MARITIME ECONOMICS RESEARCH PAPER

A Capesized vessel: by Shiptrade house, Nov.2016, 25th.

TITLE: A market forecasting report for the dry bulk capesize subsector

Athens, January 2017

By: Ioannis Valmas LLB LLM (MSc)

ABSTRACT

This project provides a market analysis report for the dry bulk capesize subsector by: 1. Assessing current and forecasting short term (6-month) future demand. 2. Assessing current and forecasting short term (6-month) future supply. 3. Critical analysis of demand and supply equilibrium, and 4. Expected freight outcome for the next 6-month period.

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1.1 Introduction

This assignment coincides with a recession in the Dry cargo market.

This report will deal with those "dry cargoes" that can be transported by the Cape-sized ships of about 200,000 dwt, i.e. coal, iron-ore and grain.

The importance of the above 3 commodities is well recognized as iron-ore and coking coal are the raw materials of making steel. Any modern economy depends heavily on the growth of these "major bulks" as they are called.

Moreover, steam coal is a basic energy source for generating power. Grain is a different product, but by no means unimportant, as it feeds people and animals which provide the meat consumed.

1.2 Purpose of the assignment

The purpose of this assignment is to assess current data (end 2016) and predict for six months (in mid-2017) the supply and demand for dry cargo trade as well as the expected freight-rate outcome, which is determined for cape-sized ships. This means that we have to concentrate to the transport of iron-ore, coal and grain.

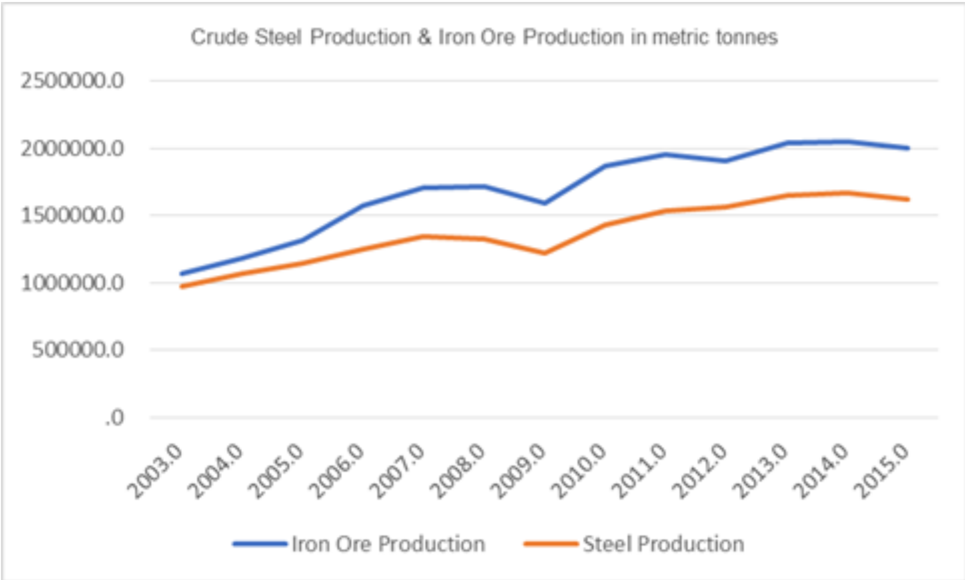
1.3 Structure of the assignment

Next, we provide a literature review. Then methodology follows and a presentation of used data appears. Next are the findings, and the recommendations to our clients. Finally we conclude and summarize the most important results of the assignment.

1.4 Literature Review

Figure 1.1 shows the close connection between steel production and iron ore production.

Figure 1.1: Crude Steel Production and Iron Ore Production by year in tons



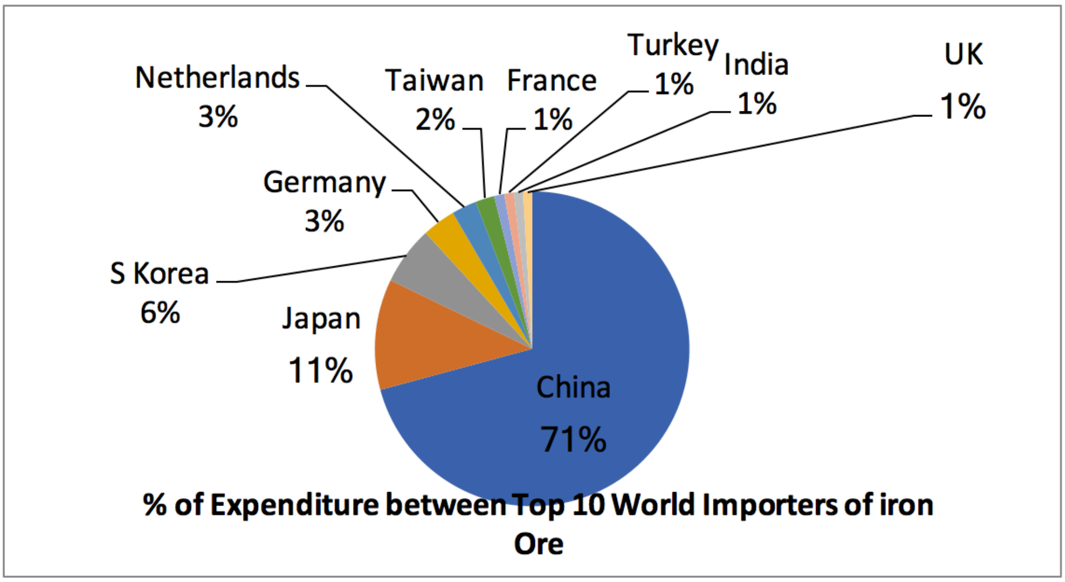
Source: Data compiled by the author from World Steel Association (www.worldsteel.org) annual reports.

As shown, the two curves move together.

Workman (2016) has worked out the 15 *major importers of iron ore* covering ~93% of all imports in 2015 in value.

The main 10 countries are shown below (Figure 1.2) covering the 90% of total revenue on imports.

Figure 1.2: The top ten importers in the World of Iron ore 2015 by % of expenditure among them in bn USD.



Source: Figure created by author based on Data from Workman (2016).

