# Measuring Business Peformance in Shipping

## 1. Introduction

The success or failure of any business depends to a large extent on valid and reliable assessment of performance. Despite the importance of performance measurement, there is a relative gap in the context of the shipping industry. The gap is reflected in the absence of a consistent and coherent stream of research and literature that deal with the issue of how shipping companies measure their performance and what techniques, methods and measures are actually available to improve the process and outcomes of performance measurement. For instance, performance may be related to economic or financial performance and measured using accounting ratios or other financial measures. Performance may also be related to efficiency and the effective utilisation of inputs into a production process, which in this case, includes not only the provision of transportation services but also the process of managing the transportation business and the performance of the business entity. A key issue in the context of the shipping industry is to develop a stream of research that would deal with the different approaches to performance measurement and their application to the major sectors of the shipping industry viz. dry bulk, tanker and container shipping. A stream of research dealing with the measurement of business performance in shipping would also provide useful managerial implications, not least because it will enable managers to assess the performance of their companies and operations and therefore provide a basis for further improvement.

## 2. Approaches to Performance Measurement: A Literature Review

Performance measurement of organisations has received extensive attention in the literature, since firm performance is the bottom line of a business. Performance reflects the outcome of the implementation of any strategic task and whether such outcome is deemed to be successful or disastrous.

One of the most widely used operational measures for evaluating firm performance is market share, which also serves as a surrogate measure of firm profitability (Tanriverdi and Lee, 2008). Studies that have focused on sectors characterised by network externalities, customer switching costs, and lock-in have used market share as a performance measure. A firm's market share is measured as the sum over all product markets of the sales-weighted shares of each market (Tanriverdi and Lee, 2008). Other studies, however, have used subjective means to capture market share and proved that subjective measures are as good as the objective ones. Jain and Bhatia (2007), adopting the method of previous studies, have used a "structured non-disguised" questionnaire which requires respondents to state their perceptions on their firm's market share on a five-point Likert scale.

Nonetheless, most studies in the literature have consistently used accounting-based ratios or measures to assess firm performance. Such measures include Return on Assets (ROA) (Hawawini, Subramanian and Verdin, 2003; Short, *et al.*, 2007; O'Sullivan and Abela, 2007; Morgan, Vorhies and Mason, 2009), Return on Investment (ROI) (Hult, Ketchen and Slater, 2005; Nadkarni and Narayanan, 2007), Return on Capital (ROC) (Capon *et al.*, 1988), Return on Sales (ROS) (Makino, Isobe and

Chan, 2004; Boone and Hendricks, 2009), Return on Equity (ROE) (Luo, Aric and Tse, 2007; Hult, Ketchen and Slater, 2005), Return on Capital Employed (ROCE) (Rajagopalan, 1997), and Return on Invested Capital (ROIC) (Christensen and Montgomery, 1981).

Accounting-based measures have been criticised by researchers as being unsuitable for assessing firm performance. They are historic in nature and do not focus on the firm's future performance or potential. What is more, the differences in accounting policies and in methods of consolidating accounts and the possibility of distortions due to depreciation policies, inventory valuation, and specific treatment of income and expenditure items make their sole use to evaluate firm performance problematic (Chakravarthy, 1986). Hawawini *et al.* (2003) point out that one important aspect of firm performance is the creation of value for the firm's shareholders, in terms of earning returns greater than the cost of capital. However, accounting-based measures do not take into consideration the cost of capital or the replacement value of assets and are thus inadequate to measure the value the firm offers to its shareholders. On top of this, Chakravarthy (1986) suggests that a firm should provide value not only to its shareholders but also to the other stakeholders of the firm, such as customers, employees, and the community, in terms of product or service quality, ability to keep and develop talented people, and responsibility towards the community. Clearly, accounting-based measures do not reflect the value the firm is producing for its stakeholders.

Other studies (e.g. Morgan and Rego, 2009), in an attempt to overcome the disadvantages previously mentioned, have assessed firm performance by using Net Operating Cash Flow (defined as "EBIT + Depreciation – Taxes") and Cash Flow Variability (defined as "the coefficient of variation of the net operating cash flows"). The first reflects current shareholder value and is less dependent on the accounting practices of the firm, while the latter takes into consideration the risk level and captures the stability of a firm's cash flows.

Hawawini *et al.* (2003) measure the economic performance of a firm, instead of the accounting performance. Measures of economic performance are based on the concept of residual income, and take into account capital costs, risk, and the time value of money. Unlike traditional accounting measures, they do reflect shareholder value and are not affected by accounting policies. As measures of performance, Hawawini *et al.* (2003) use Economic Profit (EP) per dollar of Capital Employed (CE) and Total Market Value (TMV) per dollar of Capital Employed (CE), where capital employed is the sum of equity capital and debt capital. The two measures are defined as follows:

$$\frac{EP}{CE} = ROIC - WACC = \frac{NOPAT}{CE} - WACC \qquad (1)$$

where:
ROIC = Return on Invested Capital;
WACC = Weighted Average Cost of Capital;
NOPAT = Net Operating Profit after Taxes;
If ROIC is greater than WACC, economic profit per dollar of capital employed is positive and the firm creates value.

$$\frac{TMV}{CE} \qquad (2)$$

Where:

TMV = Sum of the firm's market capitalisation (market value of equity) and the market value of its debt;

If TMV is greater than CE, the firm is deemed to have increased the value of capital invested in the firm and created value.

Many other studies (Griffith, 2004; Bacidore, *et al.*, 1997; Ryan and Trahan, 2007) use economic profit-related performance measures, such as Economic Value Added (EVA), Refined Economic Value Added (REVA), Shareholder Value Added (SVA) or Cash Flow Return on Investment (CFROI). One of the most important economic performance measures is Economic Value Added (EVA), which was developed by Stern Stewart & Co. EVA is defined as "NOPAT – Cost of Capital* Amount of Capital" and it attempts to relate the firm's accounting data to its stock price. Value-based performance systems are deemed significant in the performance measurement literature, as they drive value creation (Hawawini *et al.*, 2003).

Another important market-based measure, which is widely used to assess firm performance, is Tobin's Q (Short *et al.*, 2007; Chari, Devaraj and David, 2008; Uotila *et al.*, 2009). Tobin's Q is defined as "the sum of the market value of equity, the book value of debt, and deferred taxes divided by the book value of total assets minus intangible assets" (Thomas and Waring, 1999). Tobin's Q compares a firm's market value with the replacement value of its assets; it reflects the investors' views on how the firm will generate value. A value of Tobin's Q greater than 1 implies that the investors assess that the firm will generate greater value from its asset stock than if the assets were deployed outside the firm (McGahan, 1999).

Heiens, Leach and McGrath (2007) use market adjusted holding-period returns (HPR) to assess firm performance. The market adjusted HPR is defined as "the compounded market holding period return minus the compounded stock holding period return". Other studies (e.g. Brammer and Millington, 2009) use risk-adjusted HPR as a performance measure, since it takes into consideration the risk of share ownership. This is defined as:

$$\frac{\frac{(P_t - P_{t-1}) + DIV_t}{P_{t-1}} - RISKFREE_t}{\sigma\left(\frac{(P_t - P_{t-1}) + DIV_t}{P_{t-1}}\right)}$$

where:

$P_t$= The market price of the firm's share at time t

$P_{t-1}$= The market rice of the firm's share at time t-1

$DIV_t$ = The dividend paid by the firm at time t

$RISKFREE_t$= The rate of return for a government bond at time t

Nevertheless, many researchers are of the view that there is no single accounting or financial measure that can adequately capture all aspects of firm performance. Therefore, instead of relying on only one measure to determine firm performance, a multi-factor model should be used. Altman's Z is one such multi-factor performance-measurement model. Altman's Z, an established measure of credit default risk, has received increasing consideration in the literature of performance measurement (Short *et al.*, 2007; Craighead, Hult and Ketchen, 2009). Bankruptcy is considered by more and more managers as a

strategic alternative (Short *et al.*, 2007); thus a measure which incorporates this tendency is significant when appraising firm performance in order that the prospects for firm survival are captured (Altman *et al.*, 1981).

