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International comparison of market risks across shipping-related industries

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This paper compares the behaviour of shipping and shipping-related company stock returns to reveal whether systematic risk differs from the average in the market and across sub-sectors of the maritime industry. Following an extensive collection of information through a postal questionnaire survey, 108 publicly listed shipping and shipping-related companies, across stock exchanges of the world, are classified by sector according to their core business activity. The Capital Asset Pricing Model (CAPM) is employed for the period 1996–1999 to model stock returns and measure sector βs (systematic risk). Stock returns over the period are mostly negative. The systematic risks of the Drilling and Offshore sectors are significantly higher than those of all other sectors, but are not different from each other. There is no significant difference between the systematic risks of the Bulk, Tanker, Container and Ferry sectors. The systematic risk of the Cruise sector lies somewhere between these two groups. There is no difference in the systematic risk of companies that diversified within shipping or shipping-related industries when compared to companies that diversified in other areas. Over all companies in the sample, β is lower than the market average, and so are the βs of the Ferry, Tanker, Bulk, Container and Yard sectors. Only the β of the Drilling sector is statistically higher than one, while the Cruise, Diversified and Offshore sectors are statistically one.

1. Introduction

A major question throughout the years has been how to finance investments in the shipping industry. Ships cost millions, and such large sums need careful investment decisions. Methods of financing have varied over time and place, as well as with the corporate structure of the company requiring funds to invest in shipping. Thus, while traditional borrowing from banks has always been prominent in the industry, charter backed finance has been very popular in the post-second world war period. This has

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been followed by asset-backed finance in the 1980s (e.g. ship funds) and lately—in the 1990s—a lot of interest has been placed in drawing funds from the public. The latter is materialized either by borrowing through the issuance of bonds or by offering part-ownership to the public through shares in the company.

With respect to this last form of finance, it is of interest to potential investors and financiers to have a fair valuation of shares in the industry and to have a measure of risk-return profiles in the industry. At the same time, the listing of companies in the sector in stock exchanges around the world enables the calculation of objective market-related risks and the comparison of these with other sectors. Previous studies in the literature, such as those of Kavussanos and Marcoulis [1–6], have concentrated on the valuation of listed companies in the US water transportation industry at the aggregate level. They find that the market risk in the industry, if not lower, is not different from that of the market and from other US transportation sectors, with the exception of rail transportation from which it has a significantly lower value. This paper extends the work of these studies by investigating an international portfolio of shipping companies (that is, a portfolio with shares listed across stock exchanges around the world) and by comparing the risk return profiles of different sub-sectors of the shipping industry.

The CAPM (Capital Asset Pricing Model), under which the market index alone is assumed to be driving market returns, is used to estimate and compare average βs for the following, broadly-defined, sub-sectors of the shipping industry: Bulk, Container, Cruise, Drilling, Ferry, Offshore, Tanker and Yard. Such a comparison has not been attempted before and it is perceived that it would enhance one's understanding of the risk-return profiles of companies operating in these sectors, resulting in more refined investment decisions and help shipping and shipping-related companies when considering expansion and/or diversification.

The remainder of the paper is structured as follows. The following section discusses briefly the use of the CAPM as a model of equilibrium returns and a vehicle through which to measure non-diversifiable risks. Section 3, the data section, describes how listed water transportation companies and other shipping-related stocks are classified by the industry sector depending on core business activity. The properties of the data set are also discussed here. Section 4 presents the results; average sector βs are estimated and compared with the market and between themselves to establish whether the risk/return relationship differs across sectors of the shipping industry. Finally, section 5 of the paper concludes.

2. Theory—methodology

Sharpe [7] and Lintner [8] independently developed the CAPM as a general equilibrium model for asset returns. In its simplest form, it postulates that the expected return on a firm's equity can be explained as a linear function of a single factor—the expected return on the market portfolio of assets. The ideas relate back to the seminal work by Markowitz [9, 10]. He developed the theoretical work, which considers an investor aiming to maximize utility derived from the returns obtained by holding individual assets. It is assumed that investors are risk averse, in the sense that for the same level of return investors would select stocks which have less risk. That is, he shows that there is an inverse relationship between stock returns and risk. Furthermore, Markowitz [9, 10] shows that, when investors hold more than one stock in their portfolio, the overall risk in the portfolio will decrease, thus offering safer returns to investors.

When large portfolios are held, it is not easy to calculate the relevant variance–covariance matrix, which measures the risk of these portfolios. As a consequence, Sharpe [7] and Lintner [8] developed a single index model, which showed that returns could be explained in terms of a single factor; the market return. This development has made the technical problem of calculating variance–covariance matrices tractable, even for large portfolios. Hence, the birth of the CAPM. At the same time, the model provides a theory, under which, if all investors behaved as if this is the model that explains stock returns, this becomes the general equilibrium model of returns in the economy.

CAPM divides the risk of holding an asset into two parts, systematic or market risk and non-systematic or specific risk. The systematic or market risk is the part related to the riskiness of the market portfolio; the non-systematic or specific risk is the residual part of the risk, which cannot be explained by the market and is company specific.

An investor can avoid the residual, non-systematic or specific, risk by holding a diversified portfolio. Accordingly, an investor should receive no added return for bearing diversifiable risk and, therefore, the expected return of an asset should only reflect the systematic or market risk. Mathematically, the CAPM shows this relationship in time series form by the following equation:

$$\tilde{R}_{it} = R_{Ft} + \beta_i(\tilde{R}_{Mt} - R_{Ft}); \quad i = 1, \ldots, n; \quad t = 1, \ldots, T \tag{1}$$

where $\tilde{R}_{it}$ is the expected return of stock i at time t, R_{Ft} is the risk-free rate of interest at time t, β_i is the beta for stock i and $\tilde{R}_{Mt}$ is the expected return from the market at time t.

