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Capital structure decisions, speed of adjustment and firm performance of listed shipping companies: New empirical evidence

Kapitalstruktur beslutninger, justeringshastighet og finansielt resultat av børsnoterte shipping selskaper: Ny empirisk bevis

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Abstract

This paper examines the factors that influence capital structure decisions, the relationship between capital structure and firm performance, and the speed of adjustment for the shipping industry. Shipping companies tend to have higher leverage ratios than other industries and therefore are exposed to higher financial risk. A set of traditional capital structure variables suggested by previous research were selected as possible determinants of capital structure. Our sample consists of 115 listed shipping companies for the period 1996-2016. We analyse the relationship between traditional capital structure variables and financial leverage, using ordinary least squares and fixed effects methods. For the speed of adjustment analysis, we have employed the following econometric techniques: ordinary least square, fixed effects, "difference" and "system" generalized method of moments, dynamic panel fraction and iterative bootstrap-based bias correction.

Our regression results correspond with prior research. The traditional factors have a considerable effect on financial leverage. Yet the weight of each factor is different from other industries. Tangibility, profitability and asset risk are the most important firm specific factors for shipping companies. More tangible assets are associated with a higher leverage ratio, while increased profitability and asset risk predicts a lower level of leverage. Trade-off theory appears to be the most relevant theory, but this is not an absolute conclusion considering that profitability is also predicted by pecking order theory. Macroeconomic variables appear to only have a slight impact on capital structure decisions. The results indicate that financial leverage is counter-cyclical, and thus support pecking order theory.

Our thesis also includes an analysis of whether leverage and the set of firm specific variables have an impact on financial firm performance. The results seem to vary depending on which firm performance measure was used. Tobin´s Q and return on sales support agency cost theory, whereas return on assets is inconsistent with the agency cost hypothesis.

Finally, we review the dynamics of capital structure choices. Our results demonstrate that adjustment speeds for a reversion to target ratio are higher for shipping companies than for industrial firms. In periods of economic recession, speed of adjustment values are lower and confirm business cycle dependencies. The higher leverage ratios of the shipping industry furthermore mean that financial distress costs are likely to be severe when deviating from target.

Sammendrag

Denne avhandling undersøker hvilke faktorer som har en påvirkning på valg av kapitalstruktur og forholdet mellom kapitalstruktur og finansielt resultat, og justeringshastigheten i shipping industrien. Shipping bedrifter tenderer til å ha høyere gjeldsandel enn andre industrier, og er derfor mer utsatt for økt finansiell risiko. Vi har basert valget av mulige forklaringsfaktorer for kapitalstruktur på et sett av tradisjonelle variabler foreslått av tidligere studier.

Vårt utvalg består av 115 børsnoterte shipping selskaper i tidsperioden 1996-2016. For å analysere forholdet mellom tradisjonelle kapitalstruktur variabler og gjeldsnivå bruker vi minste kvadraters metode og faste effekter metoden. For justeringshastighet analysen bruker vi følgende økonometriske metoder: minste kvadraters metode, faste effekter, "difference" og "system" generalized method of moments, dynamic panel fraction og iterative bootstrap-based bias correction.

Våre resultater er i samsvar med tidligere studier. De tradisjonelle faktorene har en stor effekt på finansiell gjeld, men vekten av hver faktor er ulik enn for andre industrier. Varige driftsmidler, lønnsomhet og risiko er de viktigste bedriftsspesifikke faktorene for shipping bedriftene. Økt materielle eiendeler er knyttet til høyere gjeldsandel, mens økt lønnsomhet og risiko støttes av lavere gjeldsandel. Trade-off teorien ser ut til å være den mest relevante teorien, men dette er ikke en absolutt konklusjon siden lønnsomhet er også forklart av pecking order teorien. De makroøkonomiske variablene har en liten innvirkning på valg av kapitalstruktur. Resultatene tyder imidlertid på at gjeldsnivå hovedsakelig er mot-syklisk og dermed støtter pecking order teorien.

Vår avhandling inneholder også en analyse av hvorvidt gjeld og et sett av bedriftsspesifikke variabler har en innvirkning på finansielt resultat. Resultatene varierer avhengig av hvilken finansiell resultat variabel som ble brukt. Tobin´s Q og return on sales støtter agentkostnad teorien, mens return on assets samsvarer ikke med agentkostnad hypotesen.

I den siste delen av avhandlingen ser vi på dynamikken i valg av kapitalstruktur. Våre resultater viser at justeringshastigheten er høyere for shipping bedrifter enn industrielle bedrifter. I perioder med lavkonjektur er hastigheten på justeringsverdiene noe lavere. Dette bekrefter dermed forretningssyklisk avhengighet. Den høye gjeldsandel i shipping industrien betyr at kostnader i forbindelse med finansiell uro vil være alvorlig når bedriften avviker fra målet.

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1. Introduction

Shipping is by far the cheapest method of trade and deserves attention in today's economy. Over 80% of today's international trade by volume is transported by merchant shipping firms (United Nations, 2017). The industry has been affected by the global financial crisis, the maritime transport sector still feeling the effects of the aftermath of the 2008 crisis. The shipping industry is highly leveraged. Recent access to global capital markets has therefore made it easier to obtain funding for new investments. These new funding opportunities contribute to business growth and value creation (Merikas, Gounopoulos and Nounis, 2009). Only larger companies have the option of issuing bonds, equity and private placements. Smaller shipping businesses are therefore forced to rely on loans from commercial banks. This is of importance in an industry that is fragmented and consists of many smaller firms with concentrated ownership. Access to capital is also affected by "episodic" market cycles that highly influence shipping risk (Stopford, 2009, p. 625-628). The shipping industry is a capital-intensive industry with volatile characteristics (Drobetz et al., 2013). A shipping company owns, leases, charters and operates its vessels and can borrow by using their balance sheet as collateral[1] (Drobetz et al., 2013). Half of the ships used by most shipping companies' are owned, while half are chartered in (United Nations, 2017).

Many shipping companies benefit less from a tax shield and are favoured by industry specific tax incentives. It should therefore be noted that shipping firms have relatively high levels of financial leverage (Drobetz et al., 2013). What factors, therefore, affect target leverage ratio, aside from the traditional trade-off between tax benefits and distress costs of too much debt? The riskiness and cyclical nature of the shipping industry makes avoiding financial distress and maintaining financial flexibility a top priority (Drobetz et al., 2013). Equity financing may provide companies with a safety margin. This is, however, the most expensive form of financing. With that in mind, we imagine that capital structure decisions are an important issue, and these might become clearer in our analysis.

[1] This constraint is with regard to our sample.

2. Capital structure and firm performance

2.1 Capital structure theories

Modigliani and Miller (1998) argue that the market value of each firm is independent of its capital structure. They furthermore argue that if a company's leverage were to increase, the increased risk would naturally lead to a higher required return on equity. Consequently, the company's total return on assets would remain unchanged. However, the assumptions[2] of the theory may seem less realistic. Other theories such as trade-off, market-timing and pecking order are an appealing extension of Modigliani and Miller (1998), because they assume market imperfections and include more realistic assumptions. We will briefly elaborate on each of these theories.

Trade-off theory suggests that a firm's capital structure is determined by the benefits of debt against the costs of debt. A number of approaches represent both the benefits and costs of debt. Kraus and Litzenberger (1973), building on the Modigliani and Miller (1958) theorem, introduced both tax benefit of debt and costs of bankruptcy to the model. The tax shield payoff is, essentially, evaluated against the bankruptcy penalty costs. The idea of having an optimal leverage ratio is, however, widely debated. For example, Eckbo and Kisser (2018) found little evidence of debt issuers managing capital structure towards a target. A second approach, called the "agency perspective", covers the agency cost of debt, including factors such as separation of ownership and control (Jensen and Meckling, 1976), and agency costs associated with negotiation, monitoring and enforcement of contracts (Myers, 1977). Section 2.3 on firm performance further discusses the agency perspective. The problem of free cash flow, by which we mean managers' capability to invest below cost of capital or wasting it on inefficiencies, is also something that should be considered (Jensen, 1986). Shareholder-debtholder conflicts can also arise, especially in firms in financial distress, in which the weakening of one financial stakeholder position exacerbates the other (Stulz, 1990). These perspectives explain the advantages or disadvantages of debt.

Market-timing theory argues that companies will use the cheapest financing option when they need capital (Baker and Wurgler 2002). There is no fixed objective for how capital structure is structured. The result is based on how the market and share price evolve. This theory differs

[2] Base assumptions of Modigliani and Miller (1958) are no taxes, zero transaction costs, full information, the cost of debt is same for investor as well as companies, and EBIT is not affected by debt financing.

from other theories in that it continuously makes an ongoing assessment of the market conditions and is based on taking advantage of the opportunities offered. When stock prices are high, and there is the potential for being overvalued, equity is more likely to be issued. Debt on the other hand is the preferred method of financing when prices are low (Mahajan and Tartaroglu, 2008). Previous studies have proved that markets are not efficient. Baker and Wurgler (2002) also discovered that more companies are financed with equity when stock markets are favourable and market-to-book ratios are high. In general, firms choose the financing options which are most valued by the financial market at the time.

Pecking order theory can be used to explain the financing decisions of firms. It assumes that companies are financed according to a prioritized order and that the idea of an optimal leverage ratio does not exist. In "clean surplus" accounting, the three funds available to firms are retained earnings, debt and equity. Myers (1984) argues that "adverse selection" implies that firms prefer internal to external funding, and debt to equity if it issues securities. This ranking of funding sources is referred to as the pecking order. This theory, contrary to Modigliani and Miller (1958), assumes that not all parties have full or the same information. For example, company managers know more about the company's financial situation and its value than outside investors. The problem of adverse selection therefore frequently arises. Asymmetric information is not the only premise for pecking order theory. Tax, agency or behavioural considerations are also possible presumptions (Frank and Goyal, 2009).

2.2 Firm specific capital structure determinants

Our capital structure variables are motivated by previous studies of factors that can affect financial leverage[3]. The first four "standard factors" tangibility, market-to-book, profitability and size are inspired by Rajan and Zingales (1995). They limited the study to these four because they were consistently associated with leverage in earlier studies. The "additional factors" found in Section 2.2.2 are proposed by Frank and Goyal (2009) and have proved to also have some influence on financial leverage in existing literature.

We, like Drobetz et al. (2013), exclude a tax factor for several reasons. Firstly, taxes are not included by Drobetz et al. (2013) nor by Frank and Goyal (2009). Secondly, shipping

[3] Relevant studies that review capital structure decisions of listed companies are Drobetz et al. (2013), Rajan and Zingales (1995), Lemmon, Roberts and Zender (2008) and Frank and Goyal (2009).

companies benefit from special tax incentives given by individual countries[4]. Lastly, many shipping companies locate their headquarters in countries with the most beneficial and tax efficient regimes (PricewaterhouseCoopers, 2015).

2.2.1 Standard factors of capital structure

Tangibility: Asset tangibility indicates the value of a firm's collateralizable assets. The trade-off perspective argues that tangible assets are easier for outsiders to value than intangible assets and that firms with a high ratio of tangible assets will have less asymmetric information and overall reduced agency costs of debt. The expected distress costs for firms with a high ratio of tangible-to-total assets will, however, be lower in times of financial turmoil, because tangible assets suffer less from loss of value (Frank and Goyal, 2009). We can therefore assume that there may be a positive correlation between debt and tangibility. Pecking order theory predicts that tangible assets with reduced asymmetric information lead to less costly acquisition of new equity. Higher tangibility is therefore identified with a lower leverage ratio (Harris and Raviv, 1991). In the vast majority of empirical studies, there is a positive correlation between tangibility and debt. This supports trade-off theory and is the strongest finding of the capital structure literature. All predictions from the trade-off and pecking order theories point in the same direction. Higher collateral levels means banks are at ease knowing that the collateral will cover the debt, at least in normal business environments.