Altman's Z is calculated as follows:

$$Z = \frac{1.2*a + 1.4*b + 3.3*c + d}{e} + \frac{0.6*f}{g}$$

where:
a = working capital
b = retained earnings
c = operating income
d = sales
e = total assets
f = net worth
g = total debt

According to Chakravarthy (1986), Altman's Z can be a valuable index of the firm's well-being, since by measuring the distance from bankruptcy, the Z factor can be a surrogate measure of strategic performance. However, Altman's Z is flawed in the sense that a well-managed firm does not devote all of its resources only in the avoidance of bankruptcy. Moreover, the calculation of the Z factor is mostly an empirical result rather than the result of theory.

Hence, an alternative multi-factor measure has been proposed by Chakravarthy (1986). Chakravarthy (1986) deals with the term "firm excellence" and asserts that strategic management is the process through which managers ensure the long-term adaptation of the firm to its environment. In this way, the useful measures of performance are those that help assess the quality of the firm's adaptation to its changing environment. A firm needs to be evaluated on the basis of how well it serves all of its stakeholders (not just its stockholders) and of how well it manages the net surplus of its slack resources. The slack resources will improve the firm's ability to adapt to uncertain or unknown future events. Therefore, the firm should be able to transform itself and adjust to the changing environment around it. Chakravarthy (1986) selects eight slack variables to represent the ability of firm transformation: Cash Flow to Investment ratio, Sales by Total Assets, R&D by Sales ratio, Market to Book Value, Sales per Employee, Debt by Equity ratio, Working Capital by Sales ratio, and Dividend Payout ratio.

Despite the widespread use of the various financial measures mentioned above, there has been increased use of non-financial measures to evaluate firm performance. Proponents of such measures insist that non-financial measures are better predictors of long-term performance than financial measures and help management focus on the long-term effects of their actions (Banker, Potter and Srinivasan, 2000). One of the most important non-financial measures used is customer satisfaction (Ittner and Larcker, 1998; Banker *et al.*, 2000; Jain and Bhatia, 2007). Other measures include productivity (Koka and Prescott, 2008), product quality (Wisner, 2003), and manufacturing-related measures, such as cycle time, lead time, setup times or inventory turnover (Perera *et al.*, 1997; Dehning *et al.*, 2007).

One of the most important performance measurement systems in the literature is the Balanced

Scorecard (Kaplan and Norton, 1992; Hult *et al.*, 2008). Kaplan and Norton (1992) assert that no single performance measure can incorporate all the critical areas of a business; thus, they developed four sets of perspectives that the firm should focus on to evaluate its performance. These perspectives are: customer performance, financial performance, internal process performance, and innovation and learning performance. The measures which will be included in each category will depend on the firm, its goals, and the type of business it is into, but could include lead time, on-time delivery, growth, profitability, cycle time, productivity or ability to launch new products. The Balanced Scorecard's effectiveness lies in the fact that it reduces information overload, as it limits the number of measures used and that it ensures the optimisation of the whole system, instead of the subsystem. Table 1 presents a summary of some key papers in the firm performance measurement literature together with the performance dimensions and indicators used.

## 3. Performance Measurement of Shipping Companies

To determine the extent to which the performance of the maritime industry has been subjected to systematic examination, a key word search in the electronic databases of the major shipping/transport journals was undertaken. The journals targeted include Maritime Policy and Management (MPM), Transportation Research (Part A and Part E), Journal of Transport Economics and Policy (JTEP), Transport Policy (TP), Transport Reviews (TR), and Maritime Economics and Logistics (MEL, formerly

*Table 1:* Performance dimensions and indicators

| Performance dimension | Performance indicator | Indicative literature |
|---|---|---|
| *Competition performance* | Sales growth | Tanriverdi and Lee 2008<br>de Luque *et al.* 2008 |
| | Market share | Jain and Bhatia 2007<br>Tanriverdi and Lee 2008 |
| *Financial performance* | ROA | Hawawini *et al.* 2003<br>Short *et al.* 2007<br>O'Sullivan and Abela 2007<br>Morgan, Vorhies and Mason 2009 |
| | ROI | Hult, Ketchen and Slater 2005<br>Nadkarni and Narayanan 2007 |
| | ROC | Capon *et al.* 1988 |
| | ROIC | Christensen and Montgomery 1981 |
| | ROCRR, defined as ROIC to std dev of ROIC | |
| | ROCE | Rajagopalan 1997 |
| | ROS | Makino, Isobe and Chan 2004<br>Boone and Hendricks 2009 |
| | ROE | Luo, Aric and Tse 2007<br>Hult, Ketchen and Slater 2005 |
| | Return on replacement assets, defined as "EBIT to denominator of Tobin's Q" | McGahan 1999 |
| | P/E ratio | Mehra 1996 |
| | Common stock price change | Fogler and Nutt 1975 |
| | EBITOA, defined as Earnings before interest and taxes, divided by assets | Wan and Hoskisson 2003 |
| | Cash flow | Morgan and Rego 2009 |
| | Cash flow variability | Dechow 1994 |
| | Operating Cash Flow (OCF) to Total Assets | Baliga, Moyer and Rao 1996 |

*Table 1:* (Continued)

| Performance dimension | Performance indicator | Indicative literature |
|---|---|---|
| | OCF to Sales | |
| | Operating profit | Banker *et al.* 2000 |
| | Net income | Perera *et al.* 1997 |
| | Net Income growth | Nadkarni and Narayanan 2008 |
| | Economic profit to Capital employed | Hawawini *et al.* 2003 |
| | Total market value to Capital employed | |
| | Var (material purchase price) | Perera *et al.* 1997 |
| | Sales | |
| | Compound asset growth | Peters and Waterman 1982 |
| | Compound equity growth | |
| | Market to book value | McDonald *et al.* 2008 |
| | MVA | Griffith 2004 |
| | EVA | Lovata and Costigan 2002 |
| | REVA | Bacidore *et al.* 1997 |
| | SVA | Ryan and Trahan 2007 |
| | CFROI | Madden 1998 |
| | EPS | Gomez-Mejia 1992 |
| | GEPS | Christensen and Montgomery 1981 |
| | Composite index | Bourgeois 1980 |
| | ROVA | Hofer 1983 |
| *Non-financial performance* | Customer satisfaction | Ittner and Larcker 1998<br>Banker *et al* 2000<br>Jain and Bhatia 2007 |
| | Customer loyalty | Morgan and Rego 2009 |
| | Productivity, as sales per employee | Koka and Prescott 2008 |
| | Product quality | Wisner 2003<br>Jain and Bhatia 2007 |
| | Inventory cost | Gunasekaran *et al.* 2001 |
| | Competitiveness | Jain and Bhatia 2007 |
| | Employees' organisational commitment | |

(*Continued*)