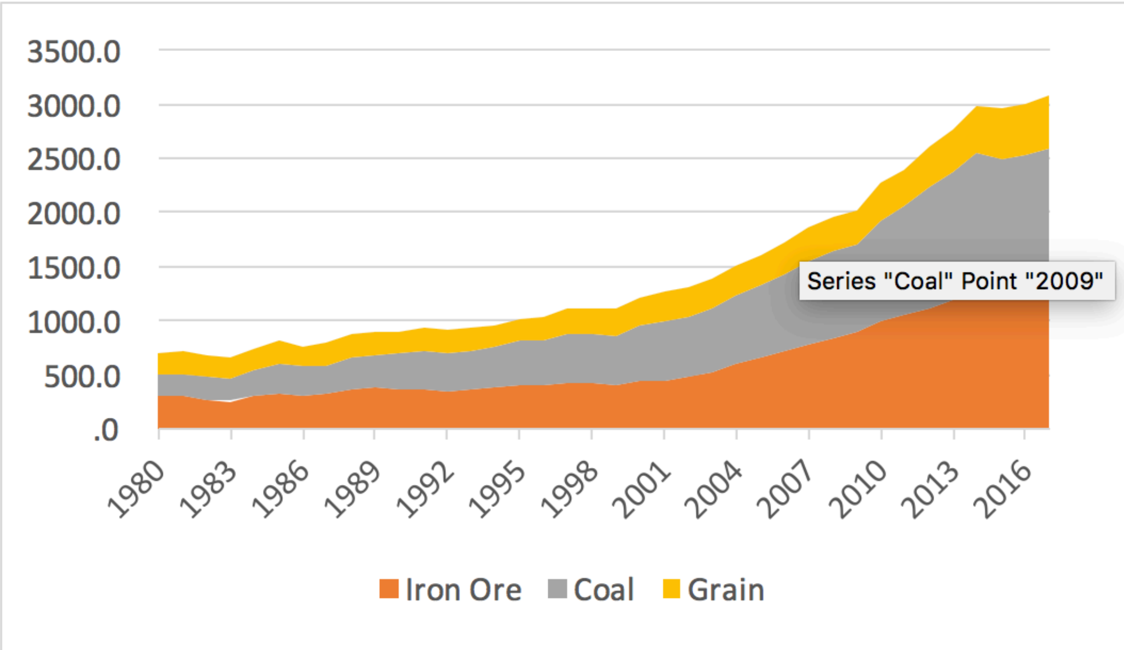
Worth noting is the dominant share of China (of 63.5% of the values of imports) as per Workman (2016). After 2008 the price of iron ore increased above the average one of $40 per m/t to $190 in 2011 (Iron Ore Facts, 2015). In 2016 (23rd Nov.), the price fell to $70 per m.t. As per the law of demand, this may boost imports. Of importance are the distances involved as will see in the part dealing with Supply.

Data from Clarksons SIN indicates that the trade of *coal* –coking and thermal) stands at 1,107mt for end-2016. China is dominant among consumers followed by USA, India, S Korea, Japan, UK and Germany. Chinese importers may need to charter more capesize vessels for the transport of coal in 2017 after the recent sanctions imposed on N. Korea (a major exporter of coal to China) by the UN (Lloyd's List, 2016).

Grain is an agricultural commodity subject to seasonal fluctuations and other turbulent factors like weather. The major importers are Egypt; EU; Brazil; Indonesia; Japan; S Korea. Smaller capes are used for the transport of grain.

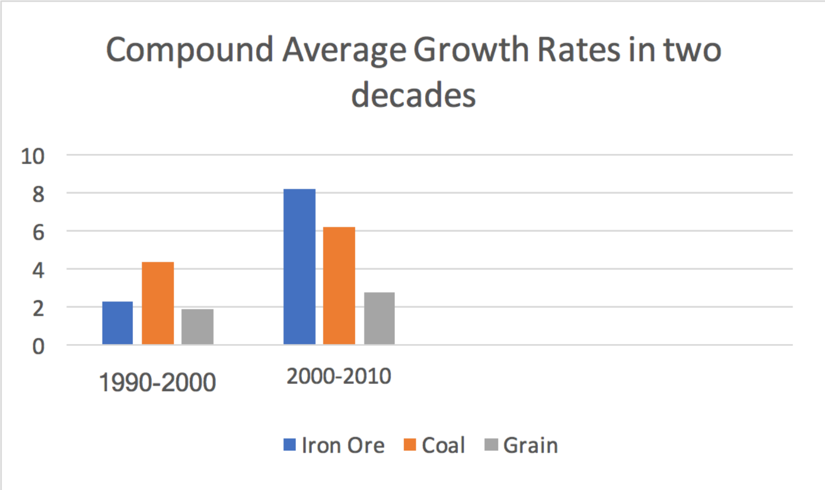
In the introduction, we stressed out the importance of the major bulk trades, which are also important for their volume. This trade achieved a remarkable growth from ~660million tons in 1980 to 1,582 in 2005 and ~3000mt in 2016 (Figure 1.3).

Figure 1.3: Seaborne trade of major bulks in million tones, 1980-2016



Source: Compiled by the author from Clarkson's Research data, 2016.

Figure 1.4: Growth rates (%) of the major bulk trades, 1990-2010



Source: Data compiled by author based on data from Clarksons' SIN

As shown in Figure 1.4, between 2000 and 2010 all major bulks' trade grew.

1.5 Methodology & Data

This report is a desk research on the Capesized dry-bulk market, which will be based on secondary data retrieved from Clarkson's Shipping Intelligence Network, on the basis of which, we will assess sector's present situation and we will forecast its next six-month level of demand, supply and freight rate.

Our methodology will be confined in the use of Regression analysis following Stopford's model (2009; p. 717-722) SMM and consisting of 9 stages. We will use the least squares regression between years and trade -known as semi-averages method.

The model is of the type: Y= a + b X [1], where Y is the dependent variable and for our case *dry cargo trade* or DCT of major bulk trades and X is the independent variable, which is global Gross domestic product or *GDP*. Thus we have: DCT_{mb}= a + b GDP [2].

Stopford used DCT regressed on GDP growth rates between 1982 and 1995. He estimated the regression as follows: DCT=65.103 + 18.4587 GDP [3]. Then he used [3] to predict 1982-2005, and he found 4.100 billion tons for 2005, lower by 300mt from the actual one… As far as the growth rates of GDP he used –not stated explicitly- these can be obtained by solving [3] for GDP and placing DCT=4,100mt. This gives: GDP=218.59. This means an average compound GDP coefficient of ~9.11 per annum for the 24 years covered.

As theory suggests, it is better to use different approaches for prediction, and so confirm one prediction from the other. We will find the trend by linear regression as Stopford (p. 719) did also regressing DCT on time (1982-2005). After all, a trend line is in fact an ordinary regression line of the variable concerned on time using the *least squares method* again, due to the fact that time values increase in equal increments. The regression is: GDP = a + b d [4], where d is the deviation of the required instant in time from the mid-point of the series and a, b are constants. Worth noting is that we consider our approach more correctly as the capesize ships transport mainly the major bulks being less than half of total DCT.