Market-to-book: A company's market-to-book or growth opportunities can be defined as the relationship between the market value and the book value of a company. Companies with a high market-to-book expect to suffer from higher costs of financial turmoil, and encounter higher debt-driven agency costs due to potential underinvestment (Myers, 1977). Trade-off theory therefore predicts that growth reduces the financial leverage ratio. Pecking order theory expects a higher debt ratio for companies with higher growth opportunities, because debt is predicted to increase when investment exceeds retained earnings (Drobetz et al., 2013). Earlier empirical studies indicate a negative correlation between growth opportunities and leverage. This is in accordance with trade-off theory. This phenomenon is also compatible with market-timing theory. If market-timing is favoured, then we would expect a

[4] The special tax incentives are for example based on a tonnage tax regime instead of taxes related to accounting profits. Other examples are lowered tax rate, narrowed tax base or complete tax exception (Drobetz et al., 2013).

higher market-to-book to reduce the leverage ratio, because companies exploit equity mispricing through equity issuance (Frank and Goyal, 2009).

Profitability: Profitable firms are expected to use more debt, because they face lower bankruptcy costs and earn more valuable interest tax shields (Frank and Goyal, 2009). This argument is based on the prediction of the static trade-off theory. The agency cost perspective furthermore predicts that profitable companies have higher debt levels to reduce agency costs related to free cash flow problems (Jensen, 1986). Pecking order theory however predicts that increased profitability will reduce the chance of issuing debt, because companies prefer internal funds. Most empirical evidence supports pecking order theory (Rajan and Zingales, 1995; Frank and Goyal, 2009). Companies with higher profitability have, over time, a lower share of debt, as companies prefer internal funding to external debt (Drobetz et al., 2013).

Firm size: Big companies often tend to be more diversified and have a lower likelihood of default (Frank and Goyal, 2009). This contributes to lower costs associated with financial turmoil. We assume, from a trade-off perspective, a positive relationship between size and debt, because larger companies are considered to be a safer investment for banks. In contrast, pecking order theory regards size as a proxy for information asymmetry between capital markets and firm insiders. Larger companies tend to make more information available to outsiders than smaller companies, resulting in a lower chance of error pricing, so making them more attractive to equity investors (Rajan and Zingales, 1995). We therefore expect an inverse relationship. Most empirical evidence supports a positive empirical relationship, and thereby the trade-off theory (Drobetz et al., 2013).

2.2.2 Additional factors

Asset risk: Volatile assets are considered to increase costs of financial distress. These assets usually have a lower value, because they are difficult to sell when the economy is in recession (Schleifer and Vishny, 1992). Trade-off theory therefore predicts an inverse dependency between asset risk and leverage. Pecking order theory has, however, an opposing view, suggesting that firms with more volatile assets would want to hold more debt based on increased adverse selection costs. The nature of an asset is expected to influence capital structure decisions. There is, however, only little empirical evidence of this (Drobetz et al., 2013). Nevertheless, Lemmon, Robert and Zender (2008) and Gropp and Heider (2010) found that asset risk is a reliable determinant of financial leverage.

Operating leverage: A firm's operating leverage is influenced by the firm's fixed production costs. Operating risk and operating leverage can be viewed as complementary measures, because the higher a firm's operating leverage, the higher its operating risk (Drobetz et al., 2013). Trade-off theory predicts that lower levels of financial leverage are associated with high levels of operating leverage, and vice versa. Evidence of an inverse relationship between operating leverage and financial leverage has been found by Kahl, Lunn and Nilsson (2012) and Harrison, Panasian and Seiler (2011).

Dividend payer: Brav et al. (2005) found, as Lintner (1956) before him, that dividend policy is still conservative and that firms tend to maintain their dividend pay-outs. This can be explained by the market's asymmetric reaction to increases or decreases in dividends (Brav et al., 2005). A higher level of dividend pay-out is therefore associated with lower retained earnings. Firms with high levels of dividend spending furthermore need to tap into external financial markets for financing. We have, from the perspective of pecking order theory, two opposing predictions. A positive relation between dividend pay-out and financial leverage is predicted given that debt is preferred to equity. In contrast, dividend paying firms are subject to market monitoring, so implying reduced information asymmetry and a possible negative relationship (Drobetz et al., 2013). Frank and Goyal (2009) found that firms who pay dividends tend to have lower leverage than firms that are non-dividend payers. These findings correspond with trade-off theory.

Table 1: Summary of the theoretical perspectives

	Trade-Off Theory	Pecking Order Theory	Market-Timing Theory
Tangibility	+	-/+	
Market-to-book	-	+	-
Profitability	+/-	-	
Size	+	-	
Operating Leverage	-		
Dividend payer	-	+/-	
Asset risk	-	+	
Macroeconomic Indicators:			
Macroeconomic Cycled	+	-	-

The table above displays the independent variables and the effect that trade-off theory, pecking order theory and market-timing theory is anticipated to have on leverage ratio.

2.3 Firm performance

The interests of the company´s managers and its shareholders are not always the same in Jensen and Meckling's (1976) agency cost theory. Managers tend to maximize their own utility rather than the value of the firm. Managers in some cases have the incentive to take high risk as part of risk shifting investment strategies (Jensen and Meckling, 1976). A central concern of the "free cash flow perspective" is motivating managers to keep the cash level low and not waste it on inefficiencies or invest it below the cost of capital (Jensen, 1986). Debt will therefore have a positive influence on the value of the firm in situations where high debt ratios are used as a disciplinary device.

Agency costs can also arise where there is disagreement between debt and equity investors when there is a risk of default. An underinvestment or a debt overhang problem might appear in a default (Myers, 1977). The value of the firm will, as a consequence, be negatively affected by debt. Stulz (1990) developed a model based on Myers (1977) and Jensen (1986), in which debt financing either mitigates overinvestment problems or aggravates the underinvestment problem. The model furthermore anticipates that debt can have a positive or negative relation to firm performance. To summarize, agency cost theory states that higher leverage will lead to lower agency costs, reduce inefficiencies and so improve firm performance (Margaritis and Psillaki, 2009).

2.3.1 Firm performance measures

Prior literature shows there are many different firm performance measures. In our analysis, we will use three different left-hand side variables as measures of financial firm performance. These dependent variables are: return on assets (ROA) calculated as net profit divided by total assets, Tobin´s Q (Q) calculated as book value of total debt plus market value of equity divided by book value of total assets, and return of sales (ROS) calculated as net income before taxes divided by net sales. A detailed overview of variable calculations can be found in Table A2 in the appendix. Independent variables include leverage (LEV) calculated as debt divided by total assets[5] and some of the variables used in standard leverage regressions. The firm specific variables selected are likely to influence firm efficiency and should therefore be included (Margaritis and Psillaki, 2009).

[5] The independent leverage variable used is the same leverage measure as book leverage in Section 5.1.

Both Q and ROA are suggested by Mehran (1994). There has been some debate around both. It is said that Q is perhaps a better proxy for growth opportunities than for firm performance. ROA is said to convey too little information about economic rate of returns (Mehran, 1994). ROS or "EBIT margin" was also added as a performance measure in one study of capital structure and firm efficiency (Iavorskyi, 2013). ROA and ROS are considered to be the most frequently used firm performance measures (Bayar et al., 2018).

3. Data

3.1 Definition of sample

Datastream provided us with a sample of 115 shipping companies for the period 1996 to 2016, on an annual basis[6]. Table 2 shows the country in which the company headquarters is located, number of companies located there and total firm years. Our data is measured in US dollars[7]. We have restricted our shipping companies to those that are in the water-transportation business and own and/or operate commercial ships. Companies that, for example, mainly provide service to oil rig companies, are therefore not included[8]. Our panel data sample consists of 1501 firm-age observations.

Table 2: Shipping companies and firm-year observations by country

Country	Companies	Firm-Years
Belgium	3	46
Bermuda	11	148
Bulgaria	1	9
Cayman Island	1	16
Chile	1	20
China	6	91
Colombia	1	20
Denmark	4	62
Dubai	1	4
Germany	2	17
Greece	16	150
Hong Kong	6	68
India	6	74
Ireland	1	20
Italy	1	19
Japan	5	92
Jordan	1	11
Luxembourg	1	9
Mexico	2	34
Monaco	6	45
Norway	8	120
Pakistan	1	16
Philippines	1	18
Qatar	2	17
Russia	4	51
Singapore	1	16
South-Korea	3	44
Taiwan	3	47
Thailand	2	40
United Kingdom	3	31
United States	9	131
Vietnam	2	15

Table 2 shows the country in which the company headquarters is located, number of companies located there and total firm years. Datastream provided us with a sample of 115 shipping companies for the period 1996 to 2016, on an annual basis.

[6] Datastream is a corporate and market information finance database, containing macroeconomic data provided by Thomson Reuters (Thomas Reuters Datastream, n.d.)
[7] The conversion to US dollars is based on historical exchange rates, collected and calculated by Datastream.
[8] For further clarification, we eliminate shipyard, operate drilling ships and offshore form our sample.

3.2 Leverage interpretation

How we measure leverage is important to our analysis. Our leverage regressions review both book and market values. One way to measure leverage is short and long-term debt divided by total assets (Frank and Goyal, 2009). This is the book leverage measure we have adapted to our analysis. Market leverage is calculated as the sum of short and long-term debt divided by the market value of assets. We will cover alternative measures of leverage in the robustness tests and see how regressions using these alterations differ from the original ones. Suggestions on alternative definitions of leverage are largely based on Rajan and Zingales (1995). The results can be found in Section 5.4. The advantages and disadvantages of each calculation are considered.

3.3 Definitions of variables

For a detailed overview of book and market leverage measures and estimation of all explanatory variables, see Table A2 in the appendix. We define the following capital structure variables, which are based on previous empirical studies: tangibility, market-to-book, profitability, firm size, operating leverage, dividend paying status and asset risk. Tangibility is obtained by dividing property, plants, and equipment by total assets. We then define market-to-book as the ratio of the market value to book value of assets. Profitability can be defined as operating income before depreciation divided by total assets. Firm size is simply a proxy for a company's size. Dividing the logarithm of total assets by 1000 gives us the desired value for size. We determine operating leverage by totalling the firms operating expenses, which represent fixed costs of seaworthiness for shipping firms. These are fixed in the sense that they only rise with inflation (Drobetz et al., 2013). Total operating expenses are then divided by total assets to obtain the operating leverage ratio. Dividend paying status is a dummy variable with the value of one if the company pays dividends in a year. It otherwise has the value of zero. Finally, as in Frank and Goyal (2009), asset risk is the unleveraged annual standard deviation of a firm's stock returns.

Table 3: Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Median	Percentiles 25th	75th	Min	Max
Book Leverage	1624	0.405	0.217	0.401	0.256	0.565	0.000	0.861
Market Leverage	1416	0.413	0.230	0.423	0.225	0.591	0.000	0.845
Book assets(m$)	1600	1955.551	3697.88	659.013	194.755	1969.857	6.617	19614.69
Tangibility	1620	0.631	0.239	0.679	0.517	0.812	0.003	0.948
Market-to-book	1417	1.092	0.452	0.989	0.832	1.212	0.515	2.907
Profitability	1594	0.097	0.093	0.096	0.054	0.146	-0.212	0.327
Size	1626	6.608	1.611	6.65	5.572	7.734	3.087	10.126
Operating Leverage	1470	0.475	0.447	0.318	0.131	0.695	0.025	2.026
Asset risk	1314	0.191	0.138	0.151	0.093	0.248	0.023	0.670
Price run-up	1469	0.161	0.783	0.000	-0.288	0.340	-0.845	3.370
Dividend payer	1547	0.669	0.471	1	0	1	0	1
Age	1501	13.052	5.010	13	9	18	3	20

The descriptive statistics display number of firm year observation (Obs.), the mean, the standard deviation (SD), the median, the 25th and 75th percentile, and the minimum and the maximum value of each variable. Datastream provided us with a sample of 115 shipping companies for the period 1996 to 2016, on an annual basis. All variables except age and dividend payer are winsorized at the upper and lower two percentile. See Table A2 in the appendix for definitions of variables.