*Table 1:* (Continued)

| Performance dimension | Performance indicator | Indicative literature |
|---|---|---|
| | Employees' esprit de corps | |
| | On time delivery<br>Number of customer complaints<br>Labour utilisation/efficiency<br>Product defects<br>Reduction in set-up times<br>Reports on whether standard product costs are met<br>Rate of new product introduction<br>Number of product returns<br>Cycle time<br>Ability to vary product characteristics<br>Machine utilisation and downtime | Perera *et al.* 1997 |
| *Inventory Management Performance* | Purchase material turnover | Kaynak 2003 |
| | Total inventory turnover | Dehning *et al.* 2007 |
| *Quality Performance* | Product/service quality | Crohin and Taylor 1992 |
| | Delivery lead time | Wang *et al.* 2002 |
| *Balanced Scorecard* | Customer perspective<br>Internal business perspective<br>Innovation and learning perspective<br>Financial perspective | Hult *et al.* 2008 |
| *Market-based performance* | Tobin's Q (the sum of the market value of equity, the book value of debt, and deferred taxes divided by the book value of total assets minus intangible assets) | Short *et al.* 2007<br>Chari *et al.* 2008<br>Uotila *et al.* 2009 |
| | Stock market value | Zott and Amid 2008 |
| | Risk-adjusted measure of market performance, defined as (market performance – risk free)/std dev of market portfolio | Brammer and Millington 2008 |
| | Benchmark-adjusted buy and hold abnormal returns | Sorescu and Spanjol 2008 |
| | Std dev of stock returns | |
| | Sharpe ratio<br>Treynor's levered and unlevered ratio<br>Jensen's levered and unlevered ratio | Dubofsky and Varadarajan 1987 |

*Table 1:* (Continued)

| Performance dimension | Performance indicator | Indicative literature |
|---|---|---|
| *Firm survival* | Altman's Z | Short *et al.* 2007<br>Craighead, Hult and Ketchen 2009 |
| *Firm excellence* | *Generation of slack*<br>Cash flow to investment<br>Sales per employee<br>Sales by total assets<br>Market to book value<br>Debt by equity ratio<br>*Investment of slack*<br>R&D by Sales ratio<br>Working capital by sales ratio<br>Dividend payout ratio | Chakravarthy 1986 |
| *Market efficiency* | Data Envelopment Analysis Models Model (inputs: earnings before extraordinary items and discontinued operations, and book value of equity); (outputs: market value – firm's market price * number of shares outstanding) | Tsai *et al.* 1996<br>Collins *et al.* 1999<br>Barth *et al.* 1998 |
| *Operational efficiency* | Data Envelopment Analysis Models Model (inputs: fixed assets (tangible and intangible) – total liabilities); (outputs: revenues – total sales); Model (inputs: profitability as cash flow from operations to total assets and leverage – total liabilities to total assets); (output: asset turnover (revenue to total assets) | |

known as the International Journal of Maritime Economics). The majority of the papers identified examine productivity/efficiency issues related to ports or container terminals. As there are already some good reviews on port/terminal productivity (see, for example, Cullinane, 2002; Panayides *et al.*, 2009), we focus here on the performance of shipping companies. Less than a dozen papers have examined this important issue. We make reference to studies outside of shipping firms where appropriate.

The existing studies on the performance of shipping companies may be divided into three main types: the first branch of the literature focuses on firms' financial performance or operational performance/efficiency, the second on the stock market performance (i.e. risk and return) of the listed firms, and the third on other aspects of performance (e.g. third-party rated performance or self-evaluation of performance). The sub-sections below first review the main research findings of the relevant studies, organised in chronological order. This is followed by an evaluation/critique of the research designs and key results of the said studies. Future research directions and opportunities are then discussed.

### *3.1 Studies of the financial/operating performance of shipping companies*

Randoy, Down and Jenssen (2003) examine the effect of corporate governance mechanisms on the financial performance of 32 publicly traded maritime firms from Norway and Sweden during the period 1996–1998. Using Return on Assets (ROA), Return on Equity (ROE) and Return on Sales (ROS) as the measure of firm performance, they find (through regression analysis) that maritime firms with a founding family CEO have better financial performance than maritime firms with a non-founding family CEO; a high level of board independence enhances profitability in maritime firms; but there is no significant relation between the level of board ownership and firm profitability in

maritime firms, although board ownership control is significant in a control sample of manufacturing firms. The authors focus on cross-sectional analysis and provide minimal evidence on the extent to which the sample maritime companies perform, either in absolute terms or relative to a chosen benchmark. The same criticism applies more or less to the other studies reviewed in this sub-section.

Lam, Yap and Cullinane (2007) investigate the structure, conduct and performance of major liner shipping routes during the period 1998–2002. They measure performance using financial performance indicators such as turnover, operating profit and net profit calculated on a per-TEU basis. The results indicate that different companies experienced varying degrees of success or failure in financial performance during the period under examination, but there is no conclusive evidence of any relationship (based on correlation coefficients) between either structure or conduct and performance. The authors note that while industry structure and the conduct of shipping lines can affect performance, the direction of causality may be reversed. For instance, shipping lines that are able to reap significant benefits from the adoption of a particular form of conduct might be persuaded to repeat that strategy, whereas those shipping lines whose conduct failed to generate sufficient returns will be motivated to seek alternative strategies. Similarly, healthy financial gains will enable shipping lines to invest in greater capacity and alter the structure of the market, while poor financial performance can lead to mergers and acquisitions or even exit from the industry altogether (pp. 372–373). In conclusion, Lam, Yap and Cullinane (2007) interpret their results as providing further validation of the assertion that the structure (high levels of concentration) and conduct (e.g. inter-firm collaboration) of shipping lines are the outcomes (as opposed to causes) of low cost strategies for survival in a beleaguered shipping sector.

Lambertides and Louca (2008) examine the relation between ownership structure and operating performance of listed European maritime firms during the period 2002–2004. They adopt multiple measures of operating performance, including cash flow from operations on assets/sales, operating return on assets/sales, capital expenditures on assets, and asset turnover. Judging by these measures, the sample companies seem to be profitable in each of the years under examination, with the average (median) cash flow from operations on assets ranging from 7.3% (8.0%) to 9.4% (10.9%), whereas the average (median) operating return on sales ranges from 1.9% (4.6%) to 8.0% (8.9%). There is also a steady improvement in maritime operating performance through time. By regressing operating performance measures on ownership structure and control variables, Lambertides and Louca (2008) find that firms with more foreign shareholders and greater participation from investment companies have higher operating performance. These and other results lead them to conclude that certain types of ownership structure can result in better investor protection and hence better operating performance. They caution, however, against inferring causality from these results, as both ownership structure and operating performance might be associated with a third, omitted factor (e.g. management quality).

### *3.2 Studies of the stock market performance of shipping companies*

One stream of the literature deals with the risk-return characteristics and behaviour of shipping company stocks and factors associated with stock market performance. Grammenos and Marcoulis (1996a) analyse the determinants of the cross-section of expected stock returns of 19 shipping companies listed in the US, Norway, Stockholm and London. Among the factors examined (company stock market beta, dividend yield, financial leverage and average age of the company's fleet), they

find that the industry-specific factor (average age of the fleet) and financial leverage are significant in explaining shipping stocks' returns, whereas the stock market beta and the dividend yield are far less significant.

Grammenos and Arkoulis (2002) present evidence, for the first time, about the relations between global macroeconomic sources of risk and shipping stock returns for 36 internationally listed shipping companies during the period 1989–1998. The return on the world equity market portfolio and innovations in the following global macro variables are employed in the analysis: (a) industrial production; (b) inflation; (c) oil prices; (d) fluctuations in exchange rates against the US dollar; and (e) laid up tonnage. Several significant relationships are established between the returns of international shipping stocks and global risk factors. Specifically, oil prices and laid up tonnage are found to be negatively related to shipping stocks, whereas the exchange rate variable displays a positive relationship. In addition, it is found that, in general, the macroeconomic factors exhibit a consistent pattern in the way in which they are linked to the shipping industry, across countries. Kavussanos and Marcoulis (2001, 2005) provide evidence that microeconomic and company-specific factors as well as the market factor are the driving force behind shipping companies' stock returns.