Miller and Scholes [11] showed that equation (1) cannot be used to accurately estimate β, because R_{Ft} is not constant over the estimation period. This can be shown by rearranging this equation to give:

$$\tilde{R}_{it} = (1 - \beta_i)R_{Ft} + \beta_i\tilde{R}_{Mt}; \quad i = 1, \ldots, n; \quad t = 1, \ldots, T \tag{2}$$

If R_{Ft} fluctuates over time and if it is correlated with $\tilde{R}_{Mt}$ there is a case of missing variable bias and β_i will be a biased estimator of the true β_i. Black *et al.* [12] solved this problem by taking as their basic time series model:

$$R_{it} - R_{Ft} = \alpha_i + \beta_i(R_{Mt} - R_{Ft}) + e_{it}; \quad i = 1, \ldots, n; \quad t = 1, \ldots, T \tag{3}$$

where R_{it} is the holding period return on the equity of company i in period t, R_{Ft} is the risk free rate, R_{Mt} is the holding period return on the market portfolio of stocks in period t, while e_{it} is the residual left unexplained—the non-systematic or specific risk.

α_i and β_i are the CAPM parameters for stock i. The α indicates whether the stock is trading at a fair price. The β is a measure of the stock's sensitivity to changes in the expected market return. The CAPM suggests that an average stock would have a β value of one and, if correctly priced, an α of zero. A negative α indicates that the stock is overpriced, since its return is higher than that implied by the CAPM; a positive α indicates that the stock is underpriced, since its return is lower than that implied by the CAPM. A stock with a β greater than one carries above average systematic risk and an investor would, therefore, require a higher expected return to hold it. Conversely, a stock with a β less than one carries below average systematic risk.

Equation (3) is estimated for each company by Ordinary Least Squares (OLS) to obtain estimates for α and β, say $\hat{\alpha}$ and $\hat{\beta}$, respectively. Averages of these, denoted $\bar{\hat{\alpha}}$ and $\bar{\hat{\beta}}$, respectively, are then calculated for each sector, and are used as estimates of the true sector $\bar{\alpha}$s and $\bar{\beta}$s. Two separate null hypotheses are tested then; that is that $\bar{\alpha} = 0$ and that $\bar{\beta} = 1$ in order to test for underpricing and whether the sector average β is 1, respectively. The following test statistics are used:

$$\frac{\bar{\hat{\alpha}}_i - \bar{\alpha}}{SE(\bar{\hat{\alpha}}_i)} \sim t(n_i - 1) \quad \text{and} \quad \frac{\bar{\hat{\beta}}_i - \bar{\beta}}{SE(\bar{\hat{\alpha}}_i)} \sim t(n_i - 1) \tag{4}$$

where $\bar{\hat{\alpha}}_i$, $\bar{\hat{\beta}}_i$, $\bar{\alpha}$ and $\bar{\beta}$ are the sector i averages of the estimated parameters and the values of the null hypotheses being tested for, and $SE(\bar{\hat{\alpha}}_i)$ and $SE(\bar{\hat{\beta}}_i)$ are the estimated standard errors of these averages.

The average βs of each sub-sector are also compared to examine whether systematic risks differ between sub-sectors of the international [13] water transportation industry. The test statistic used is:

$$\frac{\bar{\hat{\beta}}_i - \bar{\hat{\beta}}_j}{\sqrt{\frac{S^2}{n_i} + \frac{S^2}{n_j}}} \sim t(n_i + n_j - 2) : i \neq j \quad \text{where} \quad S = \frac{(n_i - 1)S_i^2 + (n_j - 1)S_j^2}{n_i + n_j - 2} \tag{5}$$

where $\bar{\hat{\beta}}_i$, $\bar{\hat{\beta}}_j$, S_i, S_j and n_i, n_j are the sector i and j averages of the estimated parameters, their standard deviations and the number of companies in sector i and sector j, respectively. S is a weighted average of S_i and S_j, which is used because the sample sizes are small.

The theoretical underpinning behind the above procedure is that the risk-return profiles of stocks in the economy vary according to the industry they belong to. Earlier work at the industry level [14–16] has shown that firms within the same industry experience similar rates of return. Furthermore, industry average rates of return exhibit significant differences; and this is reflected in the increasing focus of investors towards an industry-oriented approach by the existence of sectoral funds (e.g. transport, construction, banking etc.).

Furthermore, studies such as Capaul [17] and Weiss [18] argue that, as capital market integration develops and certain global industries are to a certain degree homogeneous, the industrial classification of a given asset becomes increasingly important to the investor. This raises the need to study industries at the international level—across country borders. That is, it is argued that the degree of integration in various industries is such, at the international level, that global asset management firms increasingly place an industry focus in their research. In addition, the world economy is becoming increasingly more globalized, with companies operating across borders, forming alliances/mergers in several industrial sectors, in some of them more than others. Given this industry internationalization in the world economy, the current study fits well within this framework, particularly in an international industry such as shipping.

3. Data classification and properties

3.1. *Classification of companies by maritime sector*

For analysis, this paper identifies every possible maritime company listed continuously in any stock exchange in the world over the most recent 3-year period and

Table 1. Maritime industry sectors.

Sector	Description
Bulk	Dry bulk, older type General cargo ships, excluding OBO.
Container	LOLO and some ROLOs with large container section.
Cruise	Cruise ships.
Drilling	Rig owners and operators.
Ferry	Passenger ferries including ROPAX.
Offshore	Supply boats and anchor handlers.
Shipping	Companies with 90% or more of revenue derived from shipping or shipping-related activities but which could not be classified into any other sector.
Tanker	Oil Tanker, excluding chemical and gas Tankers as well as FSPO. OBOs were included when operated as oil Tankers.
Yard	Shipyards excluding Rig yards.
Diversified	Companies with between 60–90% of revenue derived from shipping or shipping related activities—the balance being derived from elsewhere.
All	All of the above sectors.