3.4 Descriptive statistics

The descriptive statistics displayed in Table 3 are compared with similar capital structure studies from both related and unrelated industries. We compare our results with the following studies: Drobetz et al. (2013) for the shipping industry, Frank and Goyal (2009) for the US market, Bessler et al. (2012) for firms from G7 countries and Lemmon, Roberts and Zender (2008) for non-financial firms. Our data is, furthermore, winsorized at an upper and lower level of the second percentile, because the Datastream data contained outliners[9].

Book and market leverage ratios are in general much higher for the shipping industry than for the average industrial company. The shipping industry's mean of 40.5% for book leverage and mean market leverage of 41.3% exceeds the values of G7 firms of 22.7% and 18.4% respectively. We, as Drobetz et al. (2013) before us, have also included mean values of quartile portfolios in Table 4. Table 4 shows great diversity of shipping companies' book leverage, the first quartile (Q1) value of 21.5% differing greatly from the fourth quartile (Q4) value of 59.1%. The same is true for market leverage.

Book assets have a mean value of $1.96 billion and a median value of $0.66 billion. The mean is slightly lower and the median is slightly higher than the values of Drobetz et al.

[9] The winzorising method is a systematic approach that prevents data loss by having to many outliners, and thus makes result comparison with previous studies more accurate. By means of the analytical program STATA, extreme observations are modified by replacing the upper and lower percentile. This means that observations above the 98th percentile of the sample are replaced by the value of the 98th percentile.

(2013), $2.43 billion and $0.58 billion respectively. The mean value for tangibility is 63.1% which, when compared with Lemmon, Roberts and Zender (2008) mean value of 34%, is almost twice as high. The above numbers make sense in that the shipping industry tends to have higher amounts of tangible assets. The market-to-book ratio's mean value of 1.09 is considerably lower than for the G7 countries, US and non-financial firm's data, the values for these being 1.73, 1.76 and 1.59 respectively (Bessler et al., 2012; Frank and Goyal, 2009; Lemmon, Roberts and Zender, 2008). First quartile (Q1) value for market-to-book is as low as 0.788, and the fourth quartile (Q4) being as high as 1.294. The results indicate substantial divergence in the shipping industry. Some similarities with the compared studies listed earlier were expected for profitability. A 9.7% mean and 9.3% standard deviation tell us that there is also some variation among shipping companies. Profitable firms should give the impression of being more attractive to the investor, and thus might influence capital structure. The mean firm size in Table 3 is larger than that of Drobetz et al. (2013), which can be explained by the inclusion of different firms and time periods in our sample.

Operating leverage is, in theory, expected to be higher for the shipping industry. However, our results do not support this. The mean and median measures of 0.48 and 0.32 are lower than that of the G7 sample. We expect more volatile assets in the shipping industry. The asset risk mean measure is 19.1% compared with G7's mean value of 11.3% and 13.0% for US data. Vessel price risk is explained as being the main factor contributing to such a high asset risk (Drobetz et al., 2013). The variables price run-up and age in the bottom half of Table 3 can be compared with Drobetz et al. (2013). Our mean is slightly lower, our 0.161 compared with 0.196. On the other hand, our mean measure of 13.05 years for age is substantially higher than the 6.66 years of Drobetz et al. (2013). We expect that this is accounted for by our different time period and different sample of firms. Lastly, looking at the dummy variable dividend payer, we find that 66.9% of firms pay dividends. In Frank and Goyal (2009), dividend paying firms are associated with lower levels of leverage. Investors in shipping companies may, furthermore, have a preference for dividends due to the accompanying tax benefit.

Table 4: Quartile means

Variable	Q1	Q2	Q3	Q4	Total
Book Leverage	0.215	0.352	0.460	0.591	0.405
Market Leverage	0.186	0.355	0.490	0.628	0.413
Tangibility	0.473	0.622	0.732	0.839	0.631
Market-to-book	0.788	0.927	1.054	1.294	1.092
Profitability	0.042	0.081	0.114	0.163	0.097
Size	5.297	6.208	7.059	7.902	6.608
Operating Leverage	0.114	0.212	0.451	0.780	0.475
Asset risk	0.082	0.129	0.184	0.273	0.191

The table above displays the quartile means for the firm-specific variables. Each variable is sorted into quartile portfolios (Q1-Q4) according to their individual variable mean. Datastream provided us with a sample of 115 shipping companies for the period 1996 to 2016, on an annual basis. All variables are winsorized at the upper and lower two percentile. See table A2 in the appendix for definitions of variables.

Lastly, Table 5 illustrates pairwise correlation coefficients for all firm-level characteristics. Tangibility is positively correlated in the correlation matrix with both book and market leverage. According to Drobetz et al. (2013), companies with higher market-to-book and profitability lean towards lower leverage. Previous research by Merikas, Sigalas and Drobetz (2011) reveal that, for shipping companies, operating leverage is negatively correlated with financial leverage. Drobetz et al. (2013) found results that are consistent with the findings of Merikas, Sigalas and Drobetz (2011). Our results show the same negative correlation. Dividend payers and companies with more volatile assets are also associated with lower levels of debt (Drobetz et al., 2013). Firm size displays a positive correlation with both book and market leverage.

Table 5: Correlations matrix

	Book Leverage	Market Leverage	Tangibility	Market-to-book	Profitability	Size	Operating Leverage	Asset risk	Dividend payer
Book Leverage	1.000								
Market Leverage	0.863	1.000							
	0.000								
Tangibility	0.464	0.504	1.000						
	0.000	*0.000*							
Market-to-book	-0.030	-0.391	-0.121	1.000					
	0.263	*0.000*	*0.000*						
Profitability	-0.154	-0.201	0.069	0.116	1.000				
	0.000	*0.000*	*0.006*	*0.000*					
Size	0.236	0.228	0.205	-0.106	0.019	1.000			
	0.000	*0.000*	*0.000*	*0.000*	*0.458*				
Operating Leverage	-0.235	-0.307	-0.390	0.187	0.037	-0.054	1.000		
	0.000	*0.000*	*0.000*	*0.000*	*0.162*	*0.038*			
Asset risk	-0.469	-0.607	-0.207	0.453	0.096	-0.271	-0.044	1.000	
	0.000	*0.000*	*0.000*	*0.000*	*0.001*	*0.000*	*0.129*		
Dividend payer	-0.117	-0.132	0.057	-0.019	0.221	0.170	-0.004	-0.007	1.000
	0.000	*0.000*	*0.027*	*0.477*	*0.000*	*0.000*	*0.895*	*0.819*	

The table above displays pairwise correlation coefficients for book and market leverage as well as for the firm-specific variables. Datastream provided us with a sample of 115 shipping companies for the period 1996 - 2016, on an annual basis. All variables except dividend payer are winsorized at the upper and lower two percentile. See Table A2 in the appendix for definitions of variables. Numbers in italics below the coefficients represent the coherent p-values.

4. Methodical approach

Previous research has used different quantitative methods to determine the factors and properties that affect a company's capital structure. Frank and Goyal (2009), Frydenberg (2004) and Rajan and Zingales (1995) for example use the ordinary least squares method (OLS). Frydenberg (2004) also utilizes a type of linear regression that takes fixed effects (FE) into account. Mjøs (2007) and Drobetz et al. (2013) used the general method of moments (GMM) method for speed of adjustment concerned with regression residuals containing heteroscedasticity and serial-correlation at both company and year level. This paper, as Drobetz et al. (2013), applies the OLS and FE method. We also apply "difference" and "system" generalized method of moments, dynamic panel fraction and iterative bootstrap-based bias correction.

4.1 Ordinary Least Square (OLS)

The ordinary least square method has been widely used in previous empirical studies to analyse the factors that might influence financial leverage. One of the advantages of using this method is that the results are easily comparable to previous research. There are seven assumptions that must be met for OLS to provide valid results. The most common challenges for OLS are linearity, normality, heteroscedasticity, multicollinearity and autocorrelation. The estimators lose the statistical properties of the Gauss-Markov theorem if any of these prerequisites are violated. It is however rarely necessary to worry about non-Normality in sufficiently large samples. Evidence from a larger sample size also proves that the performance of linear regression is frequently good even with significant heteroscedasticity (Lumley et al., 2002). Pooled OLS is adopted for homogenous panel datasets without autocorrelation (see Appendix A1 for more details on the OLS method). Woolridge (2002) provided us with an autocorrelation test which can be applied to panel data. The test results indicate a positive autocorrelation in our analysis (see Appendix A7 and A8). We used clustered default errors for the firm and year specific variables to correct for autocorrelation and possible heteroskedasticity (Petersen, 2009). Finally, we used the variance inflation factors test (VIF-test), which rejects the presence of multicollinearity (see Appendix A10).

4.2 Fixed effects (FE)

Fixed effects deal with individual effects and analyse variables that vary over time. We assume, when using this method, that something within the unit we are studying has its own characteristics that affect the variables (Torres-Reyna, 2007). One reason for using fixed effects is to transform the regression equations so that the unobserved effects disappear (Wooldridge, 2010). The advantage of using this type of estimation is to avoid bias due to omitted variables that do not change over time. A typical example of this may be company-specific strategies or management's debt sharing choices. This is referred to as unobserved heterogeneity or fixed effect (see Appendix A1 for a more detailed understanding of the FE method).

4.3 Logistic regression

Logistic regression is used to measure the relationship between a categorically dependent variable[10] and one or more independent variables. There are some similarities between logistic regression and linear regression. Logistic regression is, however, used when we have a categorical dependent variable. Logistic regression breaks with the assumptions of linearity in OLS regression. When the dependent variable is transformed into a logarithmic form, nonlinear relationships will be modelled in a linear way (see Appendix A1 for a detailed overview on the subject of logistic regression).

4.4 Fixed effects or random effects?

We need to test whether to use fixed effects (FE) or random effects[11] (RE) when choosing a regression method. We use the Hausman test to determine whether FE or RE is more appropriate. If we dismiss the null hypothesis, then we should use the FE method. The null hypothesis indicates no correlation based on whether the unique error term is correlated with regressors (Torres-Reyna, 2007). The test results of the Hausman test in Appendix A9 show that FE is the preferred method.

[10] A categorical variable is a variable that can take the form of one or several specific values, such as 1 and 0.
[11] The random effect method makes it possible to estimate the effect of constant variables over time, but also takes into account unobserved individual effects.

4.5 Model specifications

Standard pooled OLS regression is used in the first model and fixed effects panel data is used in the second model:

$$L_{it} = \alpha + \beta X_{it} + \varepsilon_{it} \quad \text{(M1)}$$

$$L_{it} = \alpha + \beta X_{it} + c_f + c_t + \varepsilon_{it} \quad \text{(M2)}$$

Where L_{it} is the leverage measure of company i, t applies to time; X_{it} is a vector of firm characteristics; β denotes the vector of regression; coefficient α is the intercept and ε is an error term. Model 2 includes three underspecifications: one looks at firm fixed effects (c_f), one at calendar year fixed effects (c_t) and one at both year and firm effects.

