R A C T

It is widely accepted that the highly volatile capesize market has many peculiarities. Its importance has been recently highlighted by an increase in contribution of the Baltic Capesize Index (BCI) to the Baltic Dry Index (BDI), affecting the progress of the BDI more than any other dry bulk index. This paper investigates the behavior of the capesize market focusing on expectations and time lags. Expectations play a critical role in the freight market both for the short-term and the long-term decision making. In particular, we investigate the relation between time lags and time-charter, trip and spot market rates as well as the average earnings of the capesize vessels of various ages. Time series analysis is used to reach our conclusions. The Hannan – Quinn criterion has been selected to identify the important lags of the capesize freight market for the period 1977–2018 and an Autoregressive (AR) model has been constructed to perform the statistical analysis. The findings indicate that there is a strong correlation between time lags and capesize freight market, forecasting indeed the behavior of the market. At a practical level, better understanding of the behavior of the capesize market can improve the planning decision of ship-owners and charterers alike.

Introduction

Baltic Dry Index (BDI) is affected by the indices of the relevant dry bulk markets in weighting, with the Baltic Capesize Index (BCI) contributing by far the highest weighting. The capesize shipping market is a key barometer of commodities international trade. From the financial health of dry companies to the effects of COVID-19, to vessel cascading, newbuildings, emissions control and charter rates paid to independent shipowners, this massive dry shipping industry is at the center of global macro change. Capesize vessels, although varying in size they normally have dead weight tonnage (dwt) more than 100.000 tones. In particular, a small capesize vessel has 127.500 dwt, a big one has 170.000 dwt, while a modern capesize ship revolves around 180.000 dwt. These vessels transport mostly dry bulk cargoes, mainly iron ore and coal, under specific routes and in high volumes with freight rates suffering sky-high fluctuations both in the short and in the long term. Thus, both market expectations and time lags play a critical role in the determination of the freight market equilibrium. This paper aims to investigate the behavior of the capesize vessels' market, under conditions of high market volatility. In particular, we focus on the capesize market investigating the impact of market expectations on freight rates. We look at the relation between time lags and time charter, trip and spot market rates of the capesize vessels of various ages. We use time series analysis to reach our conclusions. The Hannan – Quinn criterion has been selected to identify the important lags of the capesize freight market for the period 1977–2018 and an Autoregressive (AR) model has been constructed to perform the statistical analysis. The findings indicate that there is a strong correlation between time lags and the capesize freight market, as far as it concerns efforts to forecast the behavior of the market. At a practical level, a better understanding of the behavior of the capesize market could contribute, we argue, in an improvement regarding ship-owners and charterers markets' forecasting. In the literature and methodology section, we focus on different models to capture future fluctuations and behavior of the freight markets, mostly in the area of autoregressive models such as autoregressive moving average (ARMA), autoregressive integrated moving average (ARIMA), vector autoregressive (VAR). We have selected an autoregressive model (AR), since the AR model provided better results than ARMA and ARIMA models for the purposes of our research. Compared with previously mentioned models, it is also highlighted that by using this method, one can accurately explain and foresee unexpected behaviors of this market, which is critical for the viabil-

* Correspondence to: 21 Labraki Ave., GR-18533 Piraeus, Greece.
E-mail addresses: pelagidi@unipi.gr, tpelagidis@Brookings.edu (T. Pelagidis).
[1] The authors would like to thank participants of the IAME Athens conference 25–28 June 2019 as well as two anonymous referees for comments and suggestions. The usual disclaimer applies.

ity of the "market players". The Hannan – Quinn criterion has been selected to identify the leading lags affecting specific time series among the last 16 observations. Once we identify the lags affecting significantly time series, we construct the AR model. We run the model for the capesize markets of spot, time charter and timecharter trips. The trade routes selected for analysis in this paper are the most established routes for the capesize markets. The empirical analysis of the results follows. We analyze the results taken from running the AR model, along with the progress of demand and supply, and the expectations for the future market being captured from the FFA market, which is taken into account to conclude. The findings indicate that it is possible to explain the fluctuations of the capesize markets and forecast future market behavior, to the benefit of the shipowner and the charterer alike.