OBO: Oil Bulk Ore; LOLO: Lift On Lift Off; ROLO: Roll On Lift Off; ROPAX: Roll On Passenger.

classifies it under pre-defined sub-sectors of the industry (see table 1 for details). This, sampling of companies across stock exchanges (rather than focusing on companies listed in one exchange) gives the largest possible cross-sectional sample of maritime companies in each sub-sector, and at the same time a sufficient length of time series data for returns (36 monthly observations) to enable estimation and inferences.

The starting point is the Maritime Transport and Energy list of traded shares appearing in the Financial World page of the *Lloyds List*. This is supplemented by any other public companies known to be involved in shipping or shipping-related industries but not listed there [19, 20]. In order to classify companies into sectors, a short questionnaire was sent to 250 of these companies in July 1999, asking them to classify the percentage of their core business activity in a number of pre-defined sectors. This information was supplemented by consulting their annual reports for 1998 and 1995. There was an approximately 20% response to the initial questionnaire, with a further 30% replying after a reminder letter, which was sent 4 weeks later. Financial information for companies that did not reply was obtained from the Wright Investors' Service web page (http://www.wisi.com), from the Fairplay Online Directory (http://www.wsdonline.com) and from individual company web pages.

In order to make inferences for each sector which reflect the risk/return profile of operating in the specific sector, companies whose economic activity in shipping or shipping-related activities was less than 60% were considered overly diversified and were discarded from the sample [21]. Companies for which there was no information on revenue, companies involved in mergers, acquisitions and/or changes in their core business during the sample timeframe and companies for which stock data could not be found on DataStream were excluded from the analysis.

To account for the possibility that different degrees of diversification have varying effects on the risk-return profiles of sectors, the companies that remained were classified and analysed according to whether 60, 75 and 90% of their core business activity was in the same sector. Specialized companies operating only in one sector were straightforward to classify. Companies whose core activity was over 90% in more than one sector of shipping but for which no detailed breakdown of the

percentages attributable to each sector were available were classified in a general category called 'shipping'. Companies with diverse core business that included over 10% of activities not shipping-related were classified as 'diversified'. The sectors 'Reefer', 'Gas', 'Chemical Tankers', 'Brokers' and 'Ports' had to be abandoned due to too few listed companies belonging to them. In total, 108 companies made up the final sample used for analysis. The number of companies in each sector under the 60, 75 and 90% classification criteria are shown in table 2.

3.2. *Data sources and summary statistics*

Monthly stock price and dividend yield (in percentage form) data for each share are collected from DataStream International Service. Logarithmic monthly returns for company i at time t, R_{it}, are calculated in percentage form using the equation:

$$R_{it} = 100 * \ln\left[\frac{(P_{it} + (P_{it} * DY_{it}/1200))}{P_{it-1}}\right] \tag{6}$$

where P_{it} and P_{it-1} are the stock prices of company i at time t and $t-1$, respectively, and DY_{it} is the annualized dividend yield paid by company i at time t.

In calculating the CAPM regression of equation (3), a question of what is the relevant market is always raised. Because the sample includes companies listed on stock exchanges in different countries, the Morgan Stanley Capital International (MSCI) All Country World Index was used for analysis. Given the recent developments of the launch of maritime funds and the practice of evaluating industry-specific funds by benchmarking on sectoral indices, the MSCI International Shipping Index was also used for analysis.

Table 2. Summary statistics of mean monthly returns of each sector by classification criteria; July 1996–July 1999.

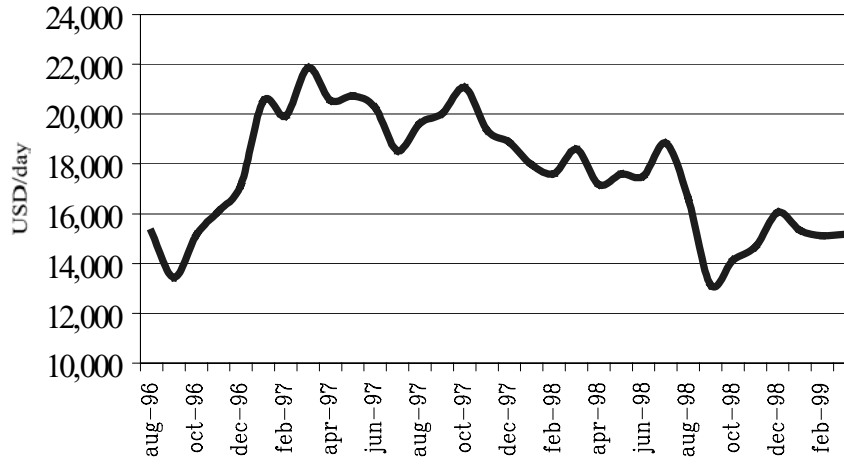
	Classification criteria										
	90%			75%			60%				
Sector	Mean	SD	No	Mean	SD	No	Mean	SD	No	Skew	Kurt
Bulk	−2.18	1.22	6	−1.79	1.54	7	−1.88	1.45	8		
Container	−0.85	2.90	7	−0.92	2.45	9	−0.92	2.45	9		
Cruise	3.04	1.32	3	3.04	1.32	3	2.93	1.10	4		
Drilling	0.32	1.12	7	0.32	1.12	8	0.33	1.05	9		
Ferry	−0.05	2.73	11	−0.47	2.60	15	−0.14	2.61	17		
Offshore	0.17	1.67	7	0.17	1.54	8	0.25	1.38	10		
Shipping	−1.68	3.79	34	−1.77	3.90	30	−2.01	3.76	30		
Tanker	−2.53	2.50	12	−2.53	2.50	12	−2.46	2.41	13		
Yard	0.60	0.46	4	0.23	1.10	6	0.23	1.00	7		
Diversified	−0.50	1.57	17	−0.12	1.72	10	N/A	N/A	N/A		
All	−0.92	2.85	108	−0.91	2.86	108	−0.91	2.86	107		
MSCI-All	1.42	4.50								−1.61	4.19
MSCI-Sh	0.28	6.34								4.19	3.65

SD = Standard Deviation, No = Number of companies classified under each sub-sector,
Skew = Coefficient of Skewness, Kurt = Coefficient of Kurtosis, MSCI-All and MSC-Sh are the Morgan Stanley All Country World Index and the Shipping Index, respectively.
Under the 60% criterion, the Diversified sector only contained one company (Wilh Wilhelmsen) and this sector was, therefore, dropped.