4.6 Speed of adjustment econometric techniques

Previous studies that review speed of adjustment use dynamic panel models. Today's leverage is, however, dependent on its previous (lagged) leverage (Flannery and Hankins, 2012):

$$L_{i,t} - L_{i,t-1} = \lambda\left(L^*_{i,t} - L_{i,t-1}\right) + \varepsilon_{i,t} \quad (1)$$

Change in leverage is determined by speed of adjustment λ, and the gap between the leverage ratio in the last period $L_{i,t-1}$ and the target leverage ratio $L^*_{i,t}$. Following a shock, $\lambda = 0$ signifies no adjustment and $\lambda = 1$ implies full readjustment back to target. $X_{i,t}$ are firm relevant factors, similar to previous regressions, that have a positive or negative relation to debt. If we rearrange and substitute $\beta X_{i,t}$ for target leverage, we reach Equation 2:

$$L_{i,t} = (1 - \lambda)L_{i,t-1} + \lambda\beta X_{i,t} + \varepsilon_{i,t} \quad (2)$$

β is a coefficient vector and X is a vector with firm-specific leverage factors. According to Nickell (1981), standard OLS is biased upwards because fixed effects are omitted. In equation 3, we divide the error term $\varepsilon_{i,t}$ into firm fixed effect μ_i and Gaussian white noise $\delta_{i,t}$:

$$L_{i,t} = (1 - \lambda)L_{i,t-1} + \lambda\beta X_{i,t} + \mu_i + \delta_{i,t} \quad (3)$$

A study by Baltagi (2005) showed that adding a dummy variable for fixed effects (FE estimator) reduced unobserved heterogeneity but did not completely remove the bias. Leverage is a function of the fixed effects. There is therefore a correlation between $L_{i,t-1}$ and μ_i, and between $L_{i,t-1}$ and $\delta_{i,t}$. It is possible, using Arellano and Bond (AB) (1991) "difference generalized method of moments" (GMM) estimator, to instrument the variables and remove the time-invariant effect:

$$\Delta L_{i,t} = (1-\lambda)\Delta L_{i,t-1} + \lambda\beta\Delta X_{i,t} + \Delta\delta_{i,1} \quad (4)$$

In the equation above, all lagged independent variables can be used to instrument the first difference lagged dependent variables $\Delta L_{i,t-1}$. The AB estimator avoids any biases because second-order serial correlation in the residuals are absent. Despite this, it will be problematic if the instruments convey little information on why leverage changes. This is a distinct problem when the coefficient on the lagged dependent variable is close to being whole, which can be expected for the persistent leverage time series (Huang and Ritter, 2009). Blundell and Bond (BB) (1998) did find a solution to this by introducing a "system GMM estimator", which expands on the AB-estimator. Their system includes both the difference Equation (5) and the level Equation (6):

$$L_{i,t} = (1-\lambda)L_{i,t-1} + \lambda\beta X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (5)$$
$$\Delta L_{i,t} = (1-\lambda)\Delta L_{i,t-1} + \lambda\beta\Delta X_{i,t} + \Delta\delta_{i,1} \quad (6)$$

In Equation 5, the lagged first differences $\Delta L_{i,t-2}, \dots, \Delta L_{i,t-1}$are, according to Drobetz et al., (2013) proper instruments. In Equation 6, the lagged independent variables are accurate instruments. The BB estimator is in general more efficient, because it allows for more instruments (Roodman, 2009). We should furthermore mention that the BB-estimator is still biased when the coefficient on the lagged dependent variable is close to unity or when second order correlation is present (Huang and Ritter, 2009; Flannery and Hankins, 2012).

We have, according to Drobetz et al. (2013), other potential biases associated with speed of adjustment estimates. We will describe two potential tendencies. All estimators in speed of adjustment ignore that leverage is a fractional variable between zero and one. Econometric estimators presume that this is due to mean reversion. Speed of adjustment estimates can therefore be positive even if financing decisions are made randomly (Chang & Dasgupta, 2009).

The mean reversion problem is the subject of a study by Elsas and Florysiak (2010). They suggest using a doubly-censored Tobit estimator, which censors the leverage ratio at zero and one. It relies on a latent variable approach, to take into account the fractional nature of the left-hand side leverage variable. According to Baltagi (2005) and Loudermilk (2007), the "dynamic panel fractional" (DPF) estimator is built on a double-censored conditional variable:

$$L_{i,t} = \begin{cases} 0 & L_{i,t}^{+} \leq 0 \\ L_{i,t}^{+} & 0 < L_{i,t}^{+} < 1 \\ 1 & L_{i,t}^{+} \geq 1 \end{cases} \tag{7}$$

As we can see from the equation above (7), $L_{i,t}^{+}$ is the observed leverage ratio. $L_{i,t}^{+}$ is either equal to zero when it is below zero, or equal to one if it is higher than one. The Tobit estimator mainly corrects data errors, as a leverage ratio which is below zero or higher than one is irregular. Fixed effects specifications capture unobserved heterogeneity and corner solutions:

$$L_{i,t} = (1 - \lambda)L_{i,t-1} + \lambda\beta X_{i,t} + \mu_i + \varepsilon_{i,t} \tag{8}$$

with

$$\mu_i = \alpha_0 + \alpha_1 L_{i,0} + E(X_i)\alpha_2 + \alpha_i \tag{9}$$

Unobserved firm fixed effects μ_i depend on $L_{i,t}^{+}$ and on the mean of the firm specific variables $E(X_i)$. The Tobit estimator is executed through maximum likelihood. Elsas and Florysiak (2010) found that the DPF-estimator is unbiased even if the underlying distribution of fixed effects is not correctly specified. The DPF-estimator in Elsas and Florysiak (2010) shows the lowest bias in their US sample compared with other dynamic panel estimators. This is an important finding.

The iterative bootstrap-based bias corrected (BC) estimator is another method of correcting for biased results (Dang, Kim and Shin, 2010). Everaert and Pozzi (2007) were the first to introduce the bootstrap based bias correction method. The purpose of the bias correction is to reduce the bias in the estimator through bootstrap simulation. It furthermore uses bootstrap simulation to resample the original data, directly or through a fitted model, thereby creating a replicated dataset (Davison and Hinkley, 1997). We will demonstrate the idea behind the bias correction method by illustrating the bias function for the biased estimator:

$$E(\hat{\xi}) \neq \xi \tag{10}$$

In the equation below, a sample has been extracted from the population, and N biased estimates $\widehat{\xi}^*{}_1(\xi), \dots, \hat{\xi}^*{}_N(\xi)$ have been created:

$$E(\hat{\xi}) = \lim_{N \to \infty} \frac{I}{N} \sum_{n=1}^{N} \widehat{\xi^*}_n(\xi) \tag{11}$$

If the condition above holds, then it is clear that $\overline{\xi}$ will be an unbiased estimator of ξ (Shin, 2008).

$$\hat{\xi} = \lim_{N \to \infty} \frac{I}{N} \sum_{n=1}^{N} \widehat{\xi^*}_n(\bar{\xi}) \tag{12}$$

In Equation 12, the unbiased estimator $\overline{\xi}$ needs to be identified. It can be identified by implementing an iterative bootstrap algorithm in the BC estimator, its role being to search over the parameter space. The purpose of this estimation technique is to correct for the bias of the FE estimator, where the coefficients are considered to be unbiased for the true population parameters:

$$L_{i,t}{}^n = \lambda\beta X_{i,t-1} + (1-\lambda)L_{i,t-1}{}^n + \widetilde{\delta_{i,t}}{}^n \tag{13}$$

5. Capital structure and firm performance analysis

5.1 Standard capital structure regressions

We evaluate, in this section, the factors that influence capital structure decisions for shipping companies. The results for both pooled OLS and various fixed effects specifications are given in Table 6. We compare our findings with Drobetz et al. (2013), Rajan and Zingales (1995) and Frank and Goyal (2009).

Column 1 presents the OLS results for four firm specific variables. The coefficients of these standard capital structure variables exhibit almost the same results as previous studies (Drobetz et al., 2013; Rajan and Zingales, 1995; Frank and Goyal, 2009). Tangibility is positively related to debt, which indicates that fixed assets provide some form of collateral for loans, thus increasing debt capacity. For market leverage, the market-to-book ratio is significant and negative. Companies with higher growth presumably suffer from high costs in poor financial times. This is in line with trade-off theory. The coefficient on profitability suggests that higher profitability is associated with a lower debt level. This result is consistent with pecking order theory, in which companies prefer retained earnings rather than debt, and debt rather than equity. Even though size has a relatively small coefficient, it is both positive and significant for both leverage models. This means that the bigger the business is, the more debt it has.

Column 2 includes all firm specific variables in the pooled OLS regression. Our results are again similar to previous studies. Market-to-book is now significant for both book and market leverage. Asset risk has a negative effect on debt when compared with the results of Welch (2004), Lemmon, Roberts and Zender (2008), and Drobetz et al. (2013). We know from section 2.2.2 that volatile assets are likely to enlarge the costs of financial distress (Drobetz et al., 2013). Trade-off theory then supports our findings of a negative relationship between asset risk and debt. Operating leverage is negatively related to the dependent variable. This supports trade-off theory. Firms with high fixed costs have higher business risk and therefore a lower leverage ratio. Lastly, firms who pay dividends tend to have less debt. This is indicated in our results by the negative coefficient on the dividend dummy variable.

The remaining columns in Table 6 show overall consistent results with minor differences. For example, size and operating leverage with some model specification are lost in estimation error. We leave it up to the reader to analyse further. We will, however, also continue the discussion in Section 5.4.

Table 6: Standard leverage regressions

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Dependent variable: Book leverage								
Tangibility	0.418***	0.304***	0.360***	0.337***	0.428***	0.298***	0.333***	0.304***
	(0.052)	(0.053)	(0.065)	(0.066)	0.013	(0.026)	(0.067)	(0.075)
Market-to-book	0.037	0.155***	0.023	0.079***	0.041*	0.149***	0.048**	0.087***
	(0.026)	(0.030)	(0.017)	(0.018)	(0.022)	(0.015)	(0.020)	(0.021)
Profitability	-0.483***	-0.416***	-0.366***	-0.330***	-0.535***	-0.491***	-0.343***	-0.350***
	(0.100)	(0.090)	(0.068)	(0.075)	(0.092)	(0.042)	(0.078)	(0.090)
Size	0.022***	0.008	0.001	-0.016	0.023***	0.007**	0.032*	0.008
	(0.008)	(0.007)	(0.017)	(0.014)	(0.002)	(0.002)	(0.017)	(0.015)
Operating Leverage		-0.078***		0.001		-0.081***		0.009
		(0.023)		(0.030)		(0.009)		(0.033)
Dividend payer		-0.048*		-0.045***		-0.053***		-0.050***
		(0.025)		(0.017)		(0.014)		(0.018)
Asset risk		-0.757***		-0.430***		-0.819***		-0.460***
		(0.085)		(0.074)		(0.057)		(0.091)
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Year fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	1398	1153	1398	1153	1398	1153	1398	1153
Adj. R^2	0.285	0.476	0.688	0.746	0.293	0.490	0.701	0.756
Dependent variable: Market leverage								
Tangibility	0.445***	0.340***	0.323***	0.287***	0.448***	0.327***	0.313***	0.264***
	(0.049)	(0.050)	(0.064)	(0.057)	(0.019)	(0.027)	(0.064)	(0.065)
Market-to-book	-0.152***	-0.066***	-0.156***	-0.114***	-0.141***	-0.061***	-0.121***	-0.092***
	(0.022)	(0.023)	(0.019)	(0.015)	(0.015)	(0.013)	(0.021)	(0.018)
Profitability	-0.492***	-0.408***	-0.349***	-0.282***	-0.433***	-0.380***	-0.218 **	-0.202***
	(0.096)	(0.084)	(0.071)	(0.063)	(0.077)	(0.048)	(0.078)	(0.070)
Size	0.013*	-0.001	0.001	-0.011	0.014***	-0.002	0.028*	0.009
	(0.007)	(0.006)	(0.016)	(0.012)	(0.002)	(0.003)	(0.017)	(0.013)
Operating Leverage		-0.070***		0.014		-0.073***		0.020
		(0.020)		(0.028)		(0.008)		(0.030)
Dividend payer		-0.055**		-0.054***		-0.056***		-0.053***
		(0.024)		(0.014)		(0.012)		0.015
Asset risk		-0.777***		-0.548***		-0.846***		-0.577***
		(0.075)		(0.061)		(0.076)		(0.076)
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Year fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	1398	1153	1398	1153	1398	1153	1398	1153
Adj. R^2	0.409	0.594	0.716	0.798	0.418	0.604	0.741	0.813

Table 6 displays results of the standard regression model using a sample of 115 globally listed shipping companies for the period 1996 - 2016, on an annual basis. All variables except dividend payer are winsorized at the upper and lower two percentile. See Table A2 in the appendix for definitions of variables. Clustered, robust standard errors at a firm level are given in parentheses. Firm fixed effects and year fixed effects indicate whether firm or year specification is used.