Literature Review and methodology

Literature review

According to the cobweb theorem, when an abrupt change in the demand occurs, the market balances with a time-lag, since changes in supply take some time to realize (Stopford, 2009). In the shipping industry in particular, the supply technically changes as an immediate effect. For example, the improvement of the fleet productivity results to the short-term increase of the supply, adjusting to the new market situation. In the long term, the supply increases with the deliveries of new vessels, which take about two years, creating a time lag which is a critical factor. When demand changes, shipowners increase or decrease the supply of fleet capacity, depending on expectations for the future level of the freight market (Stopford, 2009). Any change in the supply and/or in the demand functions, causes changes to the world fleet capacity and/or to the world seaborne trade, nudging fluctuations to the freight market. This effect is known as the cobweb effect as these oscillations will either lead to a new stable or unstable equilibrium (McConville, 1999). Both freight rates and the volume seaborne trade have a significant effect on the fleet size too. The ship-owners tend to increase the fleet size when cargoes are available to fill their ships and the return of such an investment depends on the volume of trade. If the fleet size has not been increased while trade grows, sea transport will be overburdened due to a shortage of ships. If fleet size has been increased but trade does not grow, expensive ships will move to lay-up. Therefore, shipping companies adjust their fleet size when they are optimistic about the cargo volume for shipping services (Lun and Quaddus, 2009). The short-term fluctuations of the freight market do not imply anything about the expected returns to owning or operating the ship. However, it is noticed that after a sudden increase of the demand for shipping services, freight market prices will go up and ship-owners will tend to invest in new ships. Heavy investment during booms depresses future earnings and the price of the capital, leading prices to overshoot their rational-expectations levels (Greenwood and Hanson, 2013). In the shipping industry, the expectations can be explained by analyzing the forward freight agreement (FFA) market, as according to Batchelor et al (2007) the forward prices of non – storable commodities are the forecasts of future spot prices. By applying vector equilibrium correction (VECM) models, ARIMA and VAR models, Batchelor et al (2007) forecast the FFA prices and proved the close relation between spot and forward prices. GARCH models are also used for forecasting purpose. Studying the Panamax market, it is shown that the FFA market affects the relevant spot freight market (Kavussanos et al, 2004). The lead lad relationship in returns and volatilities between spot and future market has been also investigated in the Panamax market using VECM and GARCH models (Kavussanos and Visvikis, 2004). Pelagidis and Panagiotopoulos (2019) examined the connection between the trading of FFAs and its effects in the volatility of the spot capesize freight market, considering factors that affect the global economy and the volatility in shipping markets. It is found that there is a positive impact of FFAs in some main voyage capesize routes. Alizadeh (2013) investigated the price volatility and trade volume relationship in the FFA market. It is found that FFA price changes have a positive impact on trading volume. There is also a positive relation between trading volume and volatility. However, increases in price volatility lead to lower future trading activities in the FFA market. Alexandridis et al. (2017) investigated the interactions between freight rates and the freight futures in the dry bulk industry. In the capesize market, a strong interaction between time charter rates, freight futures and option prices is found. The results also point out that freight future market informationally leads the freight rate market, though freight options lag behind futures and physical freight rates.

Efforts have been made to forecast the various shipping indices, to contribute to the decision making of the participants. Such an effort was made to forecast the Baltic Dirty Tanker Index by applying Wavelet Neural Networks (WNN). It has been shown in the literature that the results are better than those of the traditional ARIMA model (Shuangrui et al, 2013). Regarding the dry bulk market, an improved Support Vector Machine (SVM) model has been used for the forecast of the BDI with satisfactory results (Qianqian et al, 2014). Duru and Yoshida (2009) investigated the judgmental forecasting for the BDI compared it with the statistical methods, with the conclusion of expert predictions to outperform traditional time series methods. Tsioumas et al (2017) developed a multivariate Vector Autoregressive model with exogenous variables (VARX) aiming to enhance the forecasting accuracy of BDI. The results indicated that the model is helpful towards predicting the direction of the BDI. Goulielmos and Psifia (2009) used nonlinear methods to forecast the weekly freight rates for one-year time charter of a Panamax vessel. Although freight rates volatility can be chaotic, there is a good possibility of a nonlinear forecast without considering expectations and time lags. Kavussanos (1997) examined the dynamics of time varying volatilities in different size second hand dry bulk ship prices, by applying autoregressive conditional heteroskedasticity (ARCH) model. It was found that prices of small vessels are less volatile than in larger vessels while these volatilities vary across sizes. Panamax volatilities are driven by "old news", while new shocks are more important for Handysize and Capesize volatilities. We take into consideration many different factors, in order to analyze the capesize market. In particular, we analyze this market by taking into consideration a number of critical factors such as the time lags, the expectations and the FFA market, supply and demand, as well as the freight rates of both spot market and time-charter rates. Although we aim to analyze the fluctuations and the behavior of different charter duration and type -and not to predict the rate level of the market-, we consider that a relevant forecast is necessary to identify the trend of the market. We rely on the concept that the present rates are formed based on the expectations of the recent past, which in turn drive the decision making which results to a certain freight market level at present time.

Methodology

In investigating the relationship between time lags and time charter, trip and spot rates as well as the average earnings of capesize vessels of various ages, we select the Hannan – Quinn criterion in order to identify the important lags of the capesize freight market as per: Eqn 1

$$AIC*(m) = ln[\![\hat{\sigma}\_\hat{m}2]\!] + N(-1)\,2m\,lnlnN \tag{1}$$

Where m is the chosen lag, N is the sample size and $[\![\hat{\sigma}\_\hat{m}2]\!]\hat{}$ is the maximum likelihood estimate of error variance from the model.

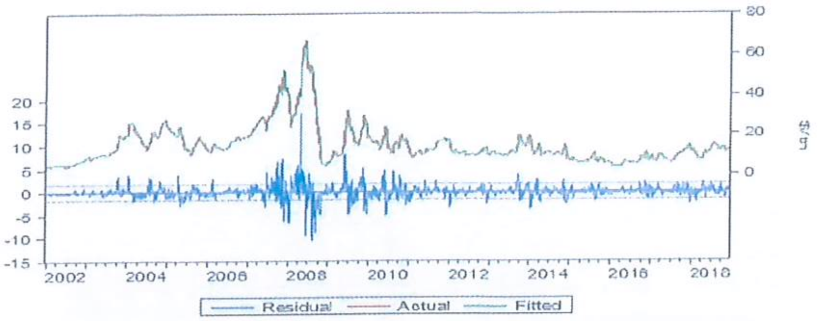

Fig. 1. Baltimore – Rotterdam Coal. Source: Elaboration by the authors.

The Akaike's information criterion is selected to identify the number of lags used in an AR model. The Hannan – Quinn criterion is a modified Akaike's criterion, which identifies the number of lags used in an AR model and at the same time it does not asymptotically overfit models.