Grammenos and Arkoulis (2001) examine the long-run performance (for the initial 24 months subsequent to public listing) of 27 shipping initial public offerings (IPOs) issued in the stock exchanges of seven different countries during the period 1987–1995. By measuring aftermarket performance respectively against the local stock market indices and against the Morgan Stanley Capital Market (MSCI) index for the shipping equity market, they find that the shipping IPOs underperform the local stock market indices by as much as 36.79% by the end of the second anniversary of public listing, but there is no evidence of underperformance relative to the MSCI shipping index. They further find that the two-year holding period returns of the sample firms are positively related to the initial level of gearing and negatively related to the fleet age of the companies at the time of the offering. In an earlier study, Grammenos and Marcoulis (1996b) find relatively small but statistically significant underpricing for 31 shipping IPOs worldwide during the period 1983–1995. In contrast, Cullinane and Gong (2002) find substantial underpricing for 50 transportation IPOs in stock exchanges in Hong Kong (with an average underpricing of approximately 44%) and the Chinese mainland (with an average underpricing of approximately 126%) during the period 1972–1998. The 23 shipping IPOs on average experienced as much as 126% underpricing, which is statistically higher than that for toll roads, freight forwarders and airlines. They attribute the higher level of underpricing for shipping IPOs to the fact that, relative to other types of transport companies which are typically guaranteed regular incomes through their status as monopolies or franchises, the (usually freight-related) shipping companies are associated with a higher level of *ex ante* uncertainty and thus they need to offer investors a higher level of initial day returns in order to compensate investors for the higher risk involved. With the benefit of hindsight (and based on the results in other related research), it is possible that the investors might have simply overpaid for the IPOs, and that the more speculative investors in the emerging Chinese stock market are just more likely to do so than investors in the more mature stock markets.

### *3.3 Other studies of performance of shipping companies*

Panayides (2003) examines the relationship between competitive strategy and performance in the

context of ship management companies. Recognising performance as a multi-dimensional construct, he measures performance using seven items of self-reported measures constructed from questionnaires that contain instruments found to be valid and reliable by previous research as well as pre-tested with managers and academics. The study finds that companies that apply competitive strategies are more likely to be high performers. The strongest influences on performance seem to be achieving economies of scale, differentiation (in particular through a wider range of services offered), and market-focus and competitor analysis. It is suggested that high performers are more likely to pursue a combination of the generic strategies rather than pursuing one of the generic strategies in isolation.

Jenssen and Randoy (2006) investigate how innovation contributes to company performance in Norwegian shipping. They hypothesise that organisational and inter-organisational variables influence innovation and innovation in turn influences performance in the shipping firms. Performance is said to be measured by financial results, market position and bargaining power, although it is not clear from the paper how these are actually computed and why they are considered appropriate. Using regression analysis based on the results of a survey of 46 Norwegian shipping companies (divided into highly differentiated companies and low differentiated companies) and two measures of innovation (product-process innovation, PPI, and market innovation, MI), they find that PPI is positively associated with performance for the whole sample and for highly differentiated firms, but not for low differentiated firms. No statistically significant relationship is found between MI and performance. Thus, the effect of innovation on performance seems to depend on the companies' degree of differentiation and the type of innovation. The authors suggest that future studies should use more objective information, such as accounting and financial market data, in order to gain more knowledge of the effect of innovation on performance.

### *3.4 Evaluation and a critique*

The key objectives of most of the existing studies on the performance of shipping companies have been to investigate the relations between performance and specific aspects of corporate strategy (e.g. inter-firm collaboration, innovation, mergers and acquisitions) or governance (e.g. ownership structure and control). Few studies take it as their primary objective the determination of objective shipping company performance. It is also difficult to compare the results from the various studies because of the different research designs and the inconsistent definition and measurement of the variables used. Such comparability issues are further complicated by the fact that the sample firms usually come from, and sometimes are spread thinly over different countries, which often adopt different accounting standards and financial reporting practices. It is not clear from the existing studies how well shipping companies have performed, either in absolute terms or against a chosen benchmark. It is also not clear what factors, if any, are associated with differential performance. The inference problem is further made difficult because of potential omitted variable bias, endogeneity bias, and/or other forms of model misspecification.

It is obvious that the ability to draw any reliable inference with respect to shipping companies' performance hinges critically on a proper definition and measurement of performance. As is well-known and as previously noted, performance is a multi-dimensional concept (Walker and Ruekert, 1987; Chakravarthy, 1986) and proves to be rather elusive if not also controversial (Eccles, 1991). The

literature review above suggests a number of possible measures of firm performance, including financial indicators (those based on financial ratios, cash flows, stock market risk-return indicators), operating performance/efficiency indicators (e.g. labour productivity, sales growth, asset turnover, "efficiency scores" based on multiple inputs–outputs), and other performance indicators (e.g. innovation, market share, customer satisfaction, social responsibility "scores").[1] In order to enhance the reliability of the results and strengthen any inference based on the results, it is important to adopt multiple measures of performance and assess the robustness of the results using different indicators of performance. Unfortunately, however, when multiple criteria are adopted in performance measurement/evaluation, one inevitably has to decide how best to aggregate such criteria into a single easy-to-use "score", or to decide on a suitable "weighting scheme".[2] Naturally, certain performance indicators may be more relevant to a given research objective than others, and thus should receive more emphasis over the others. For instance, if the research objective is to examine the effect of corporate strategy and practice on shareholder value, it seems appropriate to place emphasis on measures of financial performance rather than operating performance. In reality, these measures are closely related rather than diametrically opposed because high operational performance/efficiency should eventually lead to high financial performance. Nevertheless, in any single research study the results using different performance measures may be different, and it will be useful to report the findings even when the data do not speak in the same voice. The reader can then weigh the various pieces of empirical evidence before coming to a conclusion about shipping companies' performance.

With respect to studies that focus on the stock market performance of shipping companies, an often-raised concern is their generally small sample size (although in many cases the whole population of firms were examined), the lack of a sufficiently rigorous research design, and tangential contribution to the wider finance literature as a result of the industry focus. Nevertheless, these studies contribute to our knowledge about the risk-return characteristics of the industry and the factors driving shipping stock performance, and in some cases they do offer a unique setting in which to test specific research hypotheses. This may be considered an area of strength and is made possible by the researcher's in-depth knowledge of the industry itself and hence the ability to structure empirical tests and/or to include a concrete set of variables, something that may be difficult to do in large sample studies typical in finance research. For example, Cullinane and Gong (2002) utilise sector affiliation (water transport versus other modes of transport, freight transport versus passenger transport) to proxy for the level of *ex ante* uncertainty and are able to confirm the relationship between this variable and the level of IPO underpricing. Such concrete measures of *ex ante* uncertainty are difficult to find in the general finance literature.

# 4. Empirical Analysis: Measuring Performance Across Key Shipping Sectors

It is obvious from the above discussion that it is important to illustrate how business performance in shipping may be measured and also to gauge the possible differences in the results when using different performance measures. Therefore, in this section we present an empirical analysis of the performance of a sample of publicly quoted shipping companies spanning the three key shipping sectors, viz. dry bulk, tanker and container shipping.

## *4.1 The performance measures*

On the basis of the discussion in the preceding sections, it is deemed appropriate to assess performance using a number of key performance measures. The chosen measures consist of competition performance measures, financial performance measures, market-based performance measures and an assessment of relative efficiency. The measures are summarised in Table 2.

This study provides extensive findings on the relative productivity-efficiency and market efficiency of maritime firms. The relative productivity efficiency model incorporates inputs and outputs related to operating performance consistent with the prior financial accounting literature (Tsai *et al.*, 2006; Barth *et al.*, 1998; Collins *et al.*, 1999).

