A Combined Qualitative Ship Valuation Estimation Model

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ABSTRACT

The determination of the direction in which supply-demand balance will occur due to instability in periods of economic crisis, and the volatility of the market, necessitate the use of combined mathematical methods. Brokers experience difficulty in determining a ship's real value because of the lack of instant and unbiased data that can be accessed at anytime and anyplace in the world. Mostly, brokers use a marketing approach to determine a ship's value. However, a marketing approach does not give an accurate solution under all conditions. Ships, especially those ranging in age from 6-25, that is, more than five years old, need to be evaluated with a combined method which differs from marketing approaches. There is no systematic and standard mechanism to determine a ship's value worldwide. The aim of this study is to develop a reliable ship valuation mechanism using the ***"Combined Qualitative Ship Valuation Estimation Model"*** to validate the ship's actual price. Within this model, the ship's value can be calculated more accurately. This model will be useful in determining the adjusted ship value and to provide decision-making support for willing buyers and willing sellers.

1. INTRODUCTION

To date, many academic studies have been written about the subject of value. However, only a few of them are about the "Ship's Value". The main reason for this deficit in academic studies is that the estimation of a ship's future value is very difficult to ascertain and complex methods are needed to determine the value accurately. Brokers experience difficulty in determining a ship's real value because of the lack of instant and unbiased data that can be accessed at any time or anywhere in the world. Mostly, brokers use a marketing approach to determine a ship's value. However, a marketing approach does not give an accurate solution under all conditions. Ships, especially those ranging in age from 6-25 that is, more than five years old, need to be evaluated with a combined method which differs from marketing approaches.[1] Generally, willing buyers and willing sellers have no need for systematic rules to determine ship valuation, but ship valuation depending on systematic rules is vitally important for Sales and Purchase Brokers in terms of Long-Term Asset Values (LTAV). Reduced income (freight) cash flows covering the following 10 to 15 years, with accounts projections, are made by them.[2] However, it is very hard to estimate net asset values precisely. As a sample, in accordance with US bankruptcy codes, US courts do not accept Debtor's analysis. Even if both experts have used the same methodology (comparable company analysis; comparable transaction analysis; and discounted cash flow analysis), seller's experts and buyer's experts determine different values.[3] In this study, a ship's valuation mechanism, namely the ***"Combined Qualitative Ship Valuation Estimation Model- CQSVEM"*** has been formed. Within this model, the ship's value can be calculated more accurately.

2. GENERAL EVALUATION OF PREVIOUS SHIP VALUATION METHODS

Within the scope of the study, certain limitations related to valuation have been applied because of the very different types of ships in the shipping trade. Because of the major and minor commodities of world production cover more than 30% of the world trade, dry bulk carriers have been selected for this study [4]. In order to improve "CQSVEM", previous valuation methods were scrutinized. The differences and deficiencies of these valuation methods have been interpreted. In order to develop a new hybrid method to eliminate the gaps in the valuation methods, a field study was conducted to collect the appropriate data. These data were collected by reviewing official web sites such as Clarkson Research, Lloyd's List, Baltic Exchange, Shanghai Shipping Exchange, Hellenic Shipping News, etc. Data included the year of construction, sales year, tonnage, and sale price of the ships, the shipyard where it was built, and to which ship-owner company it was sold. In the related literature, it is understood that the most important factors that determine a ship's price are ship type, age, tonnage, and specific features according to the findings obtained from previous studies. The time element is also a very important factor for ships' valuation. Whether the estimates are to be made instantaneously, short term, medium term or over the long term, changes the methods to be applied. There are three different approaches in the literature to predicting the future. These are a market report, a forecasting model and a scenario analysis [5]. Regression models confirm these coefficients for almost every period. In addition, whether the effect of each unit increases these variables and whether there is a correlation or not between these variables on the ship's price were also predicted. Major determinants of newbuilding prices are determined as shipbuilding cost, shipyard capacity, vessel order book, freight rates, and secondhand prices by distinguished authors.