We employed the criterion above to the last 16 lags. The lags that improve the model are determined as those that reduce the result of the AIC*. We incorporated these lags to the model and we then selected the optimum lags for every each of the examined cases. For performing the statistical analysis, we have created an autoregressive model (AR): Eqn 2

$$Yt = bo + b1Yt - 1 + b2Yt - 2\ldots + bnYt - n + Dummy\ Outliers + Ut \quad (2)$$

where Yt is the outcome variable at some point, $Yt - 1$ is the previous observation (latest lag), $Yt - 2$ is two observations back (lags) from the outcome variable and so on. Dummy Outliers are constructed in the case where some spikes (very high peaks and lows) are considered separately and Ut is the white noise. This methodology is applied in four different cases and it allowed us to reach our conclusions for the analysis of the behavior of the capesize market. First, we analyzed the spot market, considering the trade routes that were followed and the cargo quantity that was transferred. We then analyzed time charter trip rates, considering the various trade routes and sizes of the vessels. Moreover, we looked into the time-charter rates, considering the duration of the hired period and the size of the vessel. Last but not least, we conducted a static forecast to predict the next rate level and a dynamic forecast for the next six month period. A static forecast, predicting the next week's rates, is safer than predicting the rates for a longer period i.e. six months like our case. However, it is important to identify the trend for the progress of the market. Thus, a dynamic forecast is performed to identify the behavior of the market long term. It is suggested to constantly update the data and perform static forecasts for a safer approach in the everyday business. We also took into consideration the demand and supply growth along with the trend of the FFA market.

Data collection

We retrieved weekly data from the Clarkson database (Shipping Intelligence Network) from 1977 until 2018. The data reflects the equilibrium level for the freight rates and time charter equivalent of the spot market and the hire level of the time charter market. We analyze the spot market freight rates and the time charter contracts of various duration, short term and long term. The time charter contracts examined are of six months, one year and three years duration. The E-views 9 software has been used and the methodology above has been applied separately in each and every case. The necessary statistical tests for autocorrelation, heteroskedasticity and residuals have been performed and the data presented is the adjusted one. The coefficient of AR (1) is below 1 in all cases, so, the stationarity of the model has been achieved.

Table 1
Baltimore – Rotterdam Coal.

R-squared	0,972438
Adjusted R-squared	0,972406
Static Forecast (Freight rate on 28/12/2018)	$11,80/tn
Actual freight rate on 28/12/2018	$11,75/tn

Source: Elaboration by the authors.

Data analysis and discussion

Spot market

The capesize vessels transport mainly iron ore and coal. Thus, we selected specific routes and various cargo quantities from these two cargo families. The selection is based on their importance and on the contribution of these trade flows to the BCI.

Baltimore – Rotterdam 133.000 tn of coal

The data for this specific trade route is on a weekly basis from 4/1/2002 until 21/12/2018. The latest lag is considered as the most important one, affecting the decisions of the participants regarding the freight rate level, according to the Hannan – Quinn criterion and other statistical parameters. This is in line with the findings of the extant literature and the practical way of the shipping participants. Specifically, for the sport market, the practical aspect is to check the latest information we have about the level of the freight rate of the suggested trade route and cargo. The construction of a dummy variable is not necessary, since the incorporation of a dummy variable to the model weakens the results. Therefore, the equation for this route is:

$$Yt = bo + b1Yt - 1 + Ut \quad (3)$$

As seen in Fig. 1, the fitted numbers of the model follow the fluctuations of the actual data in the various stages of the shipping cycle.

As seen in the above table, the predicted rate in our static forecast is very close to the actual freight rate. A dynamic forecast is also conducted for the future freight rates until 28/06/2019, with the purpose to examine the trend of the market for this specific route. According to this, the future freight rate will stay close to the equilibrium with very tight fluctuations to a slightly higher level (Table 1).

Bolivar – Rotterdam 166.000 tn of coal

Compared to the previous route, the volume of the transported cargo is larger under this route. The exporting port is different, while the destination is the same. The capesize vessel used to

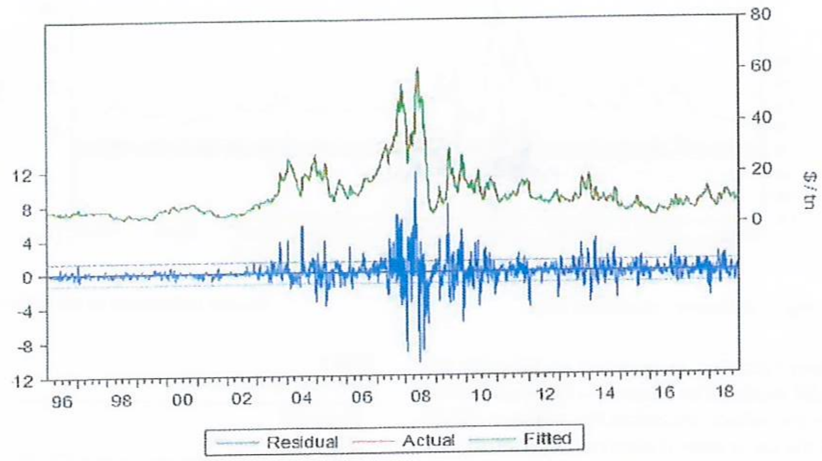

Fig. 2. Bolivar – Rotterdam Coal 166.000 tn.

Source: Elaboration by the authors.

Table 2
Bolivar – Rotterdam Coal 166.000tn.

R-squared	0,977928
Adjusted R-squared	0,977910
Static Forecast (Freight rate on 28/12/2018)	$9,28/tn
Actual freight rate on 28/12/2018	$9,25/tn

Source: Elaboration by the authors.

Table 3
Richards Bay – Rotterdam Coal.