* Statistical significance at 10% level.

** Statistical significance at 5% level.

*** Statistical significance at 1% level.

5.2 Explanatory Power

Previous studies have discovered that book leverage models have a smaller R-square than market leverage models. Lemmon, Roberts and Zender (2008) present in their study that explanatory power significantly increases where firm fixed effects are added. This means that company capital structure is driven by an unobserved time invariant component (Drobetz et al., 2013). Standard capital factors therefore become largely irrelevant when regressions encompass time-invariant firm effects. These findings are similar to that discovered by Lemmon, Roberts and Zender (2008) and Drobetz et al. (2013). We notice a large increase in adjusted R-square in Columns 3 and 4, when firm fixed effects are included. The R-square margin increases slightly more when we add year fixed effects, as shown in Columns 7 and 8.

An interesting question with respect to explanatory power is how much financial leverage models should explain. Is there an optimal level of R-square for polled OLS or FE regressions with market leverage as a dependent variable and various firm specific variables as independent variables? We have examined studies of capital structure decisions in different industries and found nine that are well-suited to comparisons. We, for OLS and FE, compare our results with Drobetz et al. (2013), Rajan and Zingales (1995), Frank and Goyal (2009), Lemmon, Roberts and Zender (2008), Sun et al. (2015), Iversen and Noraas (2014), Nilsen and Breituft (2016), Harrison, Panasian and Seiler (2011) and Gropp and Heider (2010). The OLS regressions of seven of the above-mentioned articles and ours gives an R-square mean value of 0.410[12]. The FE regressions R-square average is, as expected, larger with a value of 0.715[13][14]. Do these represent explanatory powers that can be expected from financial leverage models, by considering different industries and market conditions? They certainly provide us with a satisfactory foundation. It is important to note that R-square or goodness of fit is relative to the topic studied, and that researchers may find themselves overly influenced by it. Experience should provide the best indication of whether the goodness of fit is relatively large

[12] Average R-square OLS values: Drobetz et al. (2013) 0.533, Lemmon, Roberts and Zender (2008) 0.376 (US data non-financial firms), Rajan and Zingales (1995) 0.19 (US data non-financial firms), Frank and Goyal (2009) 0.292 (US data non-financial firms), Sun et al. (2015) 0.493 (UK data), Iversen and Noraas (2014) 0.238 (shipbuilding companies), Nilsen and Breituft (2016) 0.567 (shipping companies) and us 0.594 (shipping companies).

[13] In time series or panel data we often get a higher R-square, because of possible significant time trends in the model.

[14] Average R-square FE values: Drobetz et al. (2013) 0.806, Lemmon, Roberts and Zender (2008) 0.45 (non-financial firms), Harrison, Panasian and Seiler. (2011) 0.82 (REITs), Gropp and Heider (2010) 0.880 (Banks), Iversen and Noraas (2014) 0.448 (shipbuilding companies), Nilsen and Breituft (2016) 0.788 (shipping companies) and us 0.813 (shipping companies).

or small (Studenmund, 2014). To that end, roughly 40% of the variance in market leverage can be expected to be explained by the model using OLS and around 70% of the variance of FE.

5.3 Determinants of change in leverage

We, as have previous articles on capital structure such as Drobetz et al. (2013), Baker and Wurgler (2002) and Harrison, Panasian and Seiler (2010), include determinants of change in leverage. Table 7 is set up in the following way: we use a logistic regression model, the dependent variables being dummy variables that indicate changes in level of debt and changes in level of equity for Column 1 and 2 respectively. The dummy variable is set to 1 if a firm in a given year increases its level of debt by more than 10%, zero if not. Approximately the same is applied to equity issuance, an increase of more than 10% being designated by the value of 1, and zero otherwise[15]. For Column 3 and 4, the regressions are composed of annual changes in book and market leverage as conditional variables. All independent variables except dividend payer and price run-up represent annual changes. Price run-up can be explained as the stock return over the last 12 months. Price run-up is added to test for market-timing behaviour. Pecking order theory mentions that equity is considered to have the most severe adverse selection, debt only slight adverse selection, and retained earnings none whatsoever (Frank and Goyal, 2009). Equity issuance takes place at lower levels of information asymmetry. Price run-up is expected to be associated with lower levels of asymmetric information, because a firm's stock prices on average illustrate good return prior to equity issuance (Lucas and McDonald, 1990).

We start our analysis by studying Column 1. The determinates of change in leverage values are similar to Drobetz et al. (2013). Tangibility has a positive effect on the chance of a debt increase. Operating leverage and asset risk have a negative relation to the independent variable, as in the standard leverage regressions. The positive market-to-book and negative price run-up supports market-timing theory. Debt is less likely to be issued if a firm has had a positive return for the last 12 months. In Column 2, size has a reduced but still positive relation to the conditional variable, meaning that as firms get bigger they use debt and equity financing. Furthermore, tangibility, profitability, price run-up and asset risk are now

[15] The 10% threshold is inspired by earlier studies such as Harrison, Panasian and Seiler (2011) and Drobetz et al. (2013), both for debt and equity issuances.

oppositely related. Consequently, more tangible assets mean less chance of issuing equity. More volatile assets also means a greater chance of equity issuance, which is consistent with Bolton and Freixas (2000), firms with riskier assets being constrained to using equity for financing. As suspected, price run-up in Column 2 reveals equity is more likely to be issued where there has been a high return in the last 12 months. Also worth mentioning is that the second column has a lower explanatory power compared with the first model. Finally, Column 3 and 4 and their representation of change in financial leverage offer us results similar to the standard leverage regressions. However, we should note that their explanatory power is quite low.

Table 7: Determinants of change in leverage

	[1] Debt issuer	[2] Equity issuer	[3] Book leverage	[4] Market leverage
ΔTangibility	2.643***	-0.026**	0.407***	0.394***
	(0.463)	(0.012)	(0.088)	(0.101)
ΔMarket-to-book	2.776***	-3.858***	0.631***	-0.241*
	(0.513)	(0.756)	(0.197)	(0.143)
ΔProfitability	0.003	-0.007**	-0.001	-0.001
	(0.004)	(0.004)	(0.001)	(0.001)
ΔSize	69.609***	27.811***	1.270***	1.127**
	(10.576)	(7.126)	(0.453)	(0.540)
ΔOperating Leverage	-0.907*	0.542	-0.101**	-0.103*
	(0.475)	(0.402)	(0.046)	(0.054)
Dividend payer	0.157	-0.119	0.061	0.064
	(0.216)	(0.205)	(0.056)	(0.050)
ΔAsset risk	-0.627***	0.137**	-0.077***	-0.071***
	(0.148)	(0.069)	(0.016)	(0.021)
Price run-up	-0.919***	1.792***	-0.174***	-0.208***
	(0.249)	(0.356)	(0.050)	(0.041)
Observations	996	1026	996	996
Adj. R^2	0.352	0.239	0.100	0.130

The table above displays regression coefficients for determinants affecting the firm's security issuance decisions and changes in leverage ratios. Column 1 represents the firms decision to issue additional debt. Column 2 represents the firms decision to issue additional equity. Both presents results from a logistic regression. The dependent variables are dummy variables that indicate changes in level of debt and changes in level of equity for Column 1 and 2 respectively. If in a given year a firm increases its level of debt by more than 10%, the dummy variable is set equal to 1, and zero if not. Approximately the same implies for equity issuance, where a more than 10% increase in equity is designated with the value of 1, and zero otherwise. In Column 3 and 4, the regressions work with annual changes for book and market leverage as the conditional variables. Datastream provided us with a sample of 115 shipping companies for the period 1996 to 2016, on an annual basis. See table A2 in the appendix for definitions of variables.

* Statistical significance at 10% level.

** Statistical significance at 5% level.

*** Statistical significance at 1% level.

5.4 Comparing the impact of capital structure determinants

The results displayed in Tables 6 and 7 show only small differences between shipping companies and non-shipping companies. In Table 8, we use past studies as benchmarks. Previous studies such as Rajan and Zingales (1995), Frank and Goyal (2009) and Lemmon, Roberts and Zender (2008) have used a variety of non-financial companies, Gropp and Heider (2010) carrying out research on the banking industry and Harrison, Panasian and Seiler (2011) on real estate. We display the results of Drobetz et al. (2013) and Nilsen and Breituft (2016) next to the results obtained in this article. The results from Column 4 are obtained from Bessler et al. (2012). Bessler et al. (2012) worked with a selection of G7 countries. We will also use his elasticity results as a benchmark. This gives us a larger comparison basis for the average elasticity[16] measures.

The shipping industry has some distinctive capital structure dynamics features. One factor in particular is tangibility, which has proven to be influential for shipping companies (Drobetz et al., 2013). Studying Column 1 and the estimated elasticity of tangibility tells us that a 1% increase in the proportion of fixed total assets leads to an increase in financial leverage of 0.43%. Drobetz et al. (2013) obtained a value of 0.46%, which makes it the largest tangibility elasticity in Table 8. More tangible assets are evidently desired by creditors, as they are easier to repossess in the event of bankruptcy. Despite this, financially constrained firms will be offered lower prices for their tangible assets (Pulvino, 1998). According to Campello and Giambona (2012), the redeployability of tangible assets is found to be the most important driver of financial leverage. As a result, only the easily redeployable tangible assets speak for a higher leverage ratio. “Market tangibility” is, conclusively, the driver of leverage (Drobetz et al. 2013).

Supply and demand forces affect commercial ship values in the secondary market. Vessel price risk is, however, crucial in determining the ease with which they are redeployable. This observation is confirmed in Table 8 where the elasticity coefficient indicates that a 1% increase in asset risk will lead to a decrease in debt of 0.50%. Asset risk therefore is a second

[16] We calculate the coefficient elasticity as:

$$\varepsilon_{y,x_k} = \frac{\frac{\delta y}{\bar{y}}}{\frac{\delta x_k}{\bar{x}_k}} = \frac{\delta y}{\delta x} * \frac{\bar{x}_k}{\bar{y}} = b_k * \frac{\bar{x}_k}{\bar{y}}$$

where $\bar{x}_k$ and $\bar{y}$ are the mean of the independent and the dependent variable, and b_k is the regression coefficient of variable k.

considerable factor that is particular to the shipping industry. Drobetz et al. (2013) determined an elasticity of 0.19%, which means our results have a much greater effect. The volatility of assets has a negative relation to the collateral value of assets. This could lead to high financial distress costs (or bankruptcy) and fire sales effects during times of market recession (Pulvino, 1998). Asset risk conclusively has a negative relation to financial leverage. As stated by Benmelech and Bergman (2011), vessel price risk can affect the whole industry in circumstances where one firm's bankruptcy reduces the collateral values of other industry participants. Benmelech and Bergman (2011) found evidence for this in the airline industry. It may also apply to industries where the market for assets is illiquid (Drobetz et al., 2013). The consequence of the decrease in collateral value is increasing cost, the entire industry having fewer opportunities for financing through external debt (Drobetz et al., 2013). Drobetz et al. (2013) also believe that the probability for the sale of ships will increase with a firm's bankruptcy, the increasing supply in vessels exerting a downward pressure on the value of similar vessels. Demand for vessels is also reduced and, through increased supply and reduced demand, bankruptcies contribute to a higher likelihood of vessel fire-sales and lower collateral values. Under these circumstances, the industry-wide cost of debt capital is raised, and opportunities to raise debt are limited (Drobetz et al., 2013).