3. A PROPOSAL: THE CQSVEM MODEL

The main objective of this new improved model is to determine the variations between nominal and real sale prices. The price margin will be determined according to the anomalies of prices. Thus, the adjusted price will be calculated for investment or disinvestment decisions. The concept of the improved model is shown in Figure-1.

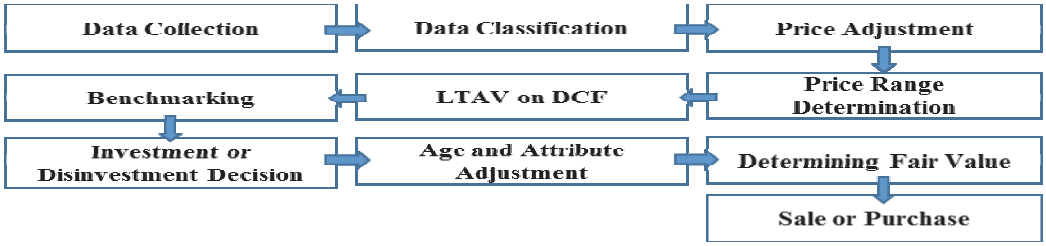

Figure-1 Combined Qualitative Ship Valuation Estimation Model

In this study, clusters are not classified by the category of bulk carriers. Initial calculations based on raw data show that 0-5-year-old bulk carriers reflect market values, but 6-20-year-old second-hand carriers are not in harmony with predicted sale values and the purchase market. 1446 dry bulk carriers' data were collected for this study. The process of determining optimum ship prices has been divided into three main methods. Firstly, ships of different ages, but similar tonnage have been classified within approximately 10.000 dwt range. The second group consists of vessels of different tonnage but the same age and same year of sale. Thirdly, selected vessels in harmony with each other in terms of tonnage and age were classified together. The third option is more favorable for meaningful multi-regression analysis. As

described in Figure-1, at the first stage, the age of the dry bulk carriers was calculated by the difference between the sale or purchase year and the construction year. In the second stage, price anomalies were detected by applying Regression Analysis. In the third stage, before making LTAV on DCF Analysis, the optimum adjusted value should be determined.

4. APPLYING THE MODEL

Within a case study to apply this model, the dry bulk carrier M/V True Frontier was selected to determine the optimum price. Firstly, the current value (market value) was calculated. Secondly, the market value was compared with reasonable value.

Table-1 The Sample of Market Valuation for a Dry Bulk Carrier.

Ship Name	DWT	Built	Sold	Age	Price ($M)
Pacific Capella	180.346	2012	2017	5	27,00
Pacific Canopus	180.330	2012	2017	5	25,00
Shin-Zui	180.201	2007	2017	10	15,00
N Fos	179.294	2010	2017	7	21,80
IVS Cabernet	177.173	2007	2017	10	20,50
Portage	176.391	2002	2017	15	9,00
Teh May	175.085	2004	2017	13	10,00
Bulk Prosperity	172.964	2001	2017	16	8,00
Blue Island	152.398	2000	2017	17	7,50
True Frontier	179.294	2010	2017	7	?
				Mean Price:	**$15,98M**

Source: Data compiled from Clarkson Research by authors [6]

In order to calculate the reasonable value, regression analysis would be a satisfactory method on which to make any investment or disinvestment decision. Sister ship transactions were collated in Table-1.

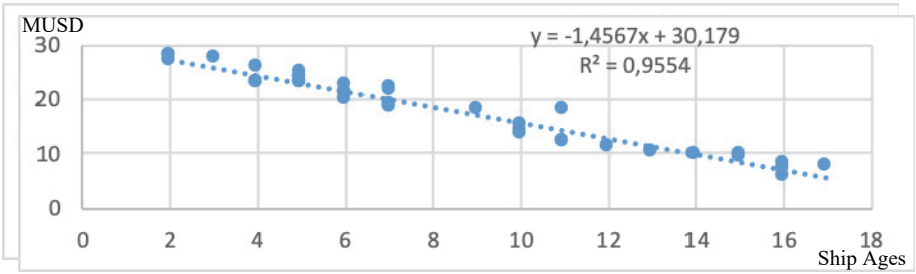

Figure-2 Regression analysis of Capesizes [7]

According to the results of regression analysis in Figure-2, it can be said that it is reasonable to sell M/V True Frontier for 21.4 million dollars. But she was actually sold for $ 30 mil. by Global Maritime Investment to Clients of H-Line Shipping. When it is considered that the mean price in Table-4 is between $15,98 mil. and $16,086 mil. in 2017, it is understood that overpricing occurred under free market conditions.