R-squared	0,975337
Adjusted R-squared	0,975322
Static Forecast (Freight rate on 28/12/2018)	$8,77/tn
Actual freight rate on 28/12/2018	$8,50/tn

Source: Elaboration by the authors.

perform this voyage, is a larger vessel able to transport larger quantities. The data used for this specific trade route is on weekly basis from 2/2/1996 until 21/12/2018. We apply the suggested methodology and we find that the optimum lag for this case to be the latest lag, as in the previous route. Thus, the equation for this route is the same with the previous route, equation (3). As seen in Fig. 2, the fitted numbers of the model follow the fluctuations of the actual data in the various stages of the shipping cycle.

A static forecast is performed and as we can see in Table 2, the freight rate is accurately predicted. A dynamic forecast is also conducted for the future freight rates until 28.06/2019, with the purpose to examine the trend of the market for this specific route. According to this, the future freight rate will stay close to the equilibrium with very tight fluctuations to a slightly higher level.

Richards Bay – Rotterdam 168.000 tn of coal

The geographical area of the loading and discharging port affects the freight rate level. Additionally, the transported cargo in terms of nature and quantity also affects the determination of the equilibrium of the freight market. As in the previous routes, the latest lag is the most important lag, the one that affects the decision of the shipping participants. The data used for this specific trade route is on weekly basis from 3/2/1989 until 21/12/2018. Thus, the equation (3) is applied to this route. As seen in Fig. 3, the fitted numbers of the model follow the fluctuations of the actual data in the various stages of the shipping cycle.

A static forecast is conducted with excellent results as seen in Table 3. A dynamic forecast is also conducted for the future freight rates until 28/06/2019, with the purpose to examine the trend of the market for this specific route. According to this, the future freight rate will stay close to the equilibrium with very tight fluctuations to a slightly higher level.

Table 4
Tubarao – Qingdao iron ore.

R-squared	0,981800
Adjusted R-squared	0,981785
Static Forecast (Freight rate on 28/12/2018)	$16,54/tn
Actual freight rate on 28/12/2018	$16/tn

Source: Elaboration by the authors.

Tubarao – Qingdao 176.000 tn of iron ore

This trade route has the characteristic of a long distance and competition of iron ore quality. Brazilian iron ore is considered of high quality and as a result imports to industrial areas, such as China, are of large volumes. However, the cost is important and sometimes other solutions are preferred. The sample used for this route is from 2/2/1996 until 21/12/2018. Only the latest lag seems to be important, like in the previous routes examined. Probably due to the long distance covered and the change of the demand until the delivery of the cargo, the participants are affected by these lags. Thus, the equation (3) is used again. The fitted numbers of the model follow the fluctuations of the actual data in the various stages of the shipping cycle. A static forecast is performed to identify the level of the next week's freight rate. As seen in Table 4, again, the forecasted rate is very close to the actual freight rate, which is very encouraging. A dynamic forecast is also conducted for the future freight rates until 28/06/2019, with the purpose to examine the trend of the market for this specific route. According to this, the future freight rate will stay close to the equilibrium with a slight trend of increased freight rates.

Tubarao – Rotterdam 176.000 tn of iron ore

This route is the main route of importing iron ore to Europe from Brazil. The sample used is on a weekly basis from 3/2/1989 until 21/12/2018. The latest lag is the most important lag for this route. Thus, the equation for this voyage is the equation (3).

A static forecast is performed as seen in Table 5. A dynamic forecast is also conducted for the future freight rates until 28/06/2019, with the purpose to examine the trend of the market for this specific route. According to this, the future freight rate will be relative to the equilibrium.

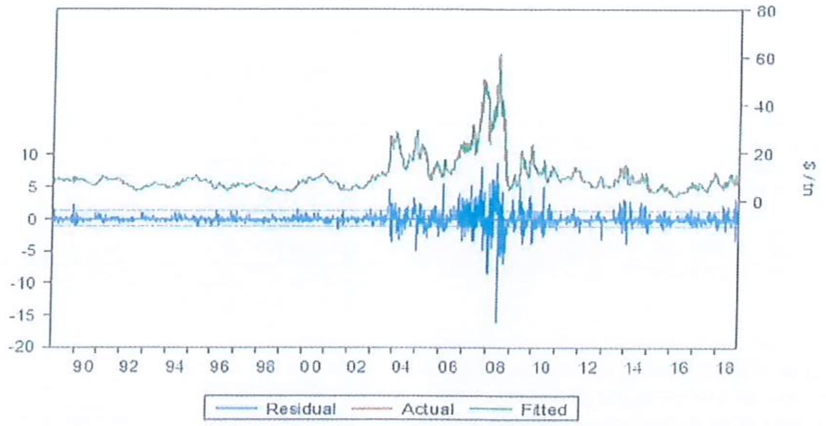

Fig. 3. Richards Bay – Rotterdam Coal. Source: Elaboration by the authors.

Table 5
Tubarao – Rotterdam iron ore.

R-squared	0,979925
Adjusted R-squared	0,979912
Static Forecast (Freight rate on 28/12/2018)	$8.76/tn
Actual freight rate on 28/12/2018	$8.5/tn

Source: Elaboration by the authors.

Table 6
West Australia – Qingdao iron ore.

R-squared	0,960410
Adjusted R-squared	0,960275
Static Forecast (Freight rate on 28/12/2018)	$7,32/tn
Actual freight rate on 28/12/2018	$6,75/tn
Dynamic Forecast	$7,3/tn–$8,5 /tn

Source: Elaboration by the authors.