The MSCI All Country World Index is calculated as a market capitalization weighted average of equity returns in 51 countries (23 developed and 28 emerging) and is quoted in gross form inclusive of dividends. The MSCI Shipping Index is one of the 38 industry indices produced by Morgan Stanley. Companies are classified based on their principal economic activity, as determined by the breakdown of earnings, which is in line with the classification method of maritime companies into sectors in this paper. If no detailed earnings data are available, then breakdown of sales data are used. In defining industries, MSCI attempts to construct homogeneous groups which are expected to react similarly to economic and political trends and events. Logarithmic monthly market percentage returns, R_{Mt}, are calculated for both the MSCI All Country World Index and the MSCI Shipping Index using equation (6), with the dividend part being excluded. The US 3-month Treasury bill rate is used as a measure of the global risk free rate of interest, R_{Ft}. Table 2 presents summary statistics for average equity returns by the maritime sector and for the returns on the MSCI world and shipping indices for the period July 1996–July 1999.

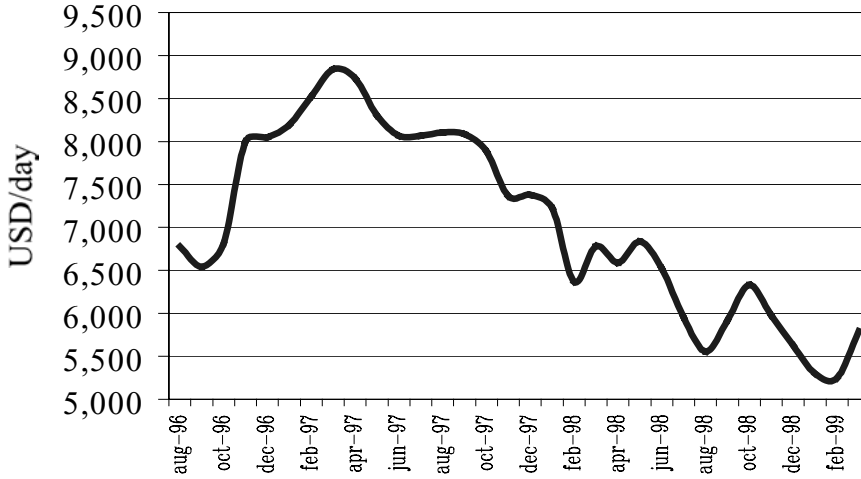
Both the MSCI All Country World Index and the Shipping Index have positive average monthly returns over the sample timeframe; however the Shipping Index under-performs the All Country World Index and has higher volatility than the latter. Both indices have negatively skewed and leptokurtic distributions. Turning next to returns in maritime sectors, it can be seen that most sectors performed poorly over the sample period, with six out of the 10 sectors showing negative average monthly returns, including the 'all' sector category.

The tanker sector seems to be the worst performer, followed by Bulk, Shipping and Container. Figures 1, 2 and 3 give an idea of how revenues in the Tanker, Bulk and Container markets faired over the sample timeframe. Although all three performed well up until early 1997, they declined steadily after that. Therefore, although alarming, the negative average monthly returns are, nonetheless, not unexpected. The Cruise sector appears to be the best performer. However, it should be noted that this sector has the fewest members—only four companies with the 60% classification criteria and three at the 75 and 90% criteria. Nevertheless, it is also true that this



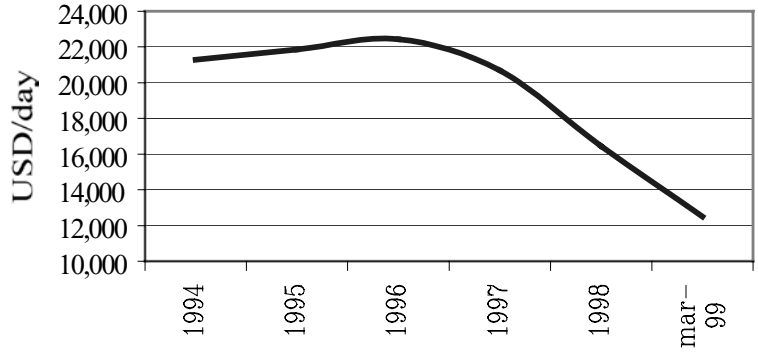
Source: Clarkson Research

Figure 1. Weighted average tanker earnings.



Source: Clarkson Research

Figure 2. Weighted average bulk carrier earnings.



Source: Clarkson Research

Figure 3. Average 1-year T/C freight rates FCC 2750 TEU.

sector has enjoyed considerable prosperity and growth over the sample timeframe and, therefore, this result is again not unexpected. Also showing positive average monthly returns are the Yard, Drilling and Offshore sectors.

The fact that the Yard sector has enjoyed positive returns whilst most other shipping sectors have suffered negative returns is not totally unexpected. If the sample timeframe is considered as the 'collapse' phase of the shipping cycle, it is not unreasonable to expect that yards would be busy completing orders placed during the previous 'peak' of the cycle. The Drilling and Offshore sectors are probably more correlated with the oil price than with other shipping sectors. Whilst both negative, the average monthly return of the Diversified sector (which contains companies with up to 40% of revenue attributable to non-shipping or non-shipping related activities) is higher than that of the Shipping sector (which contains companies with over 90% of revenue attributable to diverse shipping or shipping related

activities). This would suggest that companies that diversified outside of shipping or shipping-related activities performed better over the sample timeframe.