Table-2 Multi-regression analysis of Capesizes' Summary Output

Regression Statistics					
Multiple R	0,978099929				
R Square	0,956679471				
Adjusted R Squa	0,954272775				
Standard Error	1,423660835				
Observations	39				
ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	1611,344065	805,6720323	397,5073953	2,88727E-25
Residual	36	72,9651662	2,026810172		
Total	38	1684,309231			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	42,30933179	11,96918065	3,534856147	0,001142048	18,03470832
X Variable 1	-6,5796E-05	6,48719E-05	-1,014244685	0,317234489	-0,000197362
X Variable 2	-1,509944363	0,073665618	-20,49727416	1,93803E-21	-1,65934516

To determine the attractive price of "M/V True Frontier" shown in Table-3, the LTAV on DCF will be calculated, and then LTAV on DCF for M/V True Frontier in Table-4 will be compared with a predicted value that is calculated by multi-regression analysis. After comparing this with the actual market price and LTAV, the decision-making process has been applied (as seen in the criteria in Table-5).

Table-3 Calculation of LTAV on DCF for M/V True Frontier

Year (Y)	Age (A)	ABD (%95)	OD	DGCR (%2 IR)	1_CRAAD (%30)	2_CRAAD (%15)	1_DNCR %6.5	2_DNCR %6.5	1_ANCR	2_ANCR	AOE	SV	1_FCF	2_FCF	WACC %	PVF	1_PV $	2_PV $
2017	7	326	343	18500	18500	18500	17298	17298	6031000	6031000	2184200		3846800	3846800	73,00	0,93	3585089	3585089
2018	8	340	358	22000	22000	22000	20570	20570	7480000	7480000	2249726		5230274	5230274	73,00	0,87	4542814	4542814
2019	9	340	358	16000	16000	16000	14960	14960	5440000	5440000	2318066		3121934	3121934	73,00	0,81	2527112	2527112
2020	10	340	358	17500	17500	17500	16363	16363	5950000	5950000	2386406		3563594	3563594	73,00	0,75	2688372	2688372
2021	11	340	358	16500	16500	16500	15428	15428	5610000	5610000	2454746		3155254	3155254	73,00	0,70	2218379	2218379
2022	12	326	343	16830	16830	16830	15736	15736	5486580	5486580	2523086		2963494	2963494	73,00	0,66	1941805	1941805
2023	13	340	358	17167	17167	17167	16051	16051	5836644	5836644	2588612		3248032	3248032	73,00	0,61	1983455	1983455
2024	14	340	358	17510	17510	17510	16372	16372	5953377	5953377	2656952		3296425	3296425	73,00	0,57	1876054	1876054
2025	15	326	343	17860	17860	17860	16699	16699	5822403	5822403	2725292		3097111	3097111	73,00	0,53	1642704	1642704
2026	16	340	358	18217	18217	18217	17033	17033	6193893	6193893	2790818		3403075	3403075	73,00	0,49	1682187	1682187
2027	17	340	358	18582	18582	18582	17374	17374	6317771	6317771	2859158		3458613	3458613	73,00	0,46	1593327	1593327
2028	18	326	343	18953	18953	18953	17721	17721	6178780	6178780	2927498		3251282	3251282	73,00	0,43	1395912	1395912
2029	19	340	358	19332	19332	19332	18076	18076	6573009	6573009	2993024		3579985	3579985	73,00	0,40	1432468	1432468
2030	20	340	358	19719	13007	15794	12162	14768	4422440	5370105	3061364		1361076	2308741	73,00	0,37	507559	860953
2031	21	326	343	20113	13267	16110	12405	15063	4325146	5251963	3129704		1195442	2122259	73,00	0,35	415463	737569
2032	22	340	358	20516	13533	16433	12653	15364	4601106	5587058	3195230		1405876	2391828	73,00	0,32	455357	774701
2033	23	340	358	20926	13803	16761	12906	15672	4693129	5698799	3263570		1429559	2435229	73,00	0,30	431526	735097
2034	24	340	358	21345	14079	17096	13164	15985	4786991	5812775	3331910		1455081	2480865	73,00	0,28	409348	697924
2035	25	340	358	21771	14361	17438	13428	16305	4882731	5929030	3400250	8165855	9648336	10694635	73,00	0,26	2529634	2803956
																Mean Price	33858564	35719878