West Australia – Qingdao 176.000tn of iron ore

It is noticed that China apart from Brazil, imports iron ore from Australia, too. The Australian iron ore competes the Brazilian iron ore. The Australian competitive advantage of the shorter distance is covered by the quality of the Brazilian iron ore. Due to the fact that iron ore can be stored, many factors affect the decision of the imports made. However, the high frequency and the short trips from Australia to Qingdao, compared to the one from Tubarao, pinpoints that the charterers and ship-owners do not rely just to the latest lag. Therefore, the important lags of this route are the first, the third and the fourth. However, the first lag is the most important with the fourth one trailing. The charterers and the owners seem to monitor the previous equilibrium prices and they are affected by them for their future decisions. Although the significance of the third lag does not seem to be very important, it is selected for the model, since the model provides better results with this lag incorporated. Thus, the equation for this route is: Eqn 4

$$Yt = bo + b1Yt - 1 + b2Yt - 3 + b3Yt - 4 + Ut \quad (4)$$

The fitted numbers of the model follow the fluctuations of the actual data in the various stages of the shipping cycle. The static forecast is again very close to the actual rate of the market. A dynamic forecast is also conducted for the future freight rates until 28/06/2019, with the purpose to examine the trend of the market for this specific route. According to this, the future freight rate will be negotiated close to the equilibrium as seen in the followin Table 6.

Table 7
Transatlantic trade.

Vessel's size (DWT)	172.000 tn	180.000 tn
R-squared	0,907135	0,820819
Adjusted R-squared	0,906560	0,817591
Static Forecast (Freight rate on 28/12/2018)	$17.317/day	$17.034/day
Actual freight rate on 28/12/2018	$16.000/day	$17.000/day
Dynamic Forecast	$16.723–$15.344/day	$12.770/day

Source: Elaboration by the authors.

Trip rates

Another way of chartering a vessel in the spot market is to charter a vessel for one voyage under the terms of a time charter contract. Moreover, in order to compare the freights offered, we had to convert the terms of the voyage to the terms of the time charter, which is the time charter equivalent (TCE). This is also examined in the present paper as following.

Transatlantic trade

The capesize vessels of two different sizes have been examined in the sample data set, those of 172.000 DWT and those of 180.000 DWT. The data is retrieved on a weekly basis, from 28/8/2009 until 21/12/2018 for the capesize of 172.000 dwt and from 22/8/2014 until 21/12/2018 for the capesize of 180.000 dwt. In both vessel sizes, the dummy variable is statistically significant and is incorporated to the model. The important lags vary in both cases. The equations for both vessels are formed as following:

$$Yt = bo + b1Yt - 1 + b2Yt - 5 + Dummy + Ut \quad (5)$$

$$Yt = bo + b1Yt - 1 + b2Yt - 3 + b3Yt - 7 + Dummy + Ut \quad (6)$$

The equation (5) refers to the capesize of 172.000 dwt and the equation (6) refers to the capesize of 180.000 dwt. We observe that in both cases "older" lags affect the determination of the freight rate. This can be explained by the fact of the commodities trading and the possibility of seasonality. The reposition of the vessels and the backhaul cargoes may also affect the freight market. The lower R-squared and Adjusted R-square results, compared to the previous cases examined, are explained by the smaller sample data set. The AR models require a high number of observations to produce better results. Relevant static and dynamic forecasts are performed as shown in Table 7. There is a strong possibility for the big capesize vessels to face a suppress in the freight market. Regarding the smaller capesize vessels, market is expected to bear. The FFA mar-

Table 8
Transpacific trade.

Vessel's size (DWT)	172.000 tn	180.000 tn
R-squared	0,882481	0,827002
Adjusted R-squared	0,881996	0,823871
Static Forecast (Freight rate on 28/12/2018)	$12.964/day	$13.744/day
Actual freight rate on 28/12/2018	$12.500/day	$12.500/day
Dynamic Forecast	$13.968–$13.031/day	$11.396–$10.916/day

Source: Elaboration by the authors.

ket reflects the expectations of the shipping participants for the progress of the freight market. In this case, the FFA market indicates a decrease in the freight rates of the capesize vessels. This is in line with the literature, taking the expectations and the lags as important factors for the determination of the hire and freight rate level.

Transpacific trade

Similarly to the transatlantic trade, two different sizes of capesize vessels have been examined in the sample data set, those of 172.000 DWT and those of 180.000 DWT. The data is retrieved on a weekly basis, from 11/9/2009 until 21/12/2018 for the capesize of 172.000 dwt and from 5/9/2014 until 21/12/2018 for the capesize of 180.000 dwt. By applying the same methodology as above, we found that different lags are important in each case. On the contrary to the Transatlantic trade, the dummy variable is not statistically significant and is not incorporated to the model. The equations for both vessels are formed as following:

$$Yt = bo + b1Yt - 1 + b2Yt - 5 + Ut \quad (7)$$

$$Yt = bo + b1Yt - 1 + b2Yt - 3 + b3Yt - 7 + b4Yt - 8 + Ut \quad (8)$$

The equation (7) refers to the capesize of 172.000 dwt and the equation (8) refers to the capesize of 180.000 dwt. We observe that in both cases "older" lags affect the determination of the freight rate. This can be explained by the fact of the commodities trading and the possibility of seasonality. The reposition of the vessels and the backhaul cargoes may also affect the freight market.

As presented in Table 8 and Fig. 4 the forecasted results indicate a bear market, especially for the bigger capesize vessels.

Time charter rates

The time charter rates are negotiated in the short and in the long term. Under a time charter contract, the charterer becomes responsible for the commercial management of the vessel and pays to the owner a daily hire for the chartered period. In this paper, we examine the period of six months, the time charter of one year and the time charter of three years for the capesize vessels of 170.000 dwt and 180.000 dwt.