All sectors have lower total risk (SD) than the MSCI world index. The Shipping sector exhibits the highest total risk, followed by Ferry and then Tanker. Interestingly, sectors with positive average monthly returns generally exhibit relatively low total risk when compared to sectors with average monthly returns that are negative. However, the Bulk sector is the exception to this, having one of the highest negative average monthly returns and relatively low total risk. The Yard sector has the lowest total risk followed by the Drilling sector.

4. Systematic risk and CAPM results

As company-specific risks may be diversified through portfolio formation, one should consider market or systematic risks (β), rather than total risk (standard deviation) as the metric of risk for each sector. The CAPM of equation (3) provides the tool to measure these. Tables 3 and 4 show the average (over companies in each sector) CAPM parameters estimated for each sector across classification criteria (90, 75 and 60%), together with their standard errors in brackets and average R^2 values for the regression of excess stock returns against the excess return over the MSCI All Country World and Shipping Indices, respectively.

Table 3. Average sector CAPM parameters across classification criteria for regression against MSCI All Country World Index; July 1996–July 1999.

	Classification criteria								
	90%			75%			60%		
Sector	α	β	R^2	α	β	R^2	α	β	R^2
Bulk	−3.07**	0.46*	0.02	−2.87**	0.66**	0.08	−2.98**	0.68**	0.06
	(0.65)	(0.19)		(0.58)	(0.26)		(0.52)	(0.22)	
Container	−2.04	0.76**	0.10	−2.07**	0.73**	0.08	−2.07**	0.73**	0.08
	(1.11)	(0.25)		(0.81)	(0.17)		(0.81)	(0.17)	
Cruise	1.63	0.99**	0.17	1.63	0.99**	0.17	1.72*	0.78**	0.13
	(0.94)	(0.17)		(0.94)	(0.17)		(0.67)	(0.24)	
Drilling	−1.45**	1.33**	0.12	−1.45**	1.33**	0.12	−1.42**	1.32**	0.12
	(0.45)	(0.15)		(0.42)	(0.14)		(0.37)	(0.12)	
Ferry	−1.13	0.65**	0.08	−1.56**	0.67**	0.07	−1.19	0.63**	0.08
	(0.86)	(0.15)		(0.72)	(0.16)		(0.69)	(0.15)	
Offshore	−1.51**	1.25**	0.17	−1.53**	1.27**	0.17	−1.50**	1.32**	0.17
	(0.56)	(0.22)		(0.49)	(0.19)		(0.39)	(0.15)	
Shipping	−2.78**	0.67**	0.07	−2.83**	0.64**	0.07	−3.09**	0.66**	0.06
	(0.66)	(0.13)		(0.73)	(0.14)		(0.70)	(0.13)	
Tanker	−3.47**	0.52**	0.07	−3.47**	0.52**	0.07	−3.31**	0.43**	0.07
	(0.79)	(0.18)		(0.79)	(0.18)		(0.75)	(0.19)	
Yard	−0.08	0.26	0.03	−0.53	0.34	0.03	−0.75	0.56	0.05
	(0.36)	(0.28)		(0.56)	(0.19)		(0.52)	(0.28)	
Diversified	−1.74**	−0.81**	0.08	−1.37**	0.83**	0.09			
	(0.43)	(0.17)		(0.59)	(0.22)				
All	−2.10**	0.75**	0.10	−2.08**	0.75**	0.10	−2.08**	0.75**	0.09
	(0.28)	(0.06)		(0.28)	(0.06)		(0.28)	(0.06)	

Figures in brackets are standard errors.
* and ** indicate significance at the 10% and 5% levels, respectively.

Table 4. Average sector CAPM parameters across classification criteria for regression against MSCI Shipping Index; July 1996–July 1999.

	Classification criteria								
	90%			75%			60%		
Sector	α	β	R^2	α	β	R^2	α	β	R^2
Bulk	−2.56**	0.48**	0.06	−2.15**	0.61**	0.10	−2.24**	0.64**	0.11
	(0.50)	(0.12)		(0.59)	(0.17)		(0.52)	(0.15)	
Container	−1.33	0.68**	0.13	−1.29	0.54**	0.10	−1.29	0.54**	0.10
	(1.07)	(0.18)		(0.82)	(0.17)		(0.82)	(0.17)	
Cruise	2.67*	0.53	0.08	2.67*	0.53	0.08	2.55**	0.43*	0.07
	(0.75)	(0.19)		(0.75)	(0.19)		(0.54)	(0.17)	
Drilling	0.03	1.59**	0.35	0.03	1.59**	0.35	0.04	1.58**	0.35
	(0.40)	(0.09)		(0.40)	(0.09)		(0.35)	(0.08)	
Ferry	−0.16	0.51**	0.10	−0.84	0.56**	0.10	−0.52	0.52**	0.09
	(0.86)	(0.12)		(0.67)	(0.13)		(0.63)	(0.12)	
Offshore	−0.14	1.30**	0.30	−0.14	1.35**	0.32	−0.05	1.37**	0.33
	(0.63)	(0.25)		(0.55)	(0.22)		(0.44)	(0.17)	
Shipping	−2.04**	0.59**	0.12	−2.14**	0.60**	0.12	−2.38**	0.61**	0.12
	(0.64)	(0.09)		(0.71)	(0.09)		(0.69)	(0.09)	
Tanker	−2.90**	0.63**	0.11	−2.90**	0.63**	.011	−2.82**	0.59**	0.10
	(0.72)	(0.11)		(0.72)	(0.11)		(0.66)	(0.11)	
Yard	0.21	0.33	0.04	−0.16	0.34*	0.04	−0.15	0.45**	0.05
	(0.23)	(0.16)		(0.44)	(0.15)		(0.37)	(0.17)	
Diversified	−0.85**	0.74**	0.16	−0.47	0.78**	0.19			
	(0.38)	(0.15)		(0.54)	(0.20)				
All	−1.27**	0.72**	0.14	−1.27**	0.72**	0.14	−1.27**	0.72**	0.14
	(0.28)	(0.06)		(0.28)	(0.06)		(0.10)	(0.04)	

Figures in brackets are standard errors.
* and ** indicate significance at the 10% and 5% levels, respectively.