As recognised by Graham and Dodd (1962), fundamental analysis is a long-term oriented exercise, where the management factor plays an essential role. Well-managed firms are more likely to keep generating a steady stream of revenues in the future as well. In general, firms aim at (a) maximising revenues given their available resources; and/or (b) minimising cost given their output production. To determine these inputs and outputs we use information from the balance sheet, income and cash flow statement. Specifically, the first model (model 1) uses the following inputs and outputs:

INPUTS:

Total assets

Capex (capital expenditure)

Employee (number of employees)

OUTPUT:

Revenue (Total sales)

EBITDA

EBIT

*Table 2:* The performance measures

| Performance dimension | Performance indicator |
|---|---|
| *Competition performance* | Sales growth |
| *Financial performance* | Return on Assets (ROA), Return on Investment (ROI), Revenue, EBIT, EBITDA EBITDA margin, Cash flow from operations, Book value of equity, market value of equity, operating profit |
| *Market-based performance* | Tobin's Q (the sum of the market value of equity, the book value of debt, and deferred taxes divided by the book value of total assets minus intangible assets |
| *Market efficiency* | DEA Model. Input: earnings before extraordinary items and discontinued operations, and book value of equity, Output: market value – firm's market price*number of shares outstanding |
| *Operational efficiency* | DEA Model a. Input: fixed assets (tangible and intangible) total liabilities), Output: revenues<br>DEA Model b. Input: profitability as cash flow from operations to total assets and leverage – total liabilities to total assets, Output: asset turnover (revenue to total assets) |
| *Productivity efficiency* | DEA Model. Input: Total assets, Capital expenditure, number of employees, Output: Revenue, EBITDA, EBIT |

Following Tsai *et al.* (2006), the DEA methodology is employed to capture the entirety of performance with respect to a set of output variables of revenue, EBITDA, and operating profit (EBIT) with input variables of total assets, capex, and employee numbers. Labour is measured as the total number of employees (Karlaftis, 2004). The DEA input-oriented models are chosen for the present study because cost minimisation or reduction is used in this methodology (Tsai *et. al.*, 2006). It is now popular to rely on non-GAAP financial measures such as EBITDA and EBITDA margin (%) to assess

the operating performance of a company against that of its counterparts.

This study sheds light on the degree of relative market efficiency among maritime firms as well. Consistent with the efficient market hypothesis, earnings, cash flows and book value shall contain significant information for the valuation of market equity. Therefore, the second model (model 2) helps in identifying relative *market* efficiency. Following Barth *et al*. (1999), we assume that firm value is a function of earnings, cash flow from operations and book value of equity:

INPUTS:

Earnings (EBIT)

Cash flow from operations

Book value of equity

OUTPUT:

Market Value (firms' market price * number of shares outstanding)

Barth *et al*. (1999) base their analysis on the valuation framework in Ohlson (1999), in which the value relevance of an earnings component depends on its ability to predict future abnormal earnings incremental to abnormal earnings and the persistence of the component. Consistent with their expectations they show that accruals and cash flows provide explanatory power for equity market value incremental to equity book value and abnormal earnings. Our study is consistent with the Barth *et al*. (1999) valuation model.

### *4.2 Sample*

Our sample consists of 18 major (leading) international maritime firms. The data on inputs and outputs were collected from Datastream in 2007. Datastream provides firm accounts and market information and places great emphasis on accuracy, quality and consistency. Since our study deals with markets which have different accounting systems, using Datastream helps to mitigate the problem of inconsistency. Furthermore, to avoid exchange rate variation we denominated all figures to US dollars.

The sample firms are shown in Table 3.

### *4.3 Empirical results: financial indicators*

The results from the analysis of the financial and market indicators are shown in Table 4. We provide summary statistics for the performance measures in Table 5.

The results show that the sample shipping firms have an average of 7% return on assets (ROA), a ratio which indicates how profitable a company is relative to its total assets. The tanker and the dry bulk firms seem to out-perform the container shipping firms in terms of ROA, with a ROA of 8% vs 4% for the container shipping firms.

A similar pattern is observed for the return on investments (ROI) ratio. The average ROI for all shipping firms is 10%. Again, the tanker and dry bulk sectors exhibit a higher ROI than the container sector.

These findings are mainly driven by the fact that container firms are generally much bigger than tanker and dry bulk firms (see TA and ME in Table 5). However, it must be stressed that any conclusions on the basis of single financial ratio analysis need to be corroborated with further evidence from using other indicators and should only be considered as tentative in nature.

*Table 3:* Sample firms

| Tanker | Dry bulk | Container |
|---|---|---|
| Stolt-Nielsen | Eagle Bulk Shipping | A.P. Moeller-Maersk 'B' |
| Teekay | Diana Shipping | Evergreen Marine |
| Overseas Shiphldg.Gp. | Navios Maritime Hdg. | Nippon Yusen KK |
| Farstad Shipping | Dryships | Neptune Orient Lines |
| Euronav | Excel Maritime Carriers | Wan Hai Lines |
| Frontline | TBS International 'A' | Mitsui OSK Lines |

*Table 4:* Financial performance results

| | | ROA | ROI | TOBINSQ | SALES_GR | EBITDA margin |
|---|---|---|---|---|---|---|
| ALL | Mean | 0.0747 | 0.1047 | 1.4389 | 0.2605 | 43.74% |
| | Median | 0.0817 | 0.1089 | 1.3821 | 0.1482 | 44.57% |
| | Min | 0.0141 | 0.0307 | 1.0383 | –0.0655 | 6.12% |
| | Max | 0.1502 | 0.2084 | 2.0650 | 1.8844 | 93.73% |
| Tanker | Mean | 0.0889 | 0.1172 | 1.3652 | 0.0830 | 53.42% |
| | Median | 0.0914 | 0.1114 | 1.3325 | 0.0237 | 58.31% |
| | Min | 0.0313 | 0.0549 | 1.1459 | –0.0655 | 18.23% |
| | Max | 0.1326 | 0.2084 | 1.7288 | 0.3375 | 76.20% |
| Dry Bulk | Mean | 0.0887 | 0.1173 | 1.5799 | 0.5589 | 64.68% |
| | Median | 0.0898 | 0.1211 | 1.5606 | 0.2312 | 66.17% |
| | Min | 0.0141 | 0.0454 | 1.1457 | 0.0677 | 37.91% |
| | Max | 0.1502 | 0.1776 | 2.0650 | 1.8844 | 93.73% |
| Container | Mean | 0.0465 | 0.0796 | 1.3715 | 0.1395 | 13.13% |
| | Median | 0.0438 | 0.0641 | 1.3119 | 0.1080 | 12.74% |
| | Min | 0.0162 | 0.0307 | 1.0383 | 0.0296 | 6.12% |
| | Max | 0.0762 | 0.1380 | 1.8615 | 0.3913 | 23.11% |

This table presents summary statistics for the most used financial performance indicators. ROA: Returns on assets is net income to total assets; ROI: Return on investments is earnings before interest and taxes to total assets; TOBINSQ is market equity and total assets minus book value equity divided by total assets; SALES_GR: Sales growth is net sales change from last year divided by last year net sales; EBITDA margin (%) is calculated as EBITDA divided by net sales.

As far as the Tobin's Q statistic is concerned, the shipping industry has an average value of 1.4, which indicates that the market value of the shipping sector is greater than the value of the firms' recorded assets. This suggests that the market value reflects some unmeasured or unrecorded assets of the shipping firms (i.e. growth opportunities). Although all three sectors have greater-than-unity Tobin's Q, it seems that the dry bulk firms have a slightly higher Tobin's Q (1.5) than the tanker and the container shipping firms (1.3). This may suggest that dry bulk firms have more growth opportunities than other shipping firms, presumably due to their greater flexibility to expand their operations. The results seem to be logical bearing in mind the flexibility that characterises dry bulk shipping operations compared to tanker and container ships. In particular, dry bulk shipping may have higher growth prospects because ships can be deployed more readily in areas and routes that command higher freight rates. In contrast, container ships by definition are deployed on fixed schedules irrespective of the prevailing freight rates, whereas tankers need to operate on specific routes to cater for oil demand and supply. Investors may feel that the flexibility of dry bulk shipping firms provides them with more growth opportunities, and these are accordingly reflected in a higher market value.