1.6 Results

1.6.1 First are the results using the trend finding technique for major bulk trades.

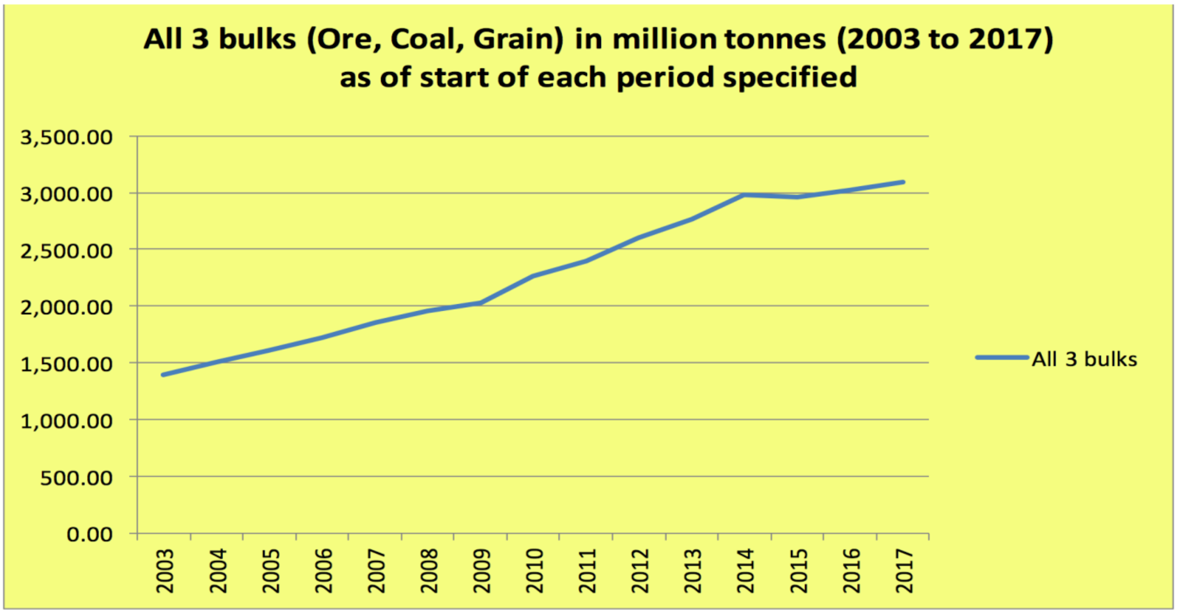
Table 1.1: Finding the trend of the Major Bulk Trades, 2003-2017

Year	Y Trade m tons	d Dummy Variable for time	Y*d	d^2
2003	1.390,08	-7	-9.730,57	49,00
2004	1.508,88	-6	-9.053,26	36,00
2005	1.610,40	-5	-8.051,98	25,00
2006	1.720,81	-4	-6.883,25	16,00
2007	1.854,79	-3	-5.564,38	9,00
2008	1.955,75	-2	-3.911,51	4,00
2009	2.025,77	-1	-2.025,77	1,00
2010	2.265,31	0	0,00	0,00
2011	2.397,35	1	2.397,35	1,00
2012	2.603,54	2	5.207,08	4,00
2013	2.760,85	3	8.282,55	9,00
2014	2.983,47	4	11.933,89	16,00
2015	2.956,28	5	14.781,40	25,00
2016	3.019,32	6	18.115,91	36,00
2017	3.092,61	7	21.648,26	49,00

Source: Data from Clarksons SIN compiled by author using a time series – least squares regression method.

So, a=34.145,21/15=2,276.35 and b=37.145,73/280=132.66 and the trend is: Y=2,276.35 + 132.66d. Now, 2018 is 8 units away from mid -point: then Y_{2018} = 3,337.63 million tons. Table 1.1 is presented also in Figure 1.5.

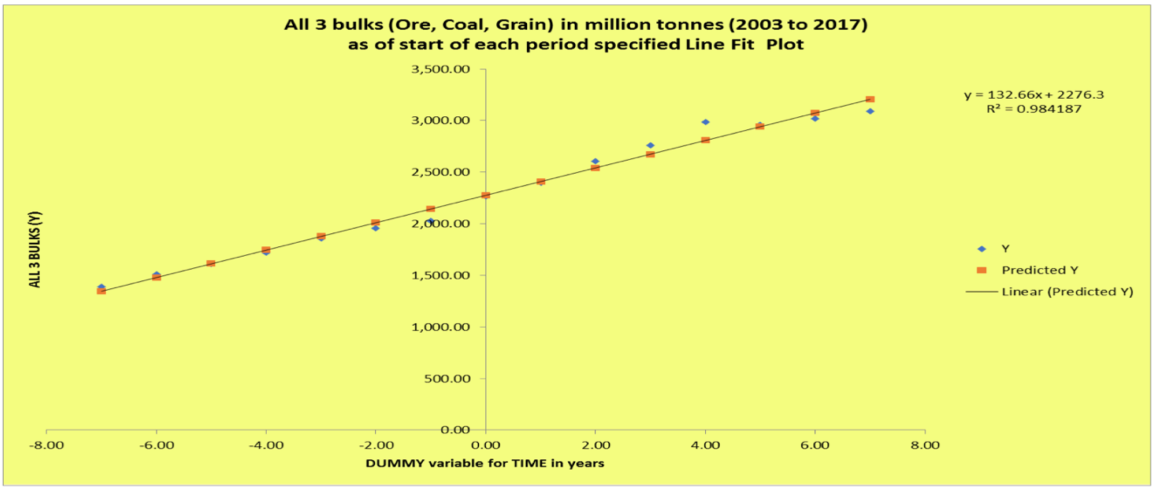
Figure 1.5: Major bulk Trades, 2003-2017 million tons



Source: Created by the author.

As shown in figure 1.5 above, as well as in figure 1.6 that follows, the forecast for 2018 for MBT-major bulk trades, and by using linear trend method, will be 3,337.63 mt or 1,668.815 mt for the first semester of 2017 assuming that the 2018 forecast is equally spread among the twelve months of the year.

Figure 1.6: The Linear Trend of Major bulk Trades, 2003-2017, million tons



Source: Created by the author.

1.6.2 Stopford's SMM model

Stopford (2009) requires nine stages for doing a demand and supply forecasting as he did in his book. The first stage is to decide what period forecast is to cover-i.e. six months. Moreover the assumptions about the world economy development is covered in what we mentioned above. The 2nd stage is the seaborne trade forecast. We did that above. The 3rd stage follows below:

Stage 3: Average Haul for Capesized Vessels

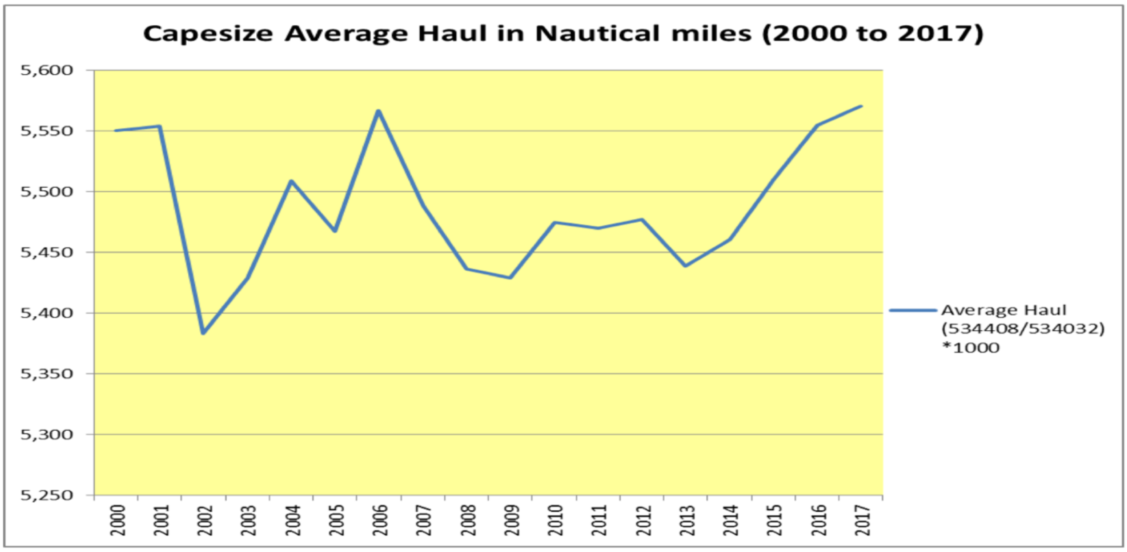
This stage involves the distance a ton of cargo has to be transported. According to Stopford (2009, p. 720) one way to forecast average haul is to analyze the trade matrix for the major bulks using historical trends. So, for capesized vessels we used data for demand from Clarksons (Appendix III) in billion ton miles for coal, iron ore & grain for *all bulk carriers* (as there is no capesize dedicated data) and divided by the total of the three commodities in million miles transported for each respective year.

Table 1.2 The Demand of Iron Ore, Coal & Grain in billion ton miles and the average haul from 2003 and 2017

Year	Demand for iron ore, coal and grain (in billion ton miles)	Iron Ore, Coal, Grain seaborne trade (in million tons)	Average Haul nautical miles 2:3=4
(1)	(2)	(3)	(4)
2003	7,477	1.390,08	5,630
2004	8,090	1.508,88	5,361
2005	8,651	1.610,40	5,377
2006	9,279	1.720,81	5,410
2007	10,007	1.854,79	5,406
2008	10,525	1.955,75	5,389
2009	11,025	2.025,77	5,442
2010	12,359	2.265,31	5,459
2011	13,055	2.397,35	5,444
2012	14,145	2.603,54	5,424
2013	14,758	2.760,85	5,345
2014	15,755	2.983,47	5,283
2015	15,810	2.956,28	5,365
2016	16,271	3.019,32	5,546
2017	16,744	3.092,61	5,414
2018 forecast	17,986	3,337.63	5,389

Source: The Clarksons SIN.

Figure 1.7 Average Haul of Iron Ore, Coal & Grain between 2003-2017 in miles.



Source: Prepared by the author on data from Table 1.2.

Our preliminary finding is that current average haul for 3 major bulks is 5414.

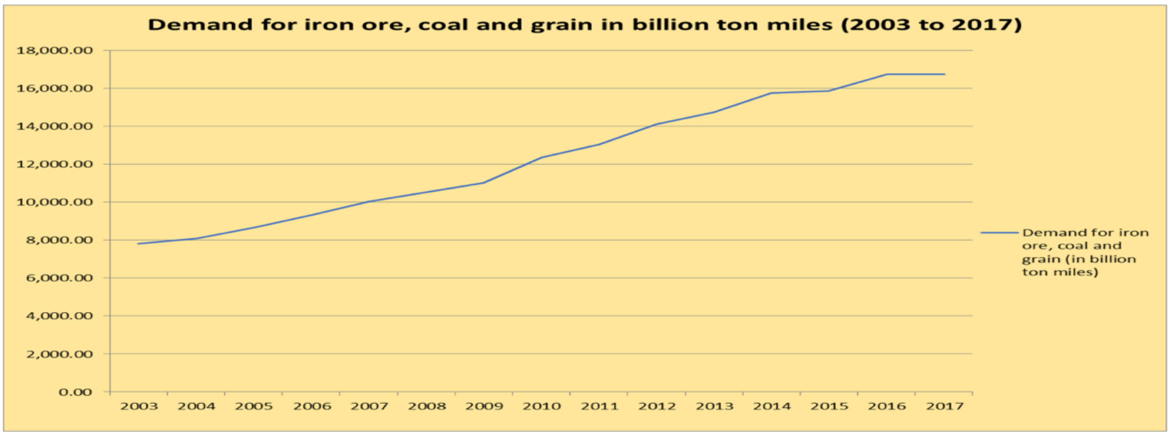
For 2018 we used a linear regression and found the following:

2018	17,986	3,337.63	5,389

Stage 4: The ship demand forecast for Capesized vessels

The ship demand in billion tonne-miles is derived by multypling the particular seaborne trade in tonnes by average haul in nautical miles for all bulk carriers including capesized ships in iron ore, coal and grain. This is presented in Figure 1.8:

Figure 1.8: Ship Demand (sum of Iron Ore, Coal & Grain) in billion ton miles from 2003 to 2017



Source: Clarkson's SIN data, compiled by the author.

Given that the above analysis concerned all bulk carriers that transport major bulks, we have to make an estimate for the demand of major bulks for the capesize subsector. In order to do this, we would need to know the percentage of the three commodities that is transported by capesized vessels. According to Alizadeh & Nomikos (2009), these were: 70% of iron ore, 45% of coal and 7% of grain.

Table 1.3: Different types of dry-bulk carriers, and the percentages in cargoes they carry according to Alizadeh & Nomikos

BULK CARRIER	**IRON ORE**	**COAL**	**GRAIN**	**SUM OF CARGO PERCENTAGES**	**CALCULATION OF TOTAL CARGO PERCENTAGE PER TYPE OF VESSEL**	**TOTAL CARGO PERCENTAGE PER TYPE OF VESSEL**
CAPESIZE	70%	45%	07%	122%	(122%/300%)*100%	40.67%
PANAMAX	22%	40%	43%	105%	(105%/300%)*100%	35.00%
HANDY CLASS	08%	15%	50%	73%	(73%/300%)*100%	24.33%
TOTALS	**100%**	**100%**	**100%**	300%	(300%/300%)*100%	100.00%

Source: Compiled by the Author on data retrieved from Table 2.3 of Alizadeh & Nomikos (2009).

It follows from the above that 40.67% of all three cargoes above (iron ore, coal, grain) are transported by capesized vessels. Since demand for seaborne trade of the three commodities forecasted by us for 2018 is 3,337.63 m tones or 1,668.82 m tones for the first 6 months multiplied with 5,389 n. miles equals to demand of 17,986.48 billion ton miles for 2018 or 8,993.24 billion ton miles for the first 6 months of 2017. Current demand for iron ore, coal and grain for the beginning of 2017 is 3.092,61 mt *5414 n.m. = 16,743.39 billion ton miles for all bulk carriers.