The R^2 values range from 0.02–0.35, indicating that little of the stocks' behaviour is explained by the MSCI Indices. R^2 values in table 4 are higher than those in table 3—signifying that the MSCI Shipping Index explains more of the stocks' behaviour than the MSCI All Country World Index. The only exception is the Cruise sector, which has a lower R^2, indicating that the behaviour of the stocks in this sector is explained more by the MSCI All Country World Index than by the MSCI Shipping Index. This is a reasonable result given the dependence of this sector on disposable incomes and the tourist industry.

Turning next to the values of the average αs, which indicate possible mis-pricing of stocks in each sector when they are different from zero, one observes the following: When the MSCI All Country World Index is used in the CAPM regression, all sectors have a negative α (with the exception of Cruise). Examining statistical significance, the α for the Container (under the 90% criterion), Cruise, Ferry (under the 90 and 60% criteria) and Yard sectors are statistically zero, indicating correct pricing of stocks. The other sectors (Bulk, Drilling, Offshore, Shipping, Tanker and Diversified) all have significantly negative α values, implying over-pricing. This is also the case for the 'All' sector, which considers all the maritime sectors together.

When regressed against the MSCI Shipping Index, significance tests show that the αs for the Container, Cruise, Drilling, Ferry, Offshore and Yard sectors are statistically zero, implying that these sectors are in fact correctly priced. The

Bulk, Shipping and Tanker sectors have significantly negative α values, indicating overpricing. The overall average of all the α values is also significantly negative, implying overpricing of maritime stocks. Thus, more sectors appear to be correctly priced when the shipping index is used as the basis for estimation in comparison to the All share index. It seems then that the choice of the index can lead to different results regarding the question of fair pricing of stocks and may affect the evaluation of maritime fund managers performance as a consequence.

Turning next to the values of the β coefficients obtained when the All Country Index is used in the CAPM regression, one observes that all sectors, with the exception of Yard (and Cruise when the Shipping Index is used), have β values that are significantly different from zero (one other exception is the Bulk sector under the 90% criterion). Overall, the Drilling sector has the highest β value (1.33), closely followed by the Offshore (1.25) sector for all three classification criteria. This makes sense because these are the sectors that show the highest average monthly returns and, therefore, would be expected to have the highest market risk. The other sectors have β values which are numerically smaller than 1. For the 90% classification criterion, the Yard sector has the lowest β value (0.26), followed by the Bulk sector (0.46) and then the Tanker (0.52), Ferry (0.65), Shipping (0.67) and Container (0.76) sectors when the all market index is used, whilst, when the shipping index is utilised, the Yard sector still has the lowest β value (albeit higher, 0.33), followed by the Bulk (0.48) and Ferry (0.51) sectors.

Across classification criteria, the sector β values show no clear pattern. As the percentage of the core activity required for classification in a sector increases, some sector β values increase, some decrease and some remain the same. For instance, the Container, Cruise, Drilling and Tanker sectors have β values which increase with increasing specialization. The Bulk, Offshore and Yard sectors have β values that decrease, while the β for the Ferry sector increases then decreases and the β for the Shipping sector does the reverse. The results are similar when the Shipping Index is used to estimate the CAPM. It seems then that the extent of diversification/specialization of maritime companies can either increase or decrease market risk according to the sector being investigated. The analysis in this paper then helps to identify differences in market risks between sectors and how they change as companies specialize or diversify within each sector.

An interesting question for stock selection in portfolio formation is the comparison of the β values for each sector with that of the market (one), as it would indicate whether sectors carry above or below average market risk. Results show that only the Drilling sector has β values that are significantly higher than one for both the All share and the shipping indices, except when the 90% classification criterion is used in the All share index. The Container (only for the 90% criterion when the Shipping Index is used), Cruise, Diversified and Offshore sectors have β values that are not statistically different from one, as does the Bulk sector (except when classified under the 90% criterion for the All share index and the 75% criterion for the Shipping index, when it is less than 1), implying that these sectors exhibit average market risk. This indicates that these sectors have the same risk as the market. For the Shipping, Tanker and Ferry (except for the 75% criterion in the All share index) sectors, the β value is significantly lower than one, signifying that these sectors exhibit less than market risk. Also, the Bulk sector, as mentioned above, shows some evidence of below average systematic risk and so does the Container sector when using the Shipping Index and under both the 75 and 60% criteria. The Yard sector results

are unreliable due to the small number of companies, which results in large standard errors; as a consequence, both the nulls of 0 and 1 are not rejected. Finally, for the 'All' sector, bundling all maritime sectors together, the β values are significantly lower than unity, implying that on average maritime stocks exhibit below average market risk.

This is in line with the results reported for the US water transportation stocks in Kavussanos and Marcoulis [6], where they find evidence of both equal and below average market risk for the sector. It seems that the formation of international portfolios—covering stocks listed across country borders—in the industry makes the result of below average market risk more of a certainty and is in line with what one would expect *a priori* from international portfolio diversification.

Equation (5) is used to test whether sector β values differ significantly from each other. Broadly speaking, the results for both the MSCI All and Shipping Indices are as follows: For the 60 and 75% classification criteria, the Drilling and Offshore sectors have average β values which are significantly higher than all the other sectors but not significantly different from each other. For the 90% classification criterion, when the All Country Index is used, the Drilling and Offshore sectors cease to be significantly different from the Cruise sector, the Offshore sector ceases to be significantly different from the Container and Diversified sectors, while the Drilling sector continues to be significantly higher than these two sectors.