*Table 5:* Summary statistics

| | | TA | Capex | Employees | Revenue | EBIT | EBITDA | EBITDA margin | BV | ME |
|---|---|---|---|---|---|---|---|---|---|---|
| ALL | Mean | 7,370.0 | 944.2 | 10,008.3 | 5,766.6 | 793.5 | 1,160.9 | 43.74% | 2,926.5 | 4,865.4 |
| | Median | 2,417.3 | 315.0 | 1,292.0 | 1,282.1 | 221.9 | 320.0 | 44.57% | 966.9 | 2,019.5 |
| | Min | 408.6 | 0.7 | 48.0 | 112.0 | 46.7 | 70.6 | 6.12% | 261.5 | 429.5 |
| | Max | 59,242.9 | 9,305.7 | 108,530.0 | 49,407.6 | 7,348.9 | 11,419.2 | 93.73% | 26,061.5 | 28,333.3 |
| Tanker | Mean | 4,043.1 | 381.4 | 2,483.8 | 1,252.5 | 425.6 | 585.4 | 53.42% | 1,405.5 | 2,723.9 |
| | Median | 3,302.1 | 328.8 | 2,065.0 | 1,282.1 | 371.6 | 529.9 | 58.31% | 1,188.3 | 2,625.3 |
| | Min | 1,527.7 | 187.1 | 48.0 | 377.4 | 187.4 | 241.1 | 18.23% | 642.4 | 1,089.7 |
| | Max | 9,391.9 | 682.1 | 5,600.0 | 2,218.5 | 912.7 | 1,114.9 | 76.20% | 2,805.6 | 4,176.2 |
| Dry Bulk | Mean | 922.3 | 176.1 | 268.5 | 209.9 | 101.4 | 138.2 | 64.68% | 449.3 | 951.4 |
| | Median | 732.8 | 183.1 | 249.5 | 188.5 | 73.0 | 108.9 | 66.17% | 466.0 | 870.3 |
| | Min | 408.6 | 0.7 | 100.0 | 112.0 | 46.7 | 70.6 | 37.91% | 261.5 | 429.5 |
| | Max | 1,619.8 | 323.3 | 501.0 | 350.6 | 257.2 | 328.7 | 93.73% | 621.8 | 1,670.2 |
| Container | Mean | 17,144.7 | 2,275.0 | 27,272.5 | 15,837.4 | 1,853.6 | 2,759.2 | 13.13% | 6,924.7 | 10,920.9 |
| | Median | 9,296.7 | 836.0 | 9,810.5 | 10,502.2 | 776.6 | 1,129.2 | 12.74% | 3,496.1 | 8,255.1 |
| | Min | 2,445.0 | 131.6 | 2,083.0 | 1,651.2 | 114.8 | 263.2 | 6.12% | 879.2 | 1,675.3 |
| | Max | 59,242.9 | 9,305.7 | 108,530.0 | 49,407.6 | 7,348.9 | 11,419.2 | 23.11% | 26,061.5 | 28,333.3 |

This table presents summary statistics for the input and output variables. TA: Total assets; Capex: Capital expenditures; Employees: number of employees; Revenue: Net sales; EBIT: earnings before interest and taxes; EBITDA: operating income plus interest, taxes and depreciation and amortisation; EBITDA margin (%) is calculated as EBITDA divided by net sales; CF; cash flow from operations; BV: book value of equity; ME: market value of equity computed as market price multiplied by shares outstanding; All mean and median values are significant at 1%.

The high growth prospects of the dry bulk sector are confirmed by the growth rate in sales as well. Although the average growth rate of the shipping sector is 26%, the dry bulk sector exhibits a very high growth rate of 55%, which is almost five times higher than the corresponding growth rate of the tanker and the container sectors, which is 8% and 13%, respectively.

Finally, the tanker and the dry bulk firms seem to out-perform the container shipping firms in terms of EBITDA margin, which measures a company's power to generate returns on shareholders' investments. The tanker and dry bulk sectors exhibit an average EBITDA margin of 53% and 64%, respectively, whereas for the container sector it is 13%. These results are in contrast to the DEA analysis of relative efficiency that is carried out in the following section.

A conclusion that emerges from this analysis is the relative high pricing of dry bulk shipping firms. This could be due to one of two things: a) either dry bulk shipping firms have more growth opportunities than other firms and investors price these opportunities (correctly); or b) dry bulk shipping firms are overpriced by investors (hence this becomes an issue of mispricing). Bearing in mind that only six firms from each sector are used, these findings cannot be over-emphasised but instead should only be interpreted as suggestive. One avenue for future research is to first confirm these findings using all firms in the dry bulk sector. Asset pricing tests may then be conducted to explore the growth-based explanation for the dry bulk sector relative to the other sectors.

### *4.4 Empirical results: relative efficiency indicators*

The data envelopment analysis (DEA) approach ranks the performance of each stock relative to the efficient frontier, indicating the (maximal output) production given the optimal (minimal input) cost. For each stock, we determine its location relative to the frontier.

Table 5 reports summary statistics for all inputs and outputs used in our analysis (models 1 and 2).

All variables are expressed in thousand dollars (except the number of employees). The broad range of values for market capitalisation (MV, TA), profitability (EBIT, Revenue), and capital expenditure (Capex) indicates that the sample consists of firms operating on different economic scales. For example, the minimum EBIT of the sample is $46.7K, whereas the maximum is $7,348.9K. In particular, the summary statistics show that the sample includes both small and large maritime companies. The smallest firm in the sample has 408K total assets and 48 employees, whereas the largest firm has 59,242K total assets and 108,530 employees.

The results also reveal a significant difference between the sizes of the three shipping specialties. Dry bulk shipping firms are small relative to the tanker and container firms as far as the total assets, market value and the number of employees are concerned. On the other hand, container shipping firms are by far the largest group. The average total assets, market value and number of employees of the container shipping firms are 17,144K, 10,920K, and 27,273, respectively. These figures are almost four times higher than those of the tanker firms and more than ten times higher than those of the dry bulk shipping firms.

Table 6 shows the Spearman correlation coefficients of the performance inputs and outputs. Consistent with prior studies, market value and revenue exhibit a high correlation with aggregate financial variables such as EBIT, book value of equity, cash flow

*Table 6:* Correlation coefficients

| | Capex | Employees | Revenue | EBIT | EBITDA | CF | BV | ME | EBITDA margin |
|---|---|---|---|---|---|---|---|---|---|
| **CAPEX** | 1 | 0.488* | 0.719** | 0.870** | 0.860** | 0.835** | 0.721** | 0.858** | -0.181 |
| | | 0.040 | 0.001 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.473 |
| **Employees** | | 1 | 0.737** | 0.477* | 0.542* | 0.566* | 0.795** | 0.724** | -0.712** |
| | | | 0.000 | 0.045 | 0.020 | 0.014 | 0.000 | 0.001 | 0.001 |
| **Revenue** | | | 1 | 0.785** | 0.849** | 0.884** | 0.932** | 0.909** | -0.697** |
| | | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| **EBIT** | | | | 1 | 0.983** | 0.911** | 0.829** | 0.897** | -0.148 |
| | | | | | 0.000 | 0.000 | 0.000 | 0.000 | 0.559 |
| **EBITDA** | | | | | 1 | 0.938** | 0.872** | 0.940** | -0.269 |
| | | | | | | 0.000 | 0.000 | 0.000 | 0.280 |
| **CF** | | | | | | 1 | 0.880** | 0.940** | -0.399 |
| | | | | | | | 0.000 | 0.000 | 0.101 |
| **BV** | | | | | | | 1 | 0.932** | -0.595** |
| | | | | | | | | 0.000 | 0.009 |
| **ME** | | | | | | | | 1 | -0.459 |
| | | | | | | | | | 0.055 |
| **EBITDA margin** | | | | | | | | | 1 |

This table presents Spearman's correlation coefficients between the input and output variables. TA: Total assets; Capex: Capital expenditures; Employees: number of employees; Revenue: Net sales; EBIT: earnings before interest and taxes; EBITDA: operating income plus interest, taxes and depreciation and amortization; EBITDA margin (%) is calculated as EBITDA divided by net sales; CF; cash flow from operations; BV: book value of equity; ME: market value of equity computed as market price multiplied by shares outstanding; Significance presented below the coefficient.
*, ** indicate correlation significance at the 0.05 and 0.01 level (2-tailed), respectively.