LTAV: Long Term Asset Value, **Y:** Year, SA: Ship Age, **OD:** Operation Days, AD: Age Discount, **DGCR:** Daily Gross Charter Rate, **ABD:** Actual Booked Days **AD:** Age Discount, **CRAAD:** Charter Rate After Age Discount, **F&C:** Fees and Commissions, **DNCR:** Daily Net Charter Revenue, **ANCR:** Annual Net Charter Revenue, **AOE:** Annual Operating Expenses, **SV:** Scrap Value, **FCF:** Free Cash Flow, **WACC:** Weighted Average Cost of Capital (Discount Rate), **PVF:** Present Value Factor, **PV:** Present Value. LTAV on DCF Formula as follows.

$$LTAV\ on\ DCF = \sum_{t=1}^{T} \left(\frac{(Ct-Bt)}{(1+i)^{t-p}} + \frac{RVT}{(1+i)^{T-p}} \right) \quad [8]$$

C_t = Charter Income, C_1= Current Net-TC Rate in running year, $C_{2\text{-}T}$= Average Net-TC Rate of the past 8-10 years, **Bt**= Average OPEX of the last 8-10 years, **i** = Discount Rate, **t** = period, t_1**:** current year, $t_{2\text{-}T}$**:** period end, **T** = Remaining period until Age 20/25, RV_T = Residual Value, **p** = time after construction.

Table-4 Fair Value of M/V True Frontier

Process	Method	Value ($M)
STEP-1	Marketing Value (Mean Price)	15,98
STEP-2	Marketing Value (Adjusted Mean Price)	16,086
STEP-3	Marketing Value (Predicted Price)	21,40
STEP-4	LTAV on DCF (Reduction Rate 15%)	34,04
STEP-5	LTAV on DCF (Reduction Rate 30%)	35,90
STEP-6	Age Adjustment	30,92
STEP-7	Attribute Adjustment	29,90
STEP-8	Regression Analysis (Age Adjustment include 2014-2017 Sales)	19,98
STEP-9	Regression Analysis (Age Adjustment include 2017 Sales only)	28,45
STEP-10	Multi-regression Analysis (Age and Attribute Adjustment include 2014-2017 Sales)	23,26
STEP-11	Multi-regression Analysis (Age and Attribute Adjustment include 2017 Sales only)	24,83
	Fair Value	**25,52**

Source: Described by the authors

In line with the case study, the following values listed in Table-4 were calculated within each step and the optimum price (fair value) determined by "CQSVEM" as $25.52M.

Table-5 Decision Making Process for Investment or Disinvestment

Actual Market Price	Vessel Owner	Potential buyer
> LTAV	**Sell**	**Don't buy**
< LTAV	**Don't Sell**	**Buy**