5. Further discussion

From the comparison of sector β values, for both the regression against the MSCI All Country World Index and the MSCI Shipping Index, it is clear that the Drilling and Offshore sectors have average β values that are consistently higher than all other sector β values, but not significantly different from each other. This suggests that these sectors exhibit a higher degree of market risk than all the other sectors. If this is the case, it should be expected that, on average, these sectors produce the highest returns. However, this is not found to be true, as the Cruise sector produces the highest average monthly return, followed by the Yard sector.

Also, while the average β values for the Drilling and Offshore sectors seem to be significantly different from all other sectors, only the Drilling sector average β is significantly greater than the market β value of one. This suggests that the Drilling sector has the highest risk and it should, therefore, have the highest return. Again, this does not seem to be true, as the Cruise sector shows the highest average monthly return.

When regressed against the MSCI All Country World Index, the β value for the Cruise sector becomes insignificantly different from the Drilling and Offshore sectors, as the companies that make up the sectors become more specialized (i.e. as the sector classification criterion increases from 60 to 75 to 90%). This could be interpreted as suggesting that the Cruise sector does in fact exhibit more risk than the other sectors (except Drilling and Offshore), even though its β value remains insignificantly different from the β values of these sectors.

It is, therefore, apparent that the Drilling, Offshore and Cruise sectors exhibit different risk/return characteristics than the other sectors. It may be possible to explain this difference by considering the market fundamentals of these sectors together with their supply/demand characteristics. Demand for the Offshore and Drilling sectors is influenced, amongst other things, by the price of crude oil and natural gas. Even if it can be argued that the crude oil price is set by politics in the

short run, it is set by demand—the world economy—in the long run. Consequently, it is reasonable to assume that these two sectors are probably more correlated with the world economy than with the shipping industry. Indeed, this argument is given further weight when one considers that these two sectors have the highest R^2 values of all sectors for the regressions against the MSCI All Country World Index.

It could also be argued that the demand for the Cruise sector is also more correlated with the world economy than with the shipping industry. If the world economy is prosperous then disposable income should be high, leading to an increase in the demand for tourism and travel. Certainly, the fact that the R^2 value for the Cruise sector is higher for the regression against the MSCI All Country World Index than for the regression against the MSCI Shipping Index implies that this sector is indeed more correlated with the world economy than with the shipping industry.

It is interesting that no significant difference could be found in the β values for the Bulk, Tanker, Container and Ferry sectors for either the regression against the MSCI All Country World Index or the MSCI Shipping Index. All these sectors have higher R^2 values when regressed against the MSCI Shipping Index than when regressed against the MSCI All Country World Index. This means that more of the behaviour of the stocks in these sectors is explained by what is happening in the shipping industry than by the world economy. This is as expected, although it should be remembered that the performance of the shipping industry itself is probably dependent on the state of the world economy in any case.

The β values for the Tanker and Bulk sectors were found to be consistently significantly less than one when estimated both from the regressions which used the MSCI All Country World Index and the MSCI Shipping Index. This suggests that these two sectors exhibit relatively low levels of market risk—a result that seems odd given that all these sectors showed negative average monthly returns. However, the low R^2 values for these sectors show that there is little correlation between the stocks in these sector and the world economy or the shipping industry. This first statement is perhaps not surprising when one considers that the lagged delivery of new tonnage can result in these markets moving out of phase with the world economy driving them. However, one would expect these sectors to be more highly correlated with the shipping industry in general.

The result for the Ferry sector is similar to that for the Bulk and Tanker sectors. Its β value is found to be consistently significantly less than one both when extracted from the regressions against the MSCI All Country World Index and the MSCI Shipping Index. On one level it could be argued that the demand for the Ferry sector should be correlated with the demand for the Cruise sector given that both are dependent on the demand for tourism and travel. However, the Ferry sector also derives revenue from freight and in this sense it is also reasonable to argue that the risk/return profile of this sector should be more like that of the Bulk, Tanker and Container sectors. Furthermore, the Ferry sector is probably at a more mature stage in its market cycle than the Cruise sector and, as such, has a more stable demand. This argument is corroborated by the fact that the Cruise sector has been going through a period of rapid expansion over the last few years, something that has not been evident in the Ferry sector.

When using the MSCI All Country World Index in the regression, the amount of risk exhibited by the Container sector was found to be insignificantly different from that of the market. This was also found to be the case when the sector was classified

using the 90% classification criterion and stock returns were regressed against the MSCI Shipping Index. This suggests that the Container sector may exhibit more risk than the Ferry and Tanker sectors (because these sectors were found to exhibit significantly less than market risk for both regressions), although no significant difference was found when comparing the β values of the sectors directly. This result is hard to explain—it could be argued that the structure of the Container market should make it relatively low risk. Certainly conferences and alliances, cartels and tariffs act as barriers to entry and make the Container sector anything but a perfect market. Again, the lagged delivery of new tonnage may explain why this sector is moving out of phase with the market. Generally, the fact that the sample size was so small for this sector means that the results should be viewed with a degree of caution.

The Yard sector exhibits a wide variety of results. Again, this may be explained by the small sample and that some of the companies in the sample were favoured by government subsidies over the period, thus interfering with market factors. Orders placed during prosperous periods help this sector during periods of recession.

No significant difference could be found between the β of the Shipping sector and the β of the Diversified sector. This suggests that there is no difference in market risk for shipping or shipping related companies that diversify their activities within shipping or outside shipping. However, although there is no significant difference between them, the β for the Shipping sector was found to be significantly different from the market for both regressions, but the β for the Diversified sector was not. Looking at the results in this way, and given that the β value for the Diversified sector is numerically higher that that for the Shipping sector, it could be argued that the Diversified sector does exhibit more market risk. This seems logical considering that the average monthly return of the Diversified sector was higher than that of the Shipping sector. This also makes sense given that this study has found that, on average, shipping stocks exhibit significantly less than average market risk.