Drobetz et al. (2013) made a third observation that is specific to the shipping industry. Shipping firms try to reduce their exposure to asset and financial risk by having a low level of operating leverage. The estimated coefficient on operating risk is, similar to Drobetz et al. (2013), lost in estimation error. The relatively high estimated elasticities of Drobetz et al. (2013) and our results nevertheless indicate that increased operating risk is associated with lower leverage. Meulbroek (2002) suggests three fundamental ways of managing a firm's risk profile. First, by modifying its operations[17]. Secondly, by adjusting its capital structure, and lastly by employing targeted financial instruments. The evaluation of each of these together form the firm's risk management strategy. An approach that concentrates on reducing exposure to risk by hedging, leads to less equity being required to support the business (Drobetz et al., 2013). If less equity is required, the use of debt will be favoured and thus supports the negative correlation between operating risk and financial leverage.

[17] Shipping companies can modify their operations by adjusting the amount of vessel that or owned, with the amount of vessels that are leased or chartered in.

In this paragraph we discuss the total risk exposure of shipping companies. This is comprised of their operating business and changes in asset values. As mentioned in the previous paragraph, firms can manage their risk exposure by modifying their operations, using derivative instruments and by adjusting their capital structure. Shipping companies need to consider these three methods together and combine these in an appropriate way. According to Drobetz et al. (2013), high risk firms in the shipping industry are more likely to engage in risk management activities, and vice versa. A negative correlation between asset risk and operating leverage endorses this assumption. Our results in Table 5 show some support of this argument. It is important to note, however, that shipping companies' engagement in risk management activities only pays off if their cost of equity capital is higher than their cost of debt capital plus the cost of hedging (Drobetz et al., 2013).

Table 8: Comparing the impact of capital structure determinants

	[1] Table 6, Column 8	[2] Drobetz et al. (2013), Table 5, Column 8	[3] Nilsen and Breituft (2016), Table 5, Column 8	[4] Bessler et al. (2012) G7 Companies	[5] Rajan and Zingales (1995), Table 9, Panel B	[6] Frank and Goyal (2009), Table 5, Column 9	[7] Lemmon et al. (2008), Table 2, Column 6	[8] Gropp and Heider (2010), Table X, Column 1	[9] Harrison, Panasian and Seiler. (2011), Table 3, Column 4
Tangibility	0.264***	0.283***	0.340***	0.147***	0.33***	0.105***	0.03***	0.006	0.064***
	(0.065)	(0.059)	(0.020)	(0.010)	(0.030)	(0.006)	(0.002)	(0.013)	(0.012)
	[0.427]	[0.457]		[0.228]		[0.128]	[0.037]	[0.002]	[0.109]
Market-to-book	-0.092***	-0.107***	-0.064***	-0.019**	-0.08***	-0.023***	-0.04***	-0.118***	-0.037***
	(0.018)	(0.018)	(0.007)	(0.001)	(0.010)	(0.001)	(0.002)	(0.039)	(0.004)
	[-0.478]	[-0.318]		[-0.178]		[-0.145]	[-0.154]	[-0.144]	[-0.094]
Profitability	-0.202***	-0.272**	-0.356***	-0.124***	-0.60***	-0.114***	-0.05***	-0.392***	-0.956***
	(0.070)	(0.125)	(0.044)	(0.006)	(0.070)	(0.003)	(0.002)	(0.079)	(0.079)
	[-0.088]	[-0.077]		[-0.018]		[-0.008]	[-0.019]	[-0.023]	[-0.109]
Size	0.009	0.006	0.029***	0.024***	0.03***	0.023***	0.03***	0.013**	0.120*
	(0.013)	(0.025)	(0.006)	(0.002)	(0.000)	(0.001)	(0.002)	(0.006)	(0.067)
	[-0.022]	[0.099]		[0.740]		[0.376]	[0.515]	[0.165]	[0.469]
Operating Leverage	0.020	-0.049	0.006	-0.012***			-0.01***		-0.068
	(0.030)	(0.033)	(0.011)	(0.002)			(0.003)		(0.060)
	[-0.126]	[-0.063]		[-0.069]			[-0.002]		[-0.186]
Dividend payer	-0.053***	-0.017	-0.017*	-0.030***		-0.102***	-0.04	-0.010	
	0.015	(0.015)	(0.011)	(0.002)		(0.003)	(0.002)	(0.007)	
	[-0.006]	[-0.034]		[-0.091]			[-0.079]	[-0.011]	
Asset risk	-0.577***	-0.375***	-0.306***	-0.028***				-0.016***	
	(0.075)	(0.120)	(0.022)	(0.006)				(0.003)	
	[-0.500]	[-0.192]		[-0.040]				[-0.001]	
Observations	1153	1007	1970	135995	2207	180552	68224	2415	2409
Adj. R^2	0.813	0.806	0.778	0.726	0.190	0.292	0.450	0.880	0.820

The table above displays regressions from previous empirical studies. The dependent variable is financial leverage. Column 1 represent our result from Table 6 Column 8. Column 2 and 3 display shipping industry results of Drobetz et al. (2013) and Nilsen and Breituft (2016). Column 4 represent result obtained from 14,523 companies from G7 countries (Bessler et al., 2012). Benchmark results based on US data are from Rajan and Zingales (1995), Frank and Goyal (2009), Lemmon, Roberts and Zender (2008). Results from bank and real estate are from Gropp and Heider (2010) and Harrison, Panasian and Seiler (2011). Leverage is defined differently across these studies. Rajan and Zingales (1995) and Frank and Goyal (2009) do not use country or time fixed effects in their analysis. Standard errors are given in parentheses. The results in the square brackets represent coefficients elasticities. Elasticities can be calculated as: $\varepsilon_{y,x_k} = \frac{\frac{\delta y}{\bar{y}}}{\frac{\delta x_k}{\bar{x}_k}} = \frac{\delta y}{\delta x} * \frac{\bar{x}_k}{\bar{y}} = b_k * \frac{\bar{x}_k}{\bar{y}}$ where $\bar{x}_k$ and $\bar{y}$ are the mean of the independent and the dependent variable, and b_k is the regression coefficient of variable k. See Table A2 in the appendix for definitions of variables.

* Statistical significance at 10% level.

** Statistical significance at 5% level.

*** Statistical significance at 1% level.

5.5 Robustness tests

There are many ways of defining leverage. It is therefore important to take these into consideration. According to previous studies, running regressions using lagged values of the independent variable should also be included in robustness checks (Frank and Goyal, 2009; Drobetz et al., 2013). We expect similar results to that found in Table 6 for the standard leverage regressions with lagged independent variables. If we review Table A3 in the appendix, we find that the results are consistent with the non-lagged regressions and remain largely unchanged.

The alternative measures of book and market leverage that we use were inspired by Rajan and Zingales (1995). First, let us review our original leverage measure, which was the ratio of short and long-term debt to total assets. The original measure should be a more appropriate method than the ratio of total liabilities to total assets presented in Column 2. It does, however, have its flaws. It fails to incorporate the idea that some assets are cancelled out by specific non-debt liabilities (Rajan and Zingales, 1995). The third measure examines the ratio of total debt to net assets. We understand net assets to be total assets excluding accounts payable and other liabilities. A negative aspect is that this financial leverage calculation can be affected by factors related to (for example) assets used as collateral for pension liabilities (Rajan and Zingales, 1995). Lastly, the fourth measurement for leverage is total debt divided by capital, capital being interpreted as total debt plus equity[18].

Table A4 in the appendix shows small differences between the original and alternative measures of book and market leverage. Tangibility, profitability and asset risk continue to have the greatest effects on financial leverage. The most relevant leverage measure in our analysis is therefore largely robust against the alternative specifications.

5.6 Regressions with macroeconomic factors

In this part of our analysis we will examine the hypothesis that macroeconomic conditions affect the ways in which firms raise capital. Supply and demand-based theories both, according to Erel et al. (2011), play a relevant role. The demand side of capital theories have their roots in information asymmetry. The supply side, however, looks at how the supply of

[18] One also needs to take into consideration that there are limits to Datastream, and hence the data on the specific variables in the calculations of the alterative leverage measures might be unreliable

capital decreases in times of recession. Erel et al. (2011) found that macroeconomic conditions impact the types of securities firms use and the way they are structured. There is therefore reason to believe that the same would apply to the shipping industry. Export and import throughout the world is, even so, vulnerable to economic fluctuations. Firms might also struggle to raise capital in the form of debt in poor economic times, and consequently be forced to consider capital in the form of equity.

Table 9 analyses macroeconomics factors and their effect on leverage. In Column 1, we repeat the results found in the standard leverage regressions with firm fixed effects. Column 2 incorporates the recession period in a business cycle for the US economy. The expansionary period is frequently associated with increases in equity, because less adverse information is conveyed. Debt is, on the other hand, more likely to be issued in bad economic times (Choe, Masulis and Nanda, 1992). The dummy variable for US recession[19] with its positive coefficient, confirms the argument that leverage is counter-cyclical. The results are also consistent with Hackbarth, Miao and Morellec (2006), who determined the same outcome for market leverage. A study with a large sample of industrial firms from 18 countries likewise discovered that target leverage ratios are significantly linked to firm characteristics and business cycles. These were also found to be counter-cyclical (Halling, Yu and Zechner, 2012). Market-timing and pecking order theory are therefore also compatible with these findings, as higher free cash flows mean firms will use internal funds. In Column 3 we find a similar approach. The difference is that the dummy variable represents a shipping specific recession[20]. The results are almost the same as the previous, the coefficient impact for market leverage being slightly higher.

As for Ferson and Harvey (1994) and Drobetz et al. (2013), we add the following macroeconomic variables in Column 4: G7 inflation rate, lagged term spread between the 10-year and 1-year US Treasury yield, aggregated G7 GDP growth rate, yearly change in the Brent crude oil price and yearly stock market return of the MSCI World Index. We observe from Column 4 that term spread with its negative coefficient is consistent with the results of Drobetz et al. (2013). Term spreads of other factors are used as conditional information in the US market, and typically predict counter-cyclical behaviour (Dahlquist and Harvey, 2001).

[19] National Bureau of Economic Research (see www.nber.org) has given us the US business cycle data. The indicator dummy variable is equal to one if at least six months in a given year represent recession months in the USA. The sample years are 2001, 2008 and 2009.

[20] For the shipping recession dummy, the depressed periods in the shipping industry run from 1998 to 2002 and for 2009.

We also find that stock market returns have a negative effect on market leverage. Debt is therefore less desirable in times of good stock market return. However, this variable is not significant for book leverage. Inflation, GDP growth and oil price are lost in estimation error. This is, however, not all that surprising given that other replicates of Drobetz et al. (2013) have found similar results (Iversen and Noraas, 2014; Nilsen and Breituft, 2016).

Lastly, Column 5 serves as a model that includes macroeconomic variables that are particular to the shipping industry. The following three variables are part of the leverage regressions: yearly change in the Clarkson Index, yearly change in the real trade-weighted US dollar index[21] and yearly change in the Clarkson All Ship Second Hand Price Index[22]. Freight rates appear to have a positive effect on leverage, which would indicate that higher freight rates give firms larger cash flows and thus increased debt capacity. We make an interesting observation for second-hand ship prices. As for Drobetz et al. (2013), vessels that are owned by a shipping company do not seem to act as a form of collateral, because higher ship prices signify higher leverage ratios. If, however, vessels are sold at a high value, the difference between the market value and the book value may end up increasing the equity post, and thus reduce the leverage ratio. The trade weighted US dollar index is insignificant in our model. The US dollar, as the leading maritime currency, therefore signifies little relevance in our model. Briefly and to end we note that all the column related macroeconomic variables seem to have contributed almost nothing to the explanatory power of the model.

[21] Yearly change in the real trade-weighted US dollar index can be calculated as foreign currency over US dollar.
[22] Clarkson's Shipping Intelligence Network provided us with all shipping related data.