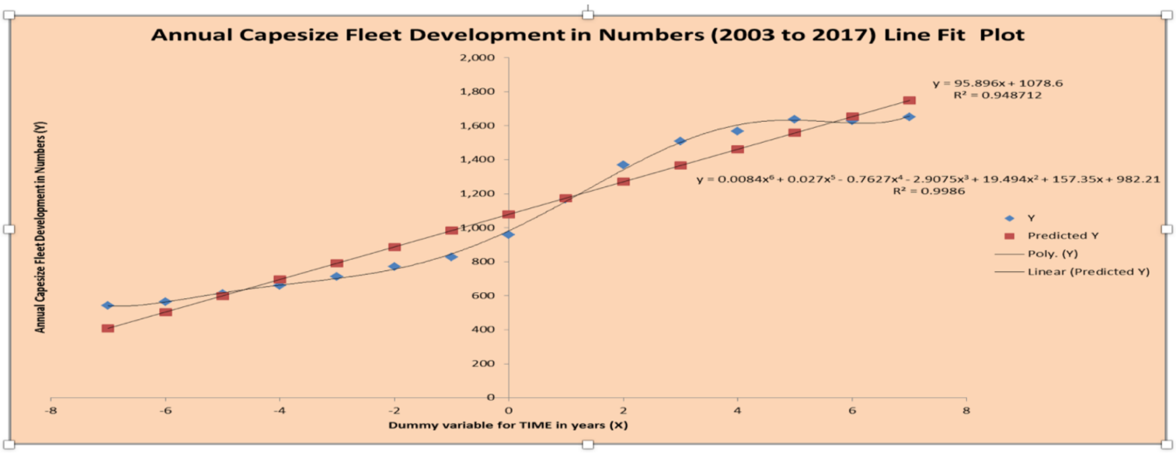
Now since capesized ships cover 40,67%, then the demand for capesized ships will be 7,315.10 billion ton miles for 2018 (40.67% of the forecasted 17,986.48 billion ton miles for 2018) and 3,657.55 billion ton miles for the first semester of 2017, assuming that the demand is equally spread among the twelve months of the year.

Current demand for capesize ships 6,809.54 billion ton miles.

Stage 5: The merchant fleet forecast

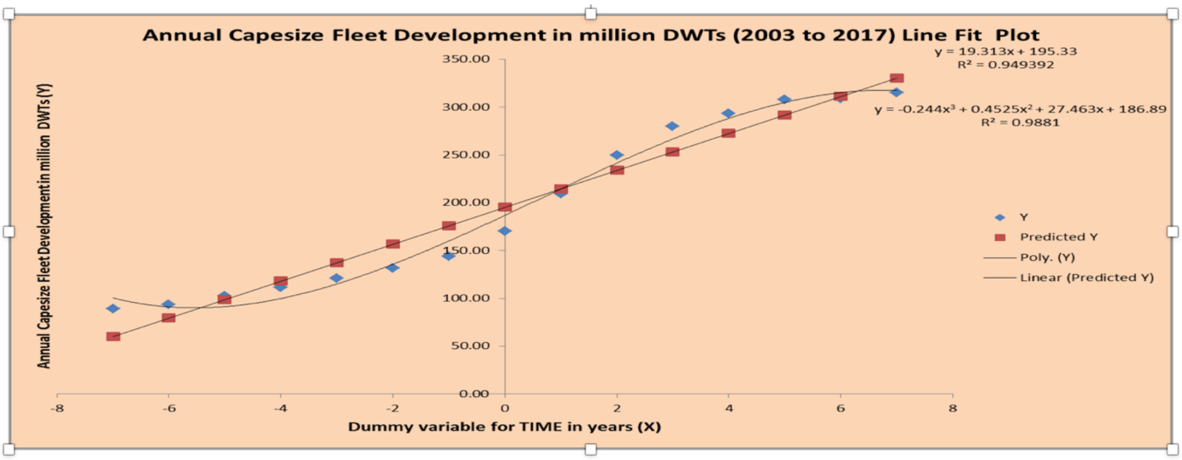
The current (31/12/2016) capesize fleet is 1652 vessels and 315.13 m DWT (Clarkson's Research).
For 2018 we ran 2 regressions one on the number of vessels and one on total DWT as shown in the following Firures 1.9 and 1.10 .

Figure 1.9: Annual Capesize Fleet Development in Numbers from 2003 to 2017.



Source: Clarkson's SIN data, compiled by the author.

Figure 1.10: Annual Capesize Fleet Development in million DWTs from 2003 to 2017.



Source: Clarkson's SIN data, compiled by the author.

By placing the value 8 for the dummy variable in the respective linear equations, we came up with 1846 ships and for 349,81 million DWTs for 1/1/2018 (or end of 2017).

Assuming that this Capesize fleet increase of the 194 ships and of the 34.68 million DWTs as opposed to the existing Capesize fleet on 1/1/2017 is evenly distributed aroud the twelve months of the year, we came up with 1,749 vessels for mid-2017 and with 332,47 m DWT , by dividing the forecasted increase by 2.

Stage 6: Ship productivity forecast

The productivity of a ship is meausured by the number of ton miles of cargo carried per dwt of merchant shipping capacity per annum. To forecast we will use Stopford's suggestion (2009, p.243):

$P_{tm} = 24*S_{tm}*LD_{tm}*DWU_{tm}$ [1],

in which S=average speed per hour; LD_{tm}=loaded days per year at sea and DWU=the deadweight utilization.

This means that a ship's productivity in ton miles of cargo carried in a year, is determined by the distance a cape actually travels in 24 hours, the number of days it spends loaded at sea per year and the % she travels with a full dwt of cargo.

The current average capesize ship capacity is, as seen above, (315.13 m DWT / 1652 =) 190,756.65 DWTs. Thus, the deadweight utilization of the capacity of 1 capesized vessel is DU=190,756.65*(1-0.05)=181,218.82 DWTs (assuming that it uses the 95 percent of its capacity in DWT as theory and practice suggests).

For the first half of 2017 the average Capesize ship capacity will be equal to, according to our forecast, 332.47 m DWT / 1749 = 190,091.48*(1-0.05)=180,586.90 DWTs.

The Capesize vessels make six 33 day laden voyages and five 30 day ballasted voyages per annum (Song D-W and Panayides, 2012). Our analysis of the Capesize voyages data that are published by Clarsons SIN (2016) in their publication "Shipping Intelligence weekly sources and methods" shows that, in reality, the average laden days at sea are quite lesser, as we found out from Clarkson's data that on average capesize vessels spent 132 ladden days at sea in 2016.

Also under the current market conditions it is highly unlikely that a vessel will sail at maximum operating speed. Evidence from the recent past has indicated that during troughs capesize bulk carrier speeds had been reduced to 10.4 knots (Lorentzen & StemoCo, 2011).