Six – months time charter

The time charter contracts offer a different option regarding the strategic decision. The capesize vessels of two different sizes have been examined in the sample data set, those of 170.000 DWT and those of 180.000 DWT. The data is retrieved on a weekly basis, from 8/2/2002 until 21/12/2018 for the capesize of 170.000 dwt and from 18/7/2014 until 21/12/2018 for the capesize of 180.000 dwt. The selected lags for the 170.000 dwt capesize is the first one, while for the 180.000 dwt capesize the selected lags are the first and the fifth lags. Thus, the equations (3) and (7) for the smaller and the bigger capesize vessels respectively, are applied. The older lags seem to be more important for the smaller capesize, while the bigger capesize is affected by the latest news of the market. It is noticed

Table 9
Six – months time charter.

Vessel's size (DWT)	172.000 tn	180.000 tn
R-squared	0,983787	0,939481
Adjusted R-squared	0,983769	0,938945
Static Forecast (Freight rate on 28/12/2018)	$17.684/day	$18.392/day
Actual freight rate on 28/12/2018	$17.500/day	$18.500/day
Dynamic Forecast	$18.097–$24.714/day	$18.345–$15.513/day

Source: Elaboration by the authors

Table 10
One – year time charter.

Vessel's size (DWT)	172.000 tn	180.000 tn
R-squared	0,985417	0,959553
Adjusted R-squared	0,985400	0,959378
Static Forecast (Freight rate on 28/12/2018)	$16.646/day	$17.378/day
Actual freight rate on 28/12/2018	$16.500/day	$17.500/day
Dynamic Forecast	$16.302–$20000/day	$17.395–$15.151/day

Source: Elaboration by the authors.

that different lags are considered for the different sizes of the vessels. Regarding the bigger capesize vessel, the participants of the industry take into consideration the first and the fifth lag, which is in our case the latest information they have and the rate level of the closing of previous month. Although statistically the latter lag does not seem important, if it is removed from the model, the results worsen. Our static and dynamic forecasts indicate that the smaller capesize vessel is expected to recover. On the contrary, the big capesize vessels are expected to suffer suppressions in a bear market, as presented in Table 9 below.

One-year time charter

The one-year contract is a safer option for the ship-owner, since the ship owner will not have to deal with the chartering issue of the vessel for a period of time. In this case, the fluctuations of the market do not affect the revenue of the ship-owner. Thus, the risk of the price volatility is a burden that the charter has to carry out. This is the reason why normally, the longer time charter contracts offer lower hire rates, as the duration of the contract is increased. Both sizes of the examined market are affected by the latest lag only. Thus, the future equilibrium is determined based on the previous lag. The equation (3) is applied.

In the Table 10 below, we present the results of the static and dynamic forecasts. Specifically for the bigger capesize vessels, a bear market is expected.

Three years time charter

The three year contract is a longer contract, is either given to the ship-owner when the expectations for the freight market are extremely high and as a result due to the expectations the ship-owner increases his revenue, or when the charterer has cargoes available for transportation on a regular basis and she/he is not willing to undertake the risk of the volatile spot market. The capesize of 170.000 dwt is affected by the older lags and equation (8) is applied. On the contrary, the 180.000 dwt capesize is affected by the latest lag only and equation (3) is applied.

According to our forecasts, the signs of the small capesize market are encouraging. On the contrary, the bigger capesize vessels are expected to face difficulties in a sharply declining market (Table 11).

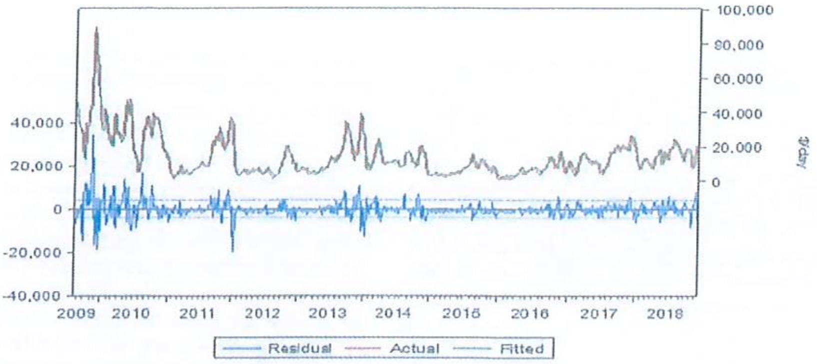

Fig. 4. Transpacific trade 172.000 dwt. Source: Elaboration by the authors.

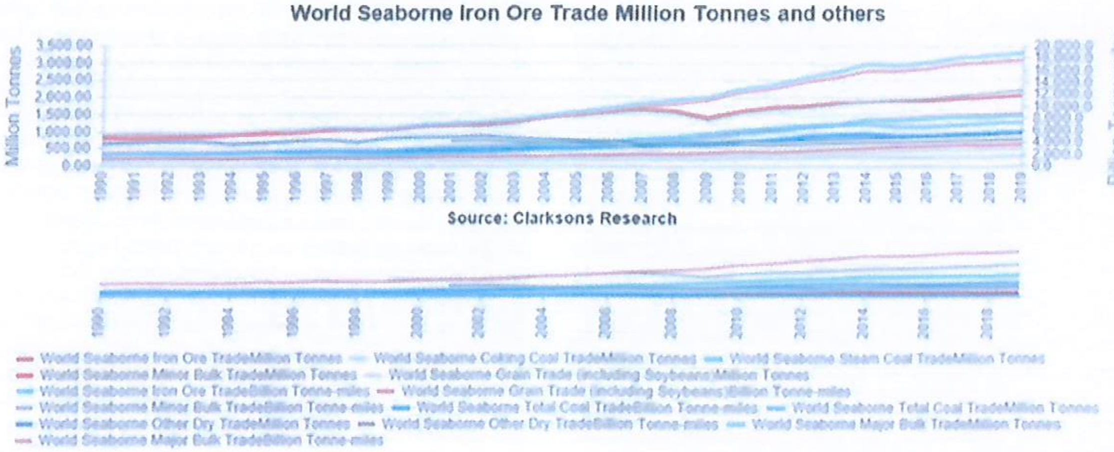

Fig. 5. World Seaborne Trade Dry Bulk. Source: Clarksons Research Intelligence Network.