In the LTAV calculations, it is assumed that operating days are 358 (maximum number of available running days-charter days in a typical year), and operating days in years with drydocking 343 (maximum number of available running days in years with dry docking-class renewal). Gross Charter Rate per day for Current Year and next four-year estimations were obtained from "Baltic Capesize Indexes" and "Advanced Shipping and Trading S.A. Weekly Reports". In addition, "Actual Booked Days" were assumed to be 326 days, which is 95% of total available running days. Daily Gross Charter Rates (Current Charter Rates) are realized as $18.500 for 2017, $22.000 for 2018 and, $16.000 for 2019 [9]. The following two years' estimations are $17.500 for 2020 and $16.500 for 2021 [10]. Other estimations of Daily Gross Charter Rates from 2021 to 2035 are consecutively calculated by the following year's daily charter rates at 2.0% interest. However, the percentage of reduction rate in the daily gross charter rate for ships with age more than 20 years was assumed to be 30% for sample-1 and 15% for sample-2 because the percentage of reduction rates can change the estimated ship prices. Ship prices can change by approximately $ 1-2 M when reduction rates between 15% and 30% are added into the calculations. After these operations "Daily Net Charter Revenues" with 6.5% (ship management fee and freight commissions as a percent of gross daily charter rate) were calculated. The next operation is to calculate Annual Operating Expenses. According to Baltic Exchange data, the daily operating expense for Capesizes was $6,700 in August of 2017 [11]. Annual Operating Expenses up to the year 2035 are consecutively calculated by the next year's daily operating expenses at 3.0% interest. M/V True Frontier's lightweight tonnage is approximately 21,990 ltd. Scrap prices per long ton change worldwide. These prices can be reduced depending on transportation needs. Scrap prices are $295 (Turkey), $260 (China), $380 (Pakistan), $385 (Bangladesh), and $375

(India) [12]. The scrap value of True Frontier is calculated as $8,165,855 for 2035 and the scrap value is discounted. Free Cash Flows from 2017 to 2035 are calculated considering Annual Net Charter Revenue, Annual Operating Expenses, and Scrap Value. FCFs provide data to calculate the present value of True Frontier. To calculate the LTAV on DCF, the Weighted Average Cost of Capital (WACC) and Present Value Factor should be determined. In this study, it is assumed that the risk-free rate is 2.2%, equity beta is 1.2 and MRP is 4.1. These data are obtained from US Treasury bond yields at 10-years for r_f in Drobetz's study for β_E [8] and in Dimson's study for Market Risk Premium [13]. Hence, the cost of equity r_E was calculated as 7.4%. The debt risk (r_D) is composed of the swap rate and credit spread. The US 10 Year Treasury Rate is 2.27% [14]. It is assumed that credit spreads are 1.5-5.0% [15], and M/V True Frontier's financed debt is 70% [16] [17], therefore r_D is calculated as 3.57%. In light of these data, the Weighted Average Cost of Capital (WACC) was calculated as 7.3%. Present Value Factors (PVFs) were used to determine the Present Value (PV) of the ship by considering Free Cash Flows (FCF). LTAV on DCF is compared with the actual market price to then decide on investment or disinvestment. However, nobody is sure whether this value is a normal or excessive price at which to purchase or sell the ship. For that reason, the actual market price should be adjusted and then compared with the LTAV on DCF. As a result of the case study, LTAV of M/V Frontier was calculated as $34-35 M. Hence, the predicted value of the ship is $21,4 M. When compared with each other, the investment or disinvestment decision should be taken as follows:

$21,4 M < $34-35 M → "Do Not Sell" for Vessel Owner, "Buy" for Willing Purchaser

According to Andreas Mietzner's study "Developing a Dynamic Vessel Valuation Method Based on Real Market Transactions", age and attribute adjustments are necessary to reduce the anomalies of sale and purchase prices [18].

5. CONCLUSION

In this study, the "CQSVEM" model has been proposed. The model is composed of eleven operational steps as summarized in Table-4. The case study shows that both marketing value and the LTAV on DCF approaches alone do not reliably assess ship value. These approaches can be used as complementary data in decision-making processes. According to Clarkson Research Data, M/V True Frontier was purchased in 2/2017 under the name "M/V N Fos" at $21,80M. However, M/V True Frontier was sold in 8/2017 at $30M. At first glance, it can be explained that M/V True Frontier's last transaction ($30M) was within Step-6 ($30,92M) and Step-7 ($29.90M), but a very important question is "For which party was this sale price advantageous?" It is very obvious that $30M is moderate for the seller whereas $21,80M is acceptable for the purchaser. Regression analysis is important to determine a reference point. This reference point will provide the buyer or seller with a reliable guide to which price ranges are reasonable for purchase or sale. CQSVEM will be helpful in determining the upper limit for the buyer and the lower limit for the seller. Hence, the calculated optimal price point ($25,52M) will provide a significant input for brokers and other third parties' decision-making procedures.

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