In order to find the currentproductivity per vessel we utilized the following equation: P= 24 (hours of the day) * S (average operating speed per hour) * LD (loaded days at sea) * DWU (deadweight utilization) or 24 * 10.4 * 132 * 181,218,82 DWT (=190,756.65 *(1-0.05))= 5.9706 billion ton miles. This is the annual productivity per vessel at present.

For 2017 with the market still in recession we suggest that it would make sense for ship owners to retain this speed or sail at a slower one. Therefore for the first half of 2017: 24 * 10.4 * 132 * 180,586.90 (DWT 190,091.48*(1-0.05)=180,586.90)= 5.9498 billion ton miles.

Stage 7: The shipping supply forecast

Our calculations above indicated that the fleet will be 1749 vessels in midterm 2017.

Therefore, the current total fleet supply is equal to 5.9706 billion ton miles * 1,652 vessels = 9,863.51 billion ton miles. One may recall our finding above that total demand on the three major bulk cargoes and on all vessels (not just capes) carrying these cargoes was 16,743.39 for the present day and (as we forecasted) 18,069.92 billion ton miles for 2017.

Supply by midterm 2017 will be equal to 5.9498 billion ton miles per vessel productivity * 1749 capes = 10,406.2 bn. t.m. or 5,203.1 bn t.m.

Stage 8: The balance of supply and demand

Current balance of supply and demand is 9,863.51 – 6,809.54 = 3,053.97 billion ton miles surplus in supply.

For 2018 it will be 10,406.2 - 7,315.10 =3,091.10 billion ton miles surplus in supply

From the above it follows that the Supply for the first half of 2017 – Demand for the first half of 2017 = 5,203.1 – 3,657.55= 1,545.55 billion ton miles surplus in supply.

Stage 9: Freight rates

Our forecast will be based on Average of the 4 T / C Routes for Baltic Capesize Index, 172,000mt.

Table 1.4 Average of the 4 T/C Routes for Baltic Capesize Index, 172,000mt

Date	Average of the 4 T / C Routes for Baltic Capesize Index, 172,000mt $/Day	Dummy variable for time
1999	11.465	-9
2000	20.902	-8
2001	12.949	-7
2002	11.918	-6
2003	40.330	-5
2004	69.058	-4
2005	50.128	-3
2006	45.139	-2
2007	116.049	-1
2008	106.025	0
2009	42.656	1
2010	33.298	2
2011	15.639	3
2012	7.680	4
2013	14.580	5
2014	13.800	6
2015	6.997	7
2016	6.374	8
2017	10.544	9

Source: Data obtained by the Clarcsons SIN. Dummy applied by the author.

To forecast the value for the next 6 months freight rates (BCI), we would have first to make a forecast for 1/1/2018.

The best line fit among the data is achieved by the polynomial equation of the 3rd order because of its higher R squared value as opposed to the liner equation. So, by using the polynomial equation, we get that the 2018 (1/1/2018) forecast for the value of the BCI is 11,542 USD per day. Now, to find the forecast value for the next six months from today, we will add up the value of the BCI in 2017 (1/1/2017) and its forecast value for 2018 (1/1/2018), and divide the sum by 2. Thus, we have that the forecast for the BCI for the next 6 months is equal to (11,542 – 10,544)/2 = 11,043, assuming that the change is equally spread throughout the months of the year. Therefore, for the next 6 month period we forecasted an increase in the value of the BCI by [(11,542-10,544)/11,542]*100 = 8,64% as opposed to its value on 1/1/2017 (or end of 2016).

Conclusions

With these in mind it appears that there is a difficult year ahead although demand will be increased, as there is still an excess of supply. We suggest that more lay ups, further demolitions supported by further stagnation in the shipbuilding activities may help tip the balance so that the distrurbed supply-demand equilibrium is restored and freights finally increase in the capesize subsector.

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Appendices:

Appendix I.

Table 1.5 DCT in m tm between 1982-2005.

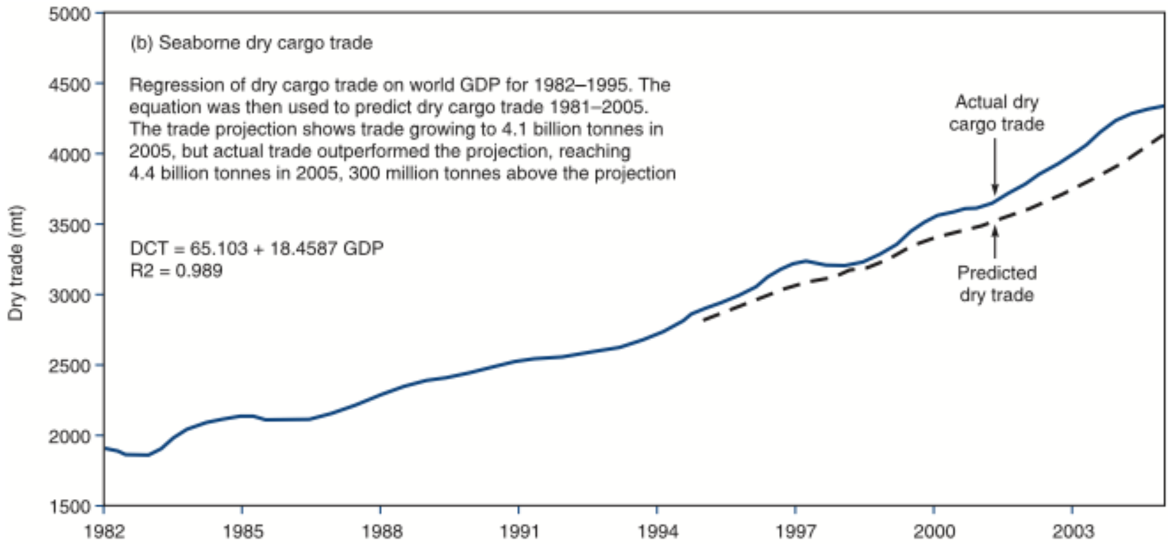
Year	DCT-Y (In million tones)	d	Y*d	d^2
1982	1900	-10.5	-19950	110.25
1983	1900	-9.5	-18050	90.25
1984	2100	-8.5	-17850	72.25
1985	2100	-7.5	-15750	56.25
1986	2100	-6.5	-13650	42.25
1987	2100	-5.5	-11550	30.25
1988	2250	-4.5	-10125	20.25
1989	2400	-3.5	- 8400	12.25
1990	2500	-2.5	-6250	6.25
1991	2500	-1.5	- 3750	2.25
1992	2490	-0.5	-1245	0.25
1993 mid	2600	0		
1994	2600	0.5	1300	0.25
1995	2900	1.5	4350	2.25
1996	3000	2.5	7500	6.25
1997	3300	3.5	11550	12.25
1998	3225	4.5	14512.5	20.25
1999	3350	5.5	18425	30.25
2000	3400	6.5	22100	42.25
2001	3600	7.5	27000	56.25
2002	3750	8.5	31875	72.25