*Table 7:* Productivity efficiency – DEA Ratings

| Company | Efficiency score | EBITDA margin (%) |
|---|---|---|
| TBS International 'A' | 100% | 37.91% |
| Excel Maritime Carriers | 100% | 69.31% |
| Evergreen Marine | 100% | 6.12% |
| Frontline | 100% | 76.20% |
| Neptune Orient Lines | 100% | 6.71% |
| Mitsui Osk Lines | 100% | 17.32% |
| AP Moller-Maersk 'B' | 94.70% | 23.11% |
| Dryships | 87.08% | 93.73% |
| Euronav | 84.12% | 74.08% |
| Farstad Shipping | 74.90% | 63.88% |
| Nippon Yusen KK | 72.38% | 9.55% |
| Overseas Shiphldg.GP. | 71.42% | 52.74% |
| Stolt-Nielsen | 70.90% | 18.23% |
| Wan Hai lines | 65.04% | 15.94% |
| Diana Shipping | 60.19% | 72.84% |
| Navios Maritime HDG. | 56.19% | 51.24% |
| Teekay | 47.60% | 35.41% |
| Eagle Bulk Shipping | 37.70% | 63.04% |
| | Average | |
| All | 79.01% | 43.74% |
| Tanker | 74.82% | 53.42% |
| Dry Bulk | 73.53% | 64.68% |
| Container | 86.42% | 14.53% |

This table presents DEA efficiency ratings using model 1 for relative productivity efficiency. EBITDA margin (%) is also presented for each company. EBITDA margin (%) is calculated as EBITDA divided by net sales.

and total assets (Barth *et al.*, 1998; Collins *et al.*, 1999). Moreover, all input and output variables have a positive and significant correlation between them. This is a necessary and basic assumption of the DEA approach known as "isotonicity". It guarantees that the increasing of an input will not cause the decreasing output of another item. This result corroborates the selection of our models.

Table 7 shows results on relative *productivity* efficiency using model 1. The average productivity efficiency of the maritime firms is 79.01%. Table 7 shows that six maritime firms exhibit 100% productivity efficiency using model 1. Two firms have less than

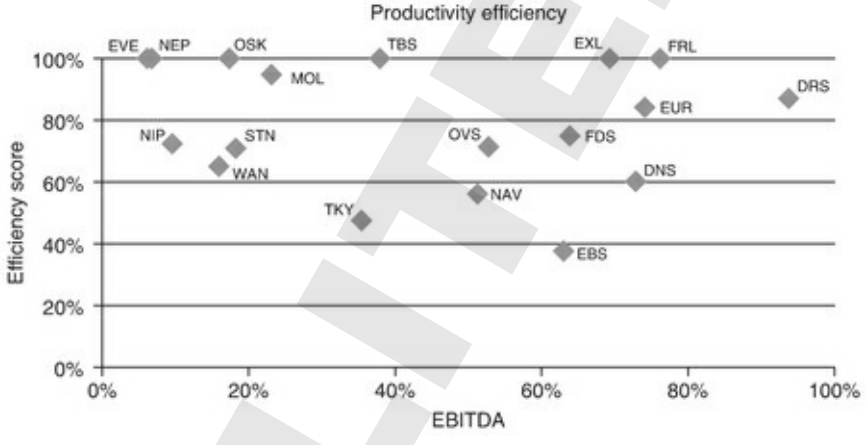


*Figure 1.* Productivity efficiency plot (EBITDA)
This figure describes the DEA efficiency ratings using model 1 for relative productivity efficiency. Y axis is % efficiency score and X axis is EBITDA.

50% productivity efficiency. The six 100% productivity efficient firms (of our sample) are TBS

International, Excel Maritime Carriers, Evergreen marine, Frontline, Neptune Orient Lines, and Mitsui OSK Lines. Eagle Bulk Shipping is the firm with the worst productivity efficiency rate relative to its competitors (Figure 1).

Table 7 also shows the EBITDA margins (%) of each firm. A higher EBITDA margin means that a company has free cash flows to make investments and generate returns on shareholders' investments. Our sample firms exhibit a mean of 43.74% EBITDA margin. This low level of financial performance is in sharp contrast with our findings on productivity efficiency using the DEA approach. Only the EBITDA margin of Dryships (93.73%) is consistent with its high DEA productivity efficiency score (87.08%). It is worth noting that Eagle Bulk Shipping has a high EBITDA margin (63.04%) relative to its corresponding low DEA efficiency score.

As far as the average efficiency scores of the three shipping sectors are concerned, Table 7 shows that the container firms are more productivity efficient than the tanker and the dry bulk shipping firms. The container shipping firms have a mean efficiency score of 86.4%, whereas the tankers and the dry bulk shipping firms have a mean of 74.8% and 73.5%, respectively. On the other hand, the average EBITDA margin of these groups shows the opposite results. Particularly, the container shipping firms have a very low EBITDA margin (14.5%) relative to the tankers and the dry bulk shipping firms, which have an average EBITDA margin of 74.8% and 73.5%, respectively. These differences between the two measures of performance are consistent with the argument that it is not proper to draw conclusions based on only two financial variables. The advantage of the DEA approach is the ability to consider various input and output variables simultaneously.

Table 8 shows market efficiency rates using model 2. Model 2 calculates market efficiency rates by maximising the market capitalisation (output) given the corresponding

*Table 8:* Market efficiency – DEA Ratings

| Company | Efficiency score | ME improvement % |
|---|---|---|
| Eagle Bulk Shipping | 100% | 0.00% |
| Dryships | 100% | 0.00% |
| Frontline | 100% | 0.00% |
| Nippon Yusen KK | 100% | 0.00% |
| Mitsui Osk Lines | 100% | 0.00% |
| Neptune Orient Lines | 97.47% | 2.60% |
| Evergreen Marine | 97.20% | 2.90% |
| Diana Shipping | 95.51% | 4.70% |
| Wan Hai lines | 73.93% | 35.30% |
| Stolt-Nielsen | 71.85% | 39.20% |
| Overseas Shiphldg.GP. | 60.39% | 65.60% |
| Euronav | 60.09% | 66.40% |
| Excel Maritime Carriers | 59.69% | 67.50% |
| Teekay | 59.59% | 67.80% |
| Farstad Shipping | 58.84% | 69.90% |
| Navios Maritime HDG. | 58.44% | 71.10% |
| TBS International 'A' | 54.12% | 84.80% |
| A P Moller-Maersk 'B' | 39.72% | 151.80% |
| | Average | |
| All | 77.05% | |
| Tanker | 68.46% | |
| Dry Bulk | 77.96% | |

This table presents DEA ratings using model 2 for relative market efficiency.

earnings, cash flow and book value of equity (inputs), the three primary summary measures of the income and cash flow statements and balance sheet. Moreover, Table 8 provides the percentage market value improvement required by each firm in order to achieve 100% relative market efficiency. This is the optimal market value (given the corresponding earnings, cash flow and book value of equity) that would set (shift) the firm on the efficient frontier.