Table 9: Macroeconomic determinants of leverage

	[1]	[2]	[3]	[4]	[5]
Tangibility	0.337***	0.332***	0.331***	0.333***	0.324***
	(0.066)	(0.068)	(0.068)	(0.069)	(0.067)
Market-to-book	0.079***	0.081***	0.086***	0.075***	0.077***
	(0.018)	(0.019)	(0.019)	(0.020)	(0.018)
Profitability	-0.330***	-0.328***	-0.321***	-0.342***	-0.316***
	(0.075)	(0.076)	(0.077)	(0.077)	(0.080)
Size	-0.016	-0.017	-0.010	-0.010	-0.019
	(0.014)	(0.014)	(0.012)	(0.014)	(0.014)
Operating Leverage	0.001	-0.001	0.002	0.003	0.001
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Dividend payer	-0.045***	-0.046***	-0.046***	-0.049***	-0.044**
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Asset risk	-0.430***	-0.457***	-0.436***	-0.432***	-0.467***
	(0.074)	(0.085)	(0.076)	(0.079)	(0.083)
Recession (US)		0.019			
		(0.013)			
Recession (shipping)			0.025**		
			(0.012)		
Inflation				0.172	
				(0.526)	
Term Spread$_{t-1}$				-0.011**	
				(0.004)	
GDP growth				0.273	
				(0.448)	
Oil Price				0.001	
				(0.008)	
Stock market returns				-0.035	
				(0.029)	
Freight rates					0.033***
					(0.010)
FX USD					-0.036
					(0.061)
Secondhand ship price					-0.072***
					(0.024)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1153	1153	1153	1129	1153
Adj. R^2	0.756	0.747	0.748	0.748	0.748
Tangibility	0.264***	0.278***	0.276***	0.282***	0.269***
	(0.065)	(0.059)	(0.060)	(0.061)	(0.056)
Market-to-book	-0.092***	-0.111***	-0.102***	-0.106***	-0.117***
	(0.018)	(0.016)	(0.017)	(0.017)	(0.015)
Profitability	-0.202***	-0.279***	-0.268***	-0.275***	-0.248***
	(0.070)	(0.062)	(0.063)	(0.064)	(0.064)
Size	0.009	-0.012	-0.001	-0.006	-0.016
	(0.013)	(0.012)	(0.011)	(0.012)	(0.012)
Operating Leverage	0.020	0.011	0.015	0.012	0.015
	(0.030)	(0.028)	(0.028)	(0.029)	(0.027)
Dividend payer	-0.053***	-0.056***	-0.056***	-0.057***	-0.052***
	0.015	(0.015)	(0.014)	(0.015)	(0.014)
Asset risk	-0.577***	-0.589***	-0.557***	-0.552***	-0.605***
	(0.075)	(0.071)	(0.062)	(0.067)	(0.070)
Recession (US)		0.030**			
		(0.012)			
Recession (shipping)			0.041***		
			(0.011)		
Inflation				-0.700	
				(0.481)	
Term Spread$_{t-1}$				-0.007	
				(0.004)	
GDP growth				0.158	
				(0.435)	

	[1]	[2]	[3]	[4]	[5]
Oil Price				0.006	
				(0.008)	
Stock market returns				-0.055*	
				(0.031)	
Freight rates					0.032***
					(0.010)
FX USD					-0.022
					(0.062)
Secondhand ship price					-0.102***
					(0.023)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1153	1153	1153	1129	1153
Adj. R^2	0.813	0.800	0.803	0.800	0.803

Table 9 displays the result of the standard leverage regression with macroeconomic variables. Datastream provided us with a sample of 115 shipping companies for the period 1996 to 2016, on an annual basis. All variables except dividend payer are winsorized at the upper and lower two percentile. All specifications include firm fixed effects. See Table A2 in the appendix for definitions of variables. Clustered, robust standard errors at firm level are given in parentheses.
* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

5.7 Firm performance estimates

We analyse, in this section, the results displayed in Table 10 in correspondence with the theory on firm performance in Section 2.3. The results will hopefully give us an indication of whether leverage and a set of firm specific variables have an impact on various performance measures. We use both the OLS and FE method, similar to the standard leverage regressions. All independent variables are lagged to avoid any simultaneity problems. According to Margaritis and Psillaki (2009), the effect of leverage on firm performance and the reverse effect are not expected to be immediate. Time lags are furthermore also considered to improve the model in view of the firm specific variables' effect on firm performance.
Table 10 shows that leverage has a positive and significant effect on Tobin's Q (Q) and return on sales (ROS). Higher leverage is associated with improved firm performance, which supports agency costs theory. The results show that there is a lower chance of managers wasting free cash on inefficiencies, because debt is used as a disciplinary device. In the OLS regression, return on assets (ROA) is significant and negatively related to leverage, possibly explained by high default costs of having too much debt. This finding is supported by previous firm performance studies such as Gleason, Mathur and Mathur (2002), Tzelepis, and Skuras (2004) and Krishnan and Moyer (1997).

Tangibility is inversely related to all firm performance measures. As a consequence, higher amounts of tangible assets are expected to reduce firm performance. Margaritis and Psillaki (2009) explain this finding based on the idea that more tangible assets reduce the firm's growth opportunities and thereby lower the agency costs associated with managers' decision making. Profitability is significant and has a positive relation to the different dependent variables. The results suggest that higher profitability is associated with higher firm efficiency. Firm size is significant and inversely related in the FE models. Firm size is expected to have a negative effect on Tobin´s Q, because more established and mature firms have lower growth potential then younger firms. Asset risk appears to only have a significant effect upon Tobin’s Q. It has a positive relation to firm performance, suggesting that more volatile assets indicate higher performance. Lastly, dividend policy is likely to have a positive effect on firm performance. Dividends can increase firm performance through reduced information asymmetry between managers and shareholders. The results of the ROS and ROA models support a positive relationship between dividends and firm performance.

Table 10: Firm performance regressions

Dependent variable	Return on assets (ROA)		Tobin´s Q (Q)		Return on sales (ROS)	
$Leverage_{t-1}$	-0.018	0.019	0.490***	0.318***	0.222***	0.292***
	(0.017)	(0.028)	(0.094)	(0.104)	(0.071)	(0.112)
$Tangibility_{t-1}$	-0.039***	-0.057*	-0.258***	-0.167	-0.309***	-0.148
	(0.015)	(0.030)	(0.066)	(0.106)	(0.074)	(0.130)
$Profitability_{t-1}$	0.429***	0.185***	0.731***	0.542***	1.255***	0.769***
	(0.044)	(0.059)	(0.223)	(0.190)	(0.181)	(0.254)
$Size_{t-1}$	-0.001	-0.030***	-0.010	-0.128***	-0.002	-0.089**
	(0.002)	(0.008)	(0.008)	(0.031)	(0.006)	(0.037)
Asset $risk_{t-1}$	0.015	0.025	0.810***	0.229	0.159	-0.007
	(0.026)	(0.039)	(0.144)	(0.148)	(0.110)	(0.173)
Dividend payer	0.020***	0.021***	-0.035	0.038	0.116***	0.076***
	(0.006)	(0.008)	(0.030)	(0.026)	(0.025)	(0.036)
Firm fixed effects	No	Yes	No	Yes	No	Yes
Year fixed effects	No	Yes	No	Yes	No	Yes
Observations	1230	1230	1233	1233	1235	1235
Adj. R^2	0.215	0.357	0.085	0.540	0.126	0.304

Table 10 displays the results of the firm performance regression with lagged independent variables (except dividend payer). The sample consist of 115 globally listed shipping companies for the period 1996 - 2016, on an annual basis. All variables except dividend payer are winsorized at the upper and lower two percentile. See Table A2 in the appendix for definitions of variables. Robust standard errors at a firm level are given in parentheses.
* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

6. Speed of adjustment analysis

So far, we have reviewed the firm specific and macroeconomic factors that can affect leverage decisions and reviewed how these relate to predictions. In this section, we turn to the dynamics of capital structure choices. For the shipping industry in particular, we want to estimate speed of adjustment back to target level ratio. The six types of different speed of adjustment models we use are: ordinary least squares (OLS), fixed effects (FE), Arellano and Bond (AB) (1991) difference generalized method of moments (GMM) estimator, Blundell and Bond (BB) (1998) system GMM estimator, the dynamic panel fractional (DPF) estimator and bootstrap-based bias corrected (BC) estimator.

6.1 Evidence from previous studies

We present, in this section, a couple of speed of adjustment findings from other studies. Flannery and Rangan (2006) observed a more than 30% per year market leverage speed of adjustment, the results of the US sample with fixed effects indicating a relative quick return to target level ratio. Lemmon, Roberts and Zender (2008) found, based on insights from Flannery and Rangan (2006), speed of adjustment to be 39% for book leverage and with fixed effects. Huang and Ritter (2009) detected a slower speed of adjustment than Flannery and Rangan (2006). Their US data for fixed effects values for book and market leverage were 19.7% and 24.6% respectively.

Another interesting finding was made by Öztekin and Flannery (2011) that speed of adjustment can be 50% higher in countries with strong institutions, financial systems and effective capital markets. In general, adjustment costs and benefits are important reliable factors of adjustment speed back to target leverage ratio. For instance, firms with below-median debt or equity issuing costs achieve an estimated 11% faster adjustment speed (Öztekin and Flannery, 2011).

Studies that include macroeconomic conditions such as Hackbarth, Miao and Morellec (2006), suggest that the speed and size of adjustment are influenced by current economic conditions. Firms should adjust their capital structure, specifically in the expansion phase of the business cycle, more often than in the recession phase. Furthermore, Cook and Tang (2010) and Halling, Yu and Zechner (2012) similarly find evidence of a connection between adjustment speed and macroeconomic conditions. Both report a slower speed of adjustment in times of recession.

Drobetz et al. (2013) also mention studies that review firm-specific factors and their effect on speed of adjustment levels. For example, more aggressive changes in leverage ratios are associated with firms that have large levels of operating cash flows (Faulkender et al., 2011). There is also heterogeneity in speed of adjustment for factors such as firm size, market-to-book and industry classification (Elsas and Florysiak, 2011).

6.2 Speed of adjustment estimates

The estimators introduced in Section 4.6 help us understand the theory behind the regressions run in Table 11[23]. We decided, in our speed of adjustment regressions, to include a set of previously used firm specific variables and an interaction term that combines a one-period lagged leverage measure and a US recession dummy. The logic behind this is that it allows us to analyse speed of adjustments over different business cycle periods. The speed of adjustment values are obtained by subtracting the lagged leverage ratio coefficients from one. These can, furthermore, be translated into half-lives of the influence of a shock on financial leverage[24] (Drobetz et al., 2013).

A first examination of Table 11 reveals that adjustment speeds vary depending on which estimator is used[25]. Adjustment speed estimates are also higher for market leverage than for book leverage[26] and the difference between adjustment speed with and without recession is larger for market leverage. Drobetz et al. (2013) focused on average adjustment speeds of all estimators instead of trying to interpret and compare every single one. We did the same in our analysis, but excluded the BC estimator for the reason that it was not included in Drobetz et al. (2013). He found the mean of all estimates for book leverage to be 40%. We got a slightly higher value of 46%. We furthermore obtained a half-life of 1.11 years. During a recession,

[23] Firm-specific explanatory variables are treated as exogenous for the AB- and BB-estimator specifications. The lagged leverage variables are modelled to be predetermined (Drobetz et al., 2013).
[24] We calculate the half-life of a leverage shock by $\log(0.5)/\log(1-\lambda)$, where λ is the estimate of speed of adjustment (Drobetz et al., 2013).
[25] The plus/minus signs corresponding to the estimated coefficients are to some extent similar to previous results (Table 6).
[26] There is no evidence on whether market leverage should have higher adjustment speed compared to book leverage or vice versa. One should then be somewhat careful when comparing the different half-life's.

our average speed of adjustment is 42.5%, giving us a half-life leverage shock of 1.25 years. The mean estimated adjustment speed for market leverage is 61%, 52% during a recession. The corresponding half-lives are 0.74 and 0.95 years. Drobetz et al. (2013) found their average mean adjustment speed for market leverage to be 58.9%, which is similar to our result. Prior studies include results of 30%, 39% and 19% (see Section 6.1), all book leverage values with fixed effects. When we compare this with our fixed effects value of 49%, we find that shipping companies tend to adjust their leverage level back to target quicker. For the BC estimator, the speed of adjustment value of 30.2% for book leverage is almost identical to the OLS result. For market leverage, however, the BC estimator is similar to the DPF estimator. According to De Vos, Everaert and Ruyssen (2015), the BC estimator should be the most appropriate method for speed of adjustment analysis, because the GMM estimators lead to unstable estimates over alternative instrument sets.