Table 11
Three – years time charter.

Vessel's size (DWT)	172.000 tn	180.000 tn
R-squared	0,987688	0,974925
Adjusted R-squared	0,987617	0,974816
Static Forecast (Freight rate on 28/12/2018)	$16.483/day	$17.370/day
Actual freight rate on 28/12/2018	$16.500/day	$17.500/day
Dynamic Forecast	$16.483–$21.380/day	$17.408–$14.674/day

Source: Elaboration by the authors.

Demand, Supply and Expectations

The purpose of our investigation is to analyze the abnormal fluctuations of the capesize market. Therefore, it is necessary to take into consideration the demand, the supply and the expectations of this market. A main factor that affects demand is world seaborne trade. As shown in Fig. 5, the trend of the world seaborne trade for the dry bulk market has been increased especially during the last 20 years. Even in the sudden drop of the freight market in 2006 and in the collapse of 2008, the demand has in general remained at high levels. Actually, it was increasing over the years. As presented in the present literature, the ship-owners have the tendency to invest when the freight market is high. This increases the supply over the years and based on the demand fluctuations, the market becomes unstable. In this case, the supply overcame the demand, resulting to the collapse of the freight market and the very long duration of the trough period, reaching historically low levels in 2016.

The supply of the capesize market has increased. According to the order book, many vessels have been delivered in 2018 (51 in number and 14.261.539 in terms of dwt) resulting to the increase of the fleet by 41 vessels in number and 8.670.000 in dwt. The supply growth of the capesize market is +3.55% from 2017 to 2018. Furthermore, an increase of 3.82% is expected for 2019 and a further 3.28% increase in 2020, with the given numbers so far. If we also take into consideration the massive deliveries and growth of the fleet from 2004 until 2014, and since we can understand that some time is still necessary to start scrapping the vessels (it is common to scrap the vessels after the age of 20), the supply is expected to rise. Another characteristic coming from the order book is that the ship-owners try to take the advantage of the big vessels, due to economies of scale, and as a result they order big capesize vessels. However, deliveries of bigger vessels and the possibility of the demand change for shipments with smaller vessels, will suppress the rates of the bigger vessels to lower levels. As stated in the relevant literature, the lags and the expectations play important role in the determination of the price. According to the findings of previous researches, the FFAs represent the expectations of participants of the market for its progress. The FFA reports indicate a drop in the capesize market for the near future. Normally, the bigger vessels are affected at a higher level, compared to the smaller vessels. The findings of this paper indicate that the participants of the industry should expect a decrease in the rate levels. Especially for the time charter contracts, the daily hire is expected to gradually decrease at low levels. This is due to the fact that the risk for the charterer is very high and since the expectations of the market indicate a decline of the capesize market, the charterers will offer lower hires. On the other hand, the ship-owners will obviously try to negotiate for higher rates. Depending on the timing, the area and all the relevant factors affecting demand and supply, the equilibrium will be preserved, thought at lower levels. Taking all the above into account, along with the FFA reports which indicate a drop in the capesize market, we can expect a drop in the freight market in the long term and especially for the bigger capesize vessels. In the short term and as shown in the previous sections, the market will still face some fluctuations and the negotiated prices will be close to the current levels.