According to Table 8, the maritime firms exhibit an average market efficiency of 77.05% (Figure 2). Five (5) of the maritime firms are 100% efficient, whereas only one (1) firm exhibits less than 50% market efficiency. The firms with the highest relative market efficiency score (100%) are Eagle Bulk Shipping, Dryships, Frontline, Nippon Yusen KK, and Mitsui OSK Lines. A.P. Moller-Maersk is the firm with the

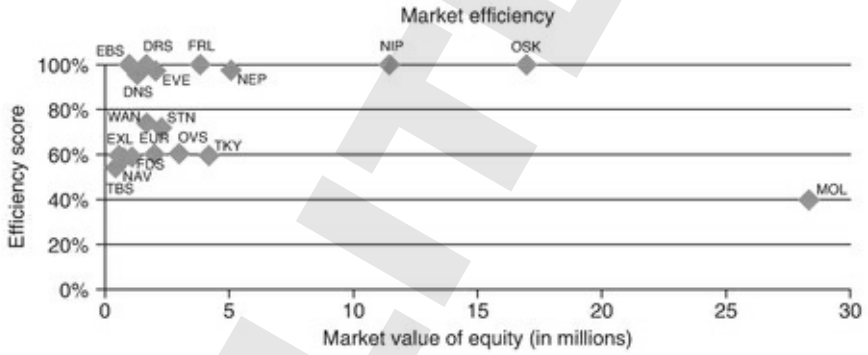


*Figure 2.* Market efficiency plot (ME)
This figure describes the DEA efficiency ratings using model 2 for relative market efficiency. Y axis is % efficiency score and X axis is market value of equity (ME).

smallest market efficiency score (39.7%). Therefore, two firms (Frontline and Mitsui) are consistently

rated as productivity and market efficient; as far as the DEA efficiency scores are concerned (Mitsui OSK has a very low EBITDA margin). It is noted that although Eagle Bulk Shipping is not productivity efficient, it is 100% market efficient. Conversely, A.P. Moller–Maersk is 94.7% productivity efficient, but it is not market efficient.

In terms of the market efficiency of the three shipping sectors, Table 8 shows that the container shipping firms are more market efficient (84.72%) than the dry bulk shipping firms (77.96%), and the dry bulk sector is more market efficient than the tanker firms (68.46%). Therefore, container firms seem to be both productivity and market efficient. Although tanker and dry bulk shipping firms exhibit similar productivity efficiency, dry bulk firms appear more market efficient than tanker firms, though the difference is relatively small.

In summary, conclusions on the productivity and market efficiency of the maritime firms seem to depend on the specific performance measure used. It seems that the container shipping sector is the most robust sector, being both productivity and market efficient, whereas the tanker and dry bulk sectors exhibit mixed evidence.

# 5. Discussion and Implications

The discussions above suggest several avenues for future research. First, there is a need to more systematically and rigorously evaluate the performance of shipping companies using multiple measures of operating and financial performance as well as in the use of inputs and outputs for relative efficiency measurement.

Performance should be measured both in absolute terms and relative to a chosen benchmark, such as the industry average (in the case of using accounting ratios or operating efficiency measures) or risk-adjusted metrics (as in stock performance evaluation). Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis have been extensively used in studies of container terminal or port/airport performance but there is room to apply these and other performance measurement methods (e.g. Balanced Scorecard) to shipping companies. One advantage of these performance measurement methods (especially when the right inputs and outputs are used) is that they may overcome difficulties in making international comparisons which may result from inconsistencies/differences in accounting and taxation rules in different countries (Schefczyk, 1993). By capturing the multi-dimensional nature of business performance, they may also mitigate inference problems arising from the use of only a small number of performance measures (variables).

In this chapter for instance we used data envelopment analysis (DEA) to estimate the so-called “efficient frontier” of international maritime firms in the dry bulk, tanker and container sectors in order to analyse deviations from such frontier corresponding to loss of efficiency. Consistent with Barth, Beaver and Landsman (1998), we build on the seminal work of Ohlson (1995) and Feltham and Ohlson (1995) concerning accounting-based valuation models. The use of this approach is innovative in the shipping industry context.

The second future research opportunity is to investigate the possible determinants of differential performance levels among shipping companies. Both within-country studies and cross-countries studies can be undertaken. Taken together, these studies have the potential to shed light on institutional, firm-specific as well as market-specific factors that are associated with differential performance. Knowledge of such factors is important for making informed decisions in resource

deployment and allocation. In this regard, the finance, economics and management literature offers much useful guidance on the possible factors that determine firm performance. A comprehensive review of this literature, supplemented by implications for the shipping industry, is currently lacking but is warranted. This chapter makes an initial attempt at this important task.

On the managerial and policy front, it will be useful to conduct more research on the long-term performance of shipping companies conditional on the adoption of a certain corporate strategy or change in industry policy. For example, it will be of interest to know how shipping companies' risk or cost of capital is affected by regulatory changes such as implementation of the International Safety Management (ISM) Code or the Tanker Management and Self Assessment approach (TMSA). It is also of interest to assess the change (if any) in the competitive positioning of a shipping company subsequent to the formation of alliances, privatisation or restructuring. There are only a limited number of studies that look into these interesting topics, and the majority of the existing studies tend to focus on short-term (as opposed to long-term) stock market reactions. Gong (2009) reviews some of the related studies in the transport industry and presents a detailed discussion of the event study methodology that is well suited for this type of research.

Given the distinct possibility that different performance measures (e.g. financial, operating, and market-based measures) may lead to different conclusions on business performance, it is important to conduct a robustness check by applying multiple performance measures before drawing any concrete conclusion. Only after such thorough analyses can reliable conclusions be drawn on the profitability and performance of the shipping industry as a whole, or of specific companies that have adopted specific strategies. Well-supported evidence of this type, which is currently missing, will be useful to all of (existing as well as prospective) investors in shipping, industry analysts, corporate managers, and policy makers alike.

# Appendix

Acronyms

| Name | Acronym | Specialty |
|---|---|---|
| Stolt-Nielsen | STN | Tanker |
| Teekay | TKY | Tanker |
| Overseas Shiphldg.GP. | OVS | Tanker |
| Farstad Shipping | FDS | Tanker |
| Euronav | EUR | Tanker |
| Frontline | FRL | Tanker |
| Eagle Bulk Shipping | EBS | Dry bulk |
| Diana Shipping | DNS | Dry bulk |
| Navios Maritime HDG. | NAV | Dry bulk |
| Dryships | DRS | Dry bulk |
| Excel Maritime Carriers | EXL | Dry bulk |
| TBS International 'A' | TBS | Dry bulk |
| A P Moller-Maersk 'B' | MOL | Container |
| Evergreen Marine | EVE | Container |
| Mitsui Osk Lines | OSK | Container |
| Nippon Yusen KK | NIP | Container |
| Wan Hai Lines | WAN | Container |
| Neptune Orient Lines | NEP | Container |

## *Endnotes*

1. In the shipping market context, Lagoudis, Lalwani and Naim (2006) use 24 factors in 4 categories (quality, service, cost and cycle time) to measure the performance (in terms of creating value) of ocean transportation companies. They find that the companies surveyed place the strongest emphasis on quality but the least emphasis on time as a value contributor. Also see Chou and Liang (2001) for the use of multiple criteria in assessing shipping company performance.
2. Jensen (2001) argues for a single corporate objective function, i.e. maximising a firm's long-term total market value, in contrast with the view of traditional stakeholder theory which argues for taking into account the interests of all stakeholders in a firm including not only financial claimants but also employees, customers, communities and even the environment. He proposes a variant of value maximisation, known as Enlightened Value Maximization, and argues it is identical to enlightened stakeholder theory (and Balanced Scorecard, the managerial equivalent of stakeholder theory).