2003	4000	9.5	38000	90.25
2004	4100	10.5	43850	110.25
2005	4400	11.5	50600	132.25
Total	$\sum Y=68565$		$\sum Yd=144,492.5$	$\sum d^2=1017.75$

Source: Obtained From Martin Stopford's Maritime Economics (2009) Figure 14(b), p. 719

Appendix II:

Figure 1.11: Obtained From Martin Stopford's Maritime Economics (2009) Figure 14(b), p. 719



GDCT in m tm between 1982-2005

Appendix III

Table 1.6 Demand in Billion Ton miles 1980 - 2016

Year		**estimated billion tonne miles**						
		Iron Ore	**Coal**	**Grain**	**Major Bulk**	**Total Dry Bulk**	**TOTAL ALL TRADED COMMODITIES**	
1980		1.528	939	1.328	3.795			
1981		1.428	1.104	1.382	3.915			
1982		1.367	1.079	1.369	3.814			
1983		1.250	1.042	1.387	3.680			
1984		1.545	1.252	1.414	4.211			
1985		1.587	1.458	1.227	4.272			
1986		1.609	1.536	1.117	4.263			
1987		1.668	1.599	1.297	4.564			
1988		1.847	1.659	1.365	4.871			
1989		1.906	1.728	1.338	4.972			
1990		1.874	1.823	1.311	5.008			
1991		1.902	1.971	1.306	5.180			
1992		1.796	1.973	1.333	5.102			
1993		1.895	1.922	1.268	5.086			
1994		2.051	1.986	1.212	5.249			
1995		2.166	2.150	1.418	5.734			
1996		2.110	2.191	1.376	5.676			
1997		2.315	2.304	1.429	6.048			
1998		2.184	2.390	1.300	5.875			
1999		2.195	2.335	1.449	5.979	12.081	**29.108**	
2000		2.446	2.531	1.551	6.528	13.166	**31.321**	**8%**
2001		2.533	2.614	1.667	6.815	13.388	**31.452**	**0%**
2002		2.685	2.637	1.640	6.963	13.501	**31.663**	**1%**
2003		2.875	2.823	1.778	7.477	14.442	**33.748**	**7%**
2004		3.300	2.975	1.814	8.090	15.966	**36.379**	**8%**
2005		3.715	3.092	1.844	8.651	16.821	**37.987**	**4%**
2006		4.080	3.270	1.929	9.279	18.131	**40.082**	**6%**
2007		4.520	3.427	2.061	10.007	19.167	**41.328**	**3%**
2008		4.826	3.541	2.158	10.525	19.342	**42.246**	**2%**
2009		5.365	3.440	2.221	11.025	18.611	**40.322**	**-5%**
2010		5.852	4.047	2.460	12.359	21.098	**44.656**	**11%**
2011		6.336	4.315	2.404	13.055	22.435	**46.936**	**5%**
2012		6.718	4.833	2.594	14.145	23.768	**49.069**	**5%**
2013		6.931	5.033	2.794	14.758	24.933	**50.642**	**3%**
2014		7.530	5.223	3.002	15.755	26.314	**52.694**	**4%**
2015		7.576	4.934	3.300	15.810	26.503	**53.498**	**2%**
2016		8.042	4.854	3.375	16.271	27.037	**54.934**	**3%**
2017		8.371	4.863	3.510	16.744			
Compound Average Growth Rates								
1990-2000		*2,7%*	*3,3%*	*1,7%*	*2,7%*			
2000-2010		*9,1%*	*4,8%*	*4,7%*	*6,6%*	*4,8%*	*3,6%*	

Source: Clarkson's SIN

Appendix IV

Table 1.7 Capesize fleet Development in number and million tones between 2003-2016 (Jan 2017)

Date	Capesize Bulkcarrier Fleet Development Number of Vessels	Capesize Bulkcarrier Fleet Development Million DWT
2003	542	89,40
2004	564	93,61
2005	611	102,49
2006	660	111,49
2007	714	121,26
2008	771	131,94
2009	826	143,84
2010	959	170,48
2011	1.167	209,82
2012	1.368	249,75
2013	1.510	279,80
2014	1.568	293,75
2015	1.637	308,06
2016	1.630	309,18
2017	1.652	315,13

Source: Clarkson’s SIN data compiled by the author

Appendix V

Table 1.8 Demand in million tones by year for Iron ore, Coal and grain.

Year		Iron Ore	Coal	Grain
1990		360	331	216
1991		366	352	217
1992		345	357	224
1993		361	358	222
1994		387	371	203
1995		408	402	213
1996		395	422	218
1997		429	448	228
1998		426	451	227
1999		402	459	245
2000		450	510	261
2001		452	548	264
2002		480	559	269
2003		516	603	272
2004		592	644	273
2005		662	674	274
2006		713	715	292
2007		777	772	306
2008		841	796	319
2009		898	807	321
2010		991	931	343
2011		1.052	1.000	345
2012		1.110	1.119	375
2013		1.189	1.180	392
2014		1.337	1.214	432
2015		1.363	1.134	459
2016		1.430	1.107	466
Compound Average Growth Rates				
1990-2000		*2,3%*	*4,4%*	*1,9%*
2000-2010		*8,2%*	*6,2%*	*2,8%*
2010-2017		*5,9%*	*2,6%*	*5,0%*

Source: Clarksons SIN

Appendix VI

Analysis of the Capesize Vessels laden days at sea in a year.

As Maritime economics theory suggests, in calculating the supply offered to the market at any time from the available at that time fleet, there are many behavioral variables that one needs to take into consideration, one of which is the number of productive days at sea in a year. The number of productive days at sea takes into consideration only the days in which the vessel is laden at sea. Martin Stopford in his Maritime Economics, 3rd ed., Routledge of London, (2009) book, p. 155, says that even in the very tight market of 2007, an average of 200 days at sea per ship across a mixed fleet of tankers and dry bulk-carriers was reported. In order for us to get an idea about the appropriate figure we should use in this case, we need to examine sample data for the operational characteristics of the usual voyages of the Capesize ships monitored by Clarksons Research. The Clarksons, apart from collecting data, they are also brokers. They collect information about the voyages followed by the vessels they work with, and they publish this information in their publications section at the Clarksons SIN under the title "Shipping Intelligence Weekly Sources and Methods", the latest of which is the "**Shipping Intelligence Weekly Sources and Methods 2016**". This publication shows on pages 10 to 15, useful information about the voyages followed by different types of ships. For the Capesize ships, useful information can be found on pages 16, 18, 19 and 20 of this publication. Our analysis of the first two voyage data shown on page 16 for the voyages done on Capesize routes B144 and B145, is shown below, while the raw data are presented in Table 1.8 below:

Table 1.9 Data for voyages one on Capesize Routes B144 and B145

CRS Voyages No.	Load		Discharge	Route Name in SIW (Issue No. 1,161 onwards)	Cargo Size Tonnes	CRS Ship No.	Voyage Dist. Miles Laden	Voyage Dist. Miles Ballast	Voyage Time - Days Sea Time	Sea Margin	Port Time	Turn Time	Canal Transit	Total Voyage Time	Oper. Speed Knots (L/B)
Capesize Modern c. 2010-built (Iron Ore)															
B144	Tubarao	-	Rotterdam	Tubarao/Rotterdam	176,000	34	5,025	5,025	33.6	1.7	6.0	1.0	0.0	42.2	12.0/13.0
B145	Tubarao	-	Japan		176,000	34	11,331	5,025	55.4	2.8	7.0	1.0	0.0	66.2	12.0/13.0

Source: Clarksons, SIN, publication Shipping Intelligence Weekly Sources and Methods 2016, p.16.