Conclusions

In this paper, the Hannan – Quinn criterion has been selected to identify the important lags of the capesize freight market for the period 1977–2018 and an Autoregressive (AR) model has been constructed to perform the statistical analysis. The findings indicate that there is a strong correlation between time lags and capesize freight market, which enables a possible forecasting of the behavior of the market. The back test for static and dynamic forecast indicate the strong predictability of the model. In most cases, the latest lag was the only lag that affected the rate level. In some other cases, more lags were taken into account to determine the rate level and this is in line with the common practice of ship-owners and charterers. Especially in the spot market where the primal factor that they consider is the freight rate paid for the latest shipment of this trade route. Moreover, we examined the behavior of the coal and iron ore markets through the most important trade routes, with various exporting and importing ports and cargo quantities shipped. As far as the iron ore market is concerned, we have selected main routes with the same quantities (176.000 tones) but different ports. Based on our research, we have concluded that the spot market will not suffer from sharp fluctuations, but the market will remain at a similar level for the next months. Apart from the freight market, it is very important to examine time charter contracts. Thus, we applied the same methodology in the trip rates for the Transatlantic and Transpacific trades for capesize vessels of 172.000 dwt and 180.000 dwt. In the Transatlantic trade, we noticed that different lags are important for the two different sizes of the vessel. The dummy variable is also important, since its use improves the results of the model in some cases. Our forecast for this market indicates small fluctuations in the current level for a smaller capesize, while for a bigger one a drop is expected, reaching low levels, even $12.770 /day. In the Transpacific trade, the important lags are very similar to the Transatlantic, while mall fluctuations are expected for the small capesize vessels. Our estimation for the bigger capsize vessels indicates a bear market, where shipowners will struggle in the big competition. Concerning period contracts, we have examined the short and the long period contracts with duration six months, one year and three years for the capesize vessels of 170.000 dwt and 180.000 dwt. Specifically for the six month contracts, we consider the latest lag to be the most important for the capesize of 170.000 dwt, while for the 180.000 dwt capesize we consider the latest lag and the fifth lag as the most important lags. These sizes of the vessels follow opposite direction in the freight market, proving that even if they belong in the capesize type, the size of the vessel can differentiate the operation of the vessel in the market. The smaller capesize vessel is expected to be operated in a recovering market while the bigger capesize in a bear market. Regarding the one-year time charter contract, the latest lag is the most important for both sizes of the capesize market. The expectations for the markets are very different. The smaller capesize market is expected to continue recovering, while the bigger capesize market is expected to drop. As far as the three-year contract is concerned, the big cape follows the latest lag, while the smaller cape is affected by the latest, the third, the fourth, the tenth and the eleventh lags. The small capesize is expected to be operated in a bull market, while we expect a bear market for the bigger capesize vessels. In order to reach a safer conclusion, we have also considered the demand and supply growth of the capesize market. According to the order book, the supply is expected to grow in the next years. We also anticipate a demand growth. However, the growth rate of supply and demand, along with scraps and losses, will determine the future progress of the market. Considering the FFA market to reflect the expectations of the shipping participants, we expect a drop in the market of the capesize vessels in the near future, which is in line with our findings. Specifically, we expect the bigger capesize vessels to decline in the freight market and have a more stable freight market with small fluctuations and in some cases improvement for the smaller capesize vessels. We also believe that based on our findings, it seems that in the future the cargoes of this market will be transported in smaller quantities but more frequent, since the demand is expected to grow. This will lead the freight market of the big capesize vessels (180.000 dwt) to face suppressed freight rates. This will also affect the decision making of the ship-owners of bigger vessels, leading to competition between smaller and bigger vessels for smaller quantities, undermining the main principle of the economies of scale theory and the purpose of the vessels being bigger. The total supply of the capesize market is increased, due to deliveries of increasing orders regarding new buildings. The scrapings remain at a low level, resulting to the growth of the fleet within the years. According to the order book, as bigger and bigger capesize vessels enter the market, competing the older capesize vessels and in combination with a change of the demand for smaller capesize vessels, the market of the big capesize vessels may come to a decline. At a practical level, this may lead to a better understanding of the behavior of the capesize market which would allow ship-owners and charterers to improve their planning decisions and investments. Further research may focus on the parameters considered by this paper. The FFAs, the demand and supply factors, such as the order book, and other factors that affect the determination of both the freight and hire rates could be possibly incorporated further to our approach.

Conflict of Interest

There is not any conflict of interest.

References

Alexandridis, G., Sahoo, S., & Visvikis, I. (2017). Economic information transmissions and liquidity between shipping markets: New evidence from freight derivatives. *Transportation Research Part E, 98*, 82–104.

Alizadeh, H. A. (2013). Trading volume and volatility in the shipping forward freight market. *Transportation Research Part E, 49*, 250–265.

Batchelor, R., Alizadeh, A., & Visvikis, I. (2007). Forecasting spot and forward prices in the international freight market. *International Journal of Forecasting, 23*, 101–114.

Duru, O., & Yoshida, S. (2009). Judgmental forecasting in the dry bulk shipping business: statistical vs. judgmental approach. *The Asian Journal of Shipping and Logistics, 25*(2), 189–217.

Goulielmos, M. A., & Psifia, M. E. (2009). Forecasting weekly freight rates for one-year time charter 65 000 dwt bulk carrier, 1989-2008, using nonlinear methods. *Maritime Policy & Management, 36*(5), 411–436.

Greenwood, R., & Hanson, S. (2013). *Waves in ship prices and investment* Working paper 19246, National Bureau of Economic Research.

Kavussanos, G. M., & Visvikis, D. I. (2004). Market interactions in returns and volatilities between spot and forward shipping freight markets. *Journal of Banking & Finance, 28*, 2015–2049.

Kavussanos, G. M., Visvikis, D. I., & Batchelor, A. R. (2004). Over-the-counter forward contracts and spot price volatility in shipping. *Transportation Research Part E, 40*, 273–296.

Lun, Y. H. V., & Quaddus, A. M. (2009). An empirical model of the bulk shipping market. *Int. J. Shipping and Transport Logistics, 1*(1), 37–54.

Mcconville, J. (1999). *Economics of maritime transport. Theory and practice*. London, UK: Witherby & Co Ltd.
Pelagidis, T., & Panagiotopoulos, G. (2019). Forward freight agreements and market transparency in the capesize sector. *Asian Journal of Shipping and Logistics, 35*(3), 154–162.
Qianqian, H., Bo, Y., Guobao, N., & Yu, B. (2014). . pp. 1–12. *Forecasting dry bulk freight index with improved SVM* (2014) Hindawi Publishing Corporation Mathematical Problems in Engineering.
Shuangrui, F., Tingyun, J., Wilmsmeier, G., & Bergqvist, R. (2013). Forecasting baltic dirty tanker index by applying wavelet neural networks. *Journal of Transportation Technologies, 3*, 68–87.
Stopford, M. (2009). *Maritime economics*. London, UK: Routledge.
Tsioumas, V., Papadimitriou, S., Smirlis, Y., & Zahran, S. Z. (2017). A novel approach to forecasting the bulk freight market. *Asian Journal of Shipping and Logistics, 33*(1), 33–41.