6. Conclusions

The aim of this paper has been to investigate the risk-return profiles of sub-sectors of the international shipping industry. Replies from an extensive questionnaire survey, regarding core business activities of public companies in the industry, have been supplemented with annual report and company web-site information to classify companies into sub-sectors. Three classification criteria (90, 75 and 60%) were used to that effect, in order to identify possible differences in the risk-return profiles of each sector as the degree of diversification changed. Both an All Country World Index and a World Shipping Index have been used in the analysis.

During the 1996–1999 period analysed, when the shipping industry was not doing particularly well, companies in sectors were broadly overpriced and average returns seemed to be negative. Market βs for all the stocks in the industry appeared to be significantly lower than the market. The Drilling and the Offshore sectors were significantly higher than one, however all other average sector βs appeared to be either equal or lower than the market average. The sectors that appeared to have βs which were significantly lower than the market are the Shipping, Tanker, Ferry and also Bulk and Containers mostly. It seems then that the maritime industry stocks do not carry above average market risk, at the international setting.

In comparing the βs amongst sectors, it seems that the Drilling and Offshore sectors have the same proportion of systemic risk in them. The β values of these sectors do not differ significantly from each other but are significantly different from

all the other sector β values except for Cruise. However, the Cruise sector β, whilst not significantly different from Drilling and Offshore, is not significantly different from any other sector. There is no significant difference in the β values of the remaining sectors (Bulk, Container, Ferry, Shipping, Tanker, Yard, Diversified and All). When regressed against the MSCI Shipping Index, the Drilling and Offshore sectors again appear to have the same degree of market risk in them. There is no significant difference in the β values of all other remaining sectors.

Finally, as more companies in the industry become public the scope for increased sample sizes for each sub-sector of the maritime industry on which to base inferences will also increase. Perhaps a further study when more data is available and also when market conditions are different (on the upturn) may add to the body of knowledge established with this paper.

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References and notes

1. Kavussanos, M. G. and Marcoulis, S., 1997, Risk and return of US water transportation stocks over time and over bull and bear market conditions. *Maritime Policy & Management*, **24**, 145–158.
2. Kavussanos, M. G. and Marcoulis, S., 1997, The stock market perception of industry risk and microeconomic factors: the case of the US water transportation industry versus other industries. *Transportation Research, Part E*, **33**, 147–158.
3. Kavussanos, M. G. and Marcoulis, S., 1998, Beta comparisons across industries—a water transportation industry perspective. *Maritime Policy & Management*, **25**, 175–184.
4. Kavussanos, M. G. and Marcoulis, S., 2000, The stock market perception of industry and macroeconomic factors: the case of the US water transportation industry versus other transport industries. *International Journal of Maritime Economics*, **2**, 235–256.
5. Kavussanos, M. G. and Marcoulis, S., 2000, The stock market perception of industry risk through the use of a multifactor model. *International Journal of Transport Economics*, **XXVII**, 77–98.
6. Kavussanos, M. G. and Marcoulis, S., 2001, *Risk and Return in Transportation and other US and Global Industries* (The Netherlands: Kluwer Academic Publishers).
7. Sharpe, W., 1964, Capital asset prices: a theory of market equilibrium under conditions of risk. *Journal of Finance*, **19**(3), 425–442.
8. Lintner, J., 1965, The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*, **47**, 13–37.
9. Markowitz, H. M., 1952, Portfolio selection. *Journal of Finance*, **1**, 77–91.
10. Markowitz, H. M., 1959, *Portfolio Selection: Efficient Diversification of Investments* (New York: Wiley). Also, 1991 (Cambridge, MA: Basil Blackwell).
11. Miller, M. H. and Scholes, M., 1972, Rates of return in relation to risk: a re-examination of some recent findings. In *Studies in the Theory of Capital Markets*, edited by M. C. Jensen (New York: Praeger).
12. Black, F., Jensen, M. C. and Scholes, M., 1972, The capital asset pricing model: some empirical tests. In *Studies in the Theory of Capital Markets*, edited by M. C. Jensen (New York: Praeger).
13. That is, of companies in the sector listed in stock exchanges around the world, internationally.
14. King B., 1966, Market and industry factors in stock price behaviour. *Journal of Business*, January, **39**(1), 139–190.

15. Nerlove, M., 1968, Factors affecting differences among rates of return on investments in individual common stocks. *The Review of Economics and Statistics*, **50**, 312–331.
16. Fabozzi, F. and Francis, J., 1979, Industry effects and the determinants of beta. *The Quarterly Review of Economics and Business*, **19**, 61–74.
17. Capaul C., 1999, Asset pricing anomalies in global industry indexes. *Financial Analysts Journal*, July/August, **55**(4), 17–37.
18. Weiss, R. A., 1998, Global sector rotation: new look at an old idea. *Financial Analysts Journal*, May/June, **54**(3), 6–8.
19. One of the sectors included in the analysis involves drilling. As an anonymous referee pointed out, this is a shipping-related business—affecting indirectly the freight market. The demand and supply side of the sector are affected by conditions which are outside those of the freight market. However, the outcome of the sector does affect the supply side of the freight market. Strictly speaking, this is the case for all sub-sectors distinguished in table 1. For instance, the economics, including the risk-return profiles, for bulk, container and tanker shipping, just to pick three sectors analysed in the paper, are very different between them—see for e.g. Kavussanos, M. G., 2002, Business risk measurement and management in the cargo carrying sector of the shipping industry. In *Maritime Economics and Business*, edited by C. Grammenos (Lloyds of London Press), Ch. 30, pp. 661–692.. Also, the same argument holds for the cruise sector, which is related to the economics of the international leisure industry, as well as shipping. However, all these sectors have been selected for analysis, because they all have some impact on various parts—sectors of the shipping industry.
20. *Lloyds List* obtain their stock price information from Bloomberg's classification list.
21. Accordingly, some companies known to have major shipping or shipping-related interests were excluded because they were too diversified elsewhere.
22. A list of companies by sector for each classification criterion is available from the authors on request.