The analysis for route B145 is as follows:
The voyage distance shows that there are two equal legs of operations. In this case, each leg amounts to 5,025 nautical miles. If we assume that the vessel is available for trading for only 350 days in a year (the rest being days dedicated to surveys and minor repairs), then since the voyage lasts for 42.2 days, this vessel can do at the maximum 350/42.2 = 8.29 = 8 voyages in a year (assuming there is a demand for a voyage once the previous voyage has ended). The 0.29 trips in a year account for any other type of delays in ports, arrests, logical delays between voyages, etc. So, within a year, it will be at sea for 42.2*8=268.8 days. Since the voyage has 2 equal legs of operations, it will be laden for 268.8/2 = 134.4 days in a year.

The analysis for route B144 is as follows:
The voyage distance shows that there are 2 legs of operations amounting to 11,221 nautical miles for the laden part and 5,025 nautical miles for the ballast part. Such a case generally occurs, when the vessels move around the Capes while they are laden, and then, return via the Suez or the Panama canals in ballast. If we assume that the vessel is available for trading for only 350 days in a year (the rest being days dedicated to surveys and minor repairs), then since the voyage lasts for 66.2 days, this vessel can do at the maximum 350/66.2 = 5.28 = 5 voyages in a year (assuming there is a demand for a new voyage, once the previous voyage has ended). The 0.28 trips in a year account for any other type of delays in ports, arrests, logical delays between voyages, etc. So, within a year, it will be at sea for 55.4*5=277 days. Since the voyage has 2 unequal legs of operations, it will be laden for 277*[11,331/(11,331+5,025)] = 191.9 days in a year. The fraction, by which we multiply the 277 days-at-sea in a year in order to find the days-laden-at-sea in a year whenever the voyage consists of uneven legs, is the nautical miles per voyage that the vessel is laden, divided by the total nautical miles of the return voyage.

Working in the same way for all the 38 voyages done by Capesize ships managed by the Clarksons, we will find out the average laden days for each voyage in a year, based on the Clarksons sample of Capesize ships. And for all the Capesize voyages, we can find out the average laden days by summing-up the laden days for each voyage and dividing their sum by the total number of Clarksons Capesize voyages. This is done in an excel spreadsheet, the data of which are presented in Table 1.9 below, together with their general average figure.

From the Capesize voyage analyses we can see that:
a. The minimum possible laden-days-at-sea number was 83.20 laden days.
b. The maximum possible laden-days-at-sea number was 203.50 laden days.
c. The arithmetic mean of all the voyages was equal to 132 laden days in a year (and thus, productive), and this is the number we will use for the Capesize fleet productivity, assuming that all the Capesize vessels were equally spread on all of these voyages. This assumption is necessary, because in reality, we do not know for every ship in the fleet the frequency of its sailings on each route within the timeframe of our analysis. If this assumption does not hold, the arithmetic mean would definitely fall between 203.50 and 83.20 laden days, but would tend to be closer to the laden days of the voyages with the greatest frequency (number) of sailings.

To sum up our analysis on the laden-days-per-year issue, we have that, under the assumption that all the Capesize vessels were equally spread on the Capesize routes monitored by the Clarksons, then the average number of laden days in a year for the Capesize fleet was estimated to be equal to 132 laden days in a year. This is the amount that we will use in the supply calculation of the Capesize fleet, not only for assessing the maximum possible current supply, but for assessing the next 6-month maximum possible supply as well.

Let us state below all the assumptions, we had to make, directly or indirectly, during the present analysis:

1. The sample data that we took from the Clarksons SIN publication under the title "Shipping Intelligence Weekly Sources and Methods 2016", we assume they are applicable to all Capesize ships of the Capesize fleet, indicating that all other brokers managing Capesize vessels, can manage them with equal efficiency to the one characterizing the management of all Capesize vessels managed by the Clarksons.
2. The vessels are assumed available for trading for only 350 days in a year.
3. We assume that there is always a demand for a new voyage, once the previous voyage has ended.
4. We assume that all Capesize vessels of the fleet are, and will be, equally spread among the Capesize routes examined by the Clarksons in their publication "Shipping Intelligence Weekly Sources and Methods 2016", and that no Capesize voyage shows, or will continue to show, a greater frequency of voyages relatively to the other Capesize voyages.
5. We assume that all the factors affecting the operation of Capesize vessels managed by the Clarksons, were also affecting, in the same way, all the other Capesize vessels in the international fleet, and that all other factors affecting the Capesize market remain, and will continue to remain, unchanged under the assumption ceteris paribus.
6. We assume that if the average Capesize vessel is laden on the average for 132 days in a year, the same happens, and will continue to happen, for any other Capesize vessel in the Capesize fleet.
7. The number of voyage days that is taken out of the calculation of the number of voyages in a year because of the number rounding, covers any port delays, arrests, and any logical delays between voyages.

In Table 1.9 below, you can see the average Laden Days at sea for all 38 Capesize vessel voyages managed by Clarksons in 2016, together with their general average figure.

Table 1.10 Average days laden at sea for Capesize vessels in 2016

		DAYS LADEN AT SEA FOR CAPESIZE VESSELS MANAGED BY CLARKSONS IN 2016								
LADDEN DAYS	Average		LADDEN DAYS	Average		LADDEN DAYS	Average		LADDEN DAYS	Average
134.40			118.50			127.80			120.00	
191.89			186.20			193.20			194.30	
187.78			118.40			157.70			111.50	
107.88			117.60			127.40			119.70	
133.93			120.00			111.30			114.30	
91.20			203.00			135.60			203.50	
107.89			110.25			83.20			113.85	
116.40			109.90			104.20			104.60	
154.05			100.40			114.80			97.02	
127.60			1,184.25	131.58		162.70			1,178.77	130.97
1,353.02	135.30					1,317.90	131.79			
General Average:		132.42	or	132 Days						

Source: Constructed by the author after analysis of raw data retrieved by Clarkson's SIN publication "Shipping Intelligence Weekly Sources and Methods 2016".