Let us consider these results in more detail. Theory mentions that speed of adjustment depends on costs associated with being at target leverage and costs accompanied with adjusting back to target. The trade-off between the two is what managers evaluate. According to Drobetz et al. (2013), shipping companies are financially constrained, and are expected to face high adjustment costs and slow adjustment speeds back to target after experiencing a shock. Despite this, we know that shipping companies have above average leverage ratios. Being above or off target therefore is associated with severe costs. As a result, faster adjustments are necessary, as confirmed by the results of our study in Table 11. Being overleveraged versus being underleveraged should also be taken into consideration. Faulkender et al. (2011) found that adjustment speeds are slower when having too little debt than when over target. Returning to the speed of adjustment results during recession, our results confirm business cycle dependencies. As Drobetz et al. (2013) sees it, we should expect much lower adjustment speeds in bad economic times. Raising debt is likely to be costlier and banks are likely to restrict loans, thus leading to increased adjustment costs.

Table 11: Speed of adjustment analysis

	[1] OLS	[2] FE	[3] AB	[4] BB	[5] DPF	[6] BC
Dependent variable: Book leverage						
Book leverage$_{t-1}$	0.706***	0.512***	0.415***	0.434***	0.609***	0.698***
	(0.032)	(0.058)	(0.031)	(0.028)	(0.023)	(0.056)
Book leverage$_{t-1}$ * Recession (US)	0.055***	0.041**	0.027*	0.025*	0.052***	0.036**
	(0.016)	(0.016)	(0.015)	(0.015)	(0.017)	(0.016)
SOA (%)	29.4	48.8	58.5	56.6	39.1	30.2
SOA-Recession (%)	23.9	44.7	55.8	54.1	33.9	26.6
Tangibility	0.136***	0.254***	0.328***	0.331***	0.210***	0.198***
	(0.023)	(0.058)	(0.033)	(0.031)	(0.021)	(0.050)
Market-to-book	0.059***	0.066***	0.056***	0.062***	0.078***	0.072***
	(0.014)	(0.015)	(0.012)	(0.012)	(0.009)	(0.016)
Profitability	-0.371***	-0.346***	-0.389***	-0.369***	-0.356***	-0.339***
	(0.046)	(0.066)	(0.037)	(0.037)	(0.034)	(0.066)
Size	0.003	-0.001	-0.004	-0.003	0.005	0.004
	(0.002)	(0.007)	(0.007)	(0.006)	(0.003)	(0.006)
Operating Leverage	-0.027***	-0.022	-0.007	0.003	-0.029***	-0.015
	(0.009)	(0.027)	(0.017)	(0.017)	(0.010)	(0.029)
Dividend payer	-0.005	-0.015	-0.017*	-0.018*	-0.009	-0.006
	(0.007)	(0.011)	(0.010)	(0.010)	(0.008)	(0.010)
Asset risk	-0.260***	-0.266***	-0.226***	-0.232***	-0.316***	-0.222***
	(0.046)	(0.059)	(0.037)	(0.036)	(0.033)	(0.061)
Observations	1113	1113	986	1113	1113	1074
Dependent variable: Market leverage						
Market leverage$_{t-1}$	0.579***	0.347***	0.276***	0.312***	0.434***	0.434***
	(0.025)	(0.038)	(0.024)	(0.023)	(0.023)	(0.040)
Market leverage$_{t-1}$ * Recession (US)	0.128***	0.092***	0.074***	0.067***	0.110***	0.096***
	(0.019)	(0.021)	(0.016)	(0.016)	(0.019)	(0.022)
SOA (%)	42.1	65.3	72.4	68.8	56.6	56.6
SOA-Recession (%)	29.3	56.1	65.0	62.1	45.6	47.0
Tangibility	0.162***	0.214***	0.240***	0.282***	0.222***	0.174***
	(0.022)	(0.042)	(0.034)	(0.031)	(0.024)	(0.046)
Market-to-book	-0.052***	-0.093***	-0.135***	-0.136***	-0.067***	-0.095***
	(0.009)	(0.016)	(0.012)	(0.012)	(0.011)	(0.017)
Profitability	-0.330***	-0.272**	-0.325***	-0.340***	-0.299***	-0.277***
	(0.034)	(0.053)	(0.037)	(0.035)	(0.035)	(0.055)
Size	-0.001	-0.010	-0.022***	-0.025***	-0.003	-0.008
	(0.002)	(0.007)	(0.008)	(0.006)	(0.004)	(0.007)
Operating Leverage	-0.035***	-0.005	0.009	-0.001	-0.030**	-0.001
	(0.008)	(0.024)	(0.016)	(0.016)	(0.014)	(0.030)
Dividend payer	-0.022***	-0.037***	-0.035***	-0.034***	-0.031***	-0.031***
	(0.007)	(0.011)	(0.010)	(0.010)	(0.008)	(0.012)
Asset risk	-0.424***	-0.469***	-0.410***	-0.388***	-0.506***	-0.431***
	(0.036)	(0.050)	(0.035)	(0.035)	(0.034)	(0.057)
Observations	1057	1057	934	1057	1057	1020

The table above displays speed of adjustment for OLS, FE, AB, BB, DPF and BC estimator for 115 globally listed shipping companies for the period 1996 - 2016, on an annual basis. Column 1 represents standard ordinary least square method (OLS). For the FE estimator in Column 2, both firm and year fixed effects are applied. Column 3 is estimated with Arellano and Bond (1991) difference GMM-estimator (AB). In Column 4, the Bundell and Bond (1998) system GMM-estimator is used. Column 5 uses the Elsas and Florysiak (2010) DPF-estimator, and Column 6 uses the Bootstrap-based bias correction-estimator (BC). The percentage of speed of adjustment (SOA) is given in row 3 and 4. It explains how fast the companies return to its target leverage ratio. Robust standard errors for OLS and FE and normal standard errors for the other methods are given in parentheses. See Table A2 in the appendix for definitions of variables.
* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

7. Conclusion

The purpose of this master thesis was to analyse the factors that have an influence on capital structure in the shipping industry. Shipping companies, with their high leverage ratios, have to deal with increased financial risk. They therefore benefit from access to global capital markets. We determined which factors, based on a set of traditional capital structure variables suggested by previous studies, have an impact on the leverage ratio in the maritime industry.

The results of our thesis are similar to prior studies which show that traditional factors have a considerable effect on the leverage ratio and that the degree of importance of each factor is different than for other industries. The most important company specific factors are tangibility, profitability and asset risk. Shipping companies with high levels of tangibility are likely to have higher leverage ratios, whereas greater profitability and asset risk contribute to a lower leverage ratio. There is no theory that can alone explain the optimal capital structure in the maritime industry. Profitability, for example, can be explained by both pecking order theory and trade-off theory. Overall, our findings show that trade-off theory was the most relevant theory. When we included macroeconomic variables, we discovered that these only had a low influence on financial leverage. Pecking order theory was seen to be the most relevant to the macroeconomic regression results, because they indicate that financial leverage is mainly counter-cyclical.

We used, in the firm performance analysis, a leverage variable and a set of standard dependent variables. Our results, however, contradict each other depending on which performance measures were adopted. On the one hand, Tobin´s Q and return on sales are consistent with agency cost theory, while on the other hand, return on asset opposes it.

Several dynamic panel estimators were used to analyse the speed of adjustment. The results were compared with other industries, the general conclusion being that adjustment speeds are much higher for the shipping industry. In times of recession, adjustment speeds are slower. In general, the relatively high adjustment speeds for shipping companies imply significant costs associated with deviating from target. This can be based on the expectance of high financial distress costs.

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Appendix

A1 - Methodical approach in detail

Ordinary least squares continued:

In our analysis we use multiple regression, and a general regression equation used in panel data may be expressed in the following way:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \cdots + \beta_K X_{Kit} + \varepsilon_{it} \qquad (1)$$

Where *i* are number of companies and *t* is the number of years.

To use OLS, Corr (ε_i, ε_j|x) = 0 for every i ≠ j. In other words, we do not have correlations between the residuals in different time periods.

Fixed effects continued:

The simplest model that can be specified for panel data is as follows:

$$Y_{it} = \beta_0 + \beta_1 x_{it1} + \beta_2 x_{it2} + \cdots + \beta_k x_{itk} + \alpha_i + u_{it} \quad t = 1,..,T, \quad i = 1,..,n \qquad (2)$$

Above, x_{itn} is the value of independent variable *nte* for unit *i* at time *t*. We can put together the factors α_i and u_{it} into a common error term v_{it},, where α_i represents heterogeneity and u_{it} are residuals that are not derived from unobserved heterogeneity. Furthermore, we calculate the average of every *i* over the period. This gives us the following equation:

$$\bar{Y}_i = \beta_0 + \beta_1 \bar{x}_i + \beta_2 \bar{x}_i + \cdots + \beta_k \overline{x}i + \alpha_i + \bar{u}_i \qquad (3)$$

Here, the average of β_0 and α_i will be constant, such that they are expressed in the same way as in Equation 2. When we deduct Equation 2 from Equation 1, we get the equation below:

$$y_{it} - \overline{Y}i = \beta_0(1-1) + \beta_1(x_{it1} - \overline{x}i) + \cdots + \beta_k(x_{itk} - \overline{x}i) + (\alpha_i - \alpha_i) + (u_{it} - \overline{u}i) \quad (4)$$

If we remove unobserved effects, the coefficients of the omitted variables are unaffected.

In general, fixed effects permits Cov $(x_{itj}, u_{it}) \neq 0$, were t = 1, 2, …, T, and j = 1, 2, …, k.

Logistic regression continued:

It is possible to have several different categorical variables, but in this paper we apply only one binary variable, Y. Furthermore, we want to moderate the contingent probability P (Y = 1 | X = x), as a function of *x* (Faraway, 2006).

Unknown parameters are estimated using the probability maximization estimator. The simplest modification of log p is the logistic transformation log($\frac{p}{1-p}$). We express the logistic regression in the following way:

$$\log\left(\frac{p(x)}{1-p(x)}\right) = \beta_0 + \sum_{i=1}^{n} \beta_1 x_i \tag{5}$$

If the above equation is solved with regard to p, we get the following equation:

$$p(x) = \frac{e^{\beta_0 + \sum_{i=1}^{n} \beta_1 x_i}}{1+e^{\beta_0} \sum_{i=1}^{n} \beta_1 x_i} = \frac{e^U}{1+e^U} = \frac{1}{1+e^{-U}} \tag{6}$$

The above expression can be understood as the logistic function, where U is the linear regression equation and i = 1, ..., n. In such a model, one can ignore the assumptions of normal OLS. It is assumed however, that the error terms are independent and that we have a sufficient number of observations.

Table A2 - Definition of variables

	Definition	Source	Database codes
Firm-level variables			
Book Leverage	Ratio of long- and short-term debt to total book assets	Datastream	(dltt+dlc)/at
Market Leverage	Ratio of long- and short-term debt to the market value of assets	Datastream	(dltt+dlc)/(at-ceq+mkval)
Debt issuer	If in a given year a firm increases its level of debt by more than 10%, the dummy variable is set to equal 1, zero if not	Datastream	=1 if dt_change > 0.1
Equity issuer	If in a given year a firm increases its level of equity by more than 10%, the dummy variable is set to equal 1, zero if not	Datastream	=1 if te_change > 0.1
Tangibility	Ratio of fixed to total book assets	Datastream	ppent/at
Market-to-book	Ratio of the market value of assets to book value of assets	Datastream	(at-ceq+mkval)/at
Profitability	Ratio of operating income before depreciation to total book assets	Datastream	oibdp/at
Size	Natural logarithm of total book assets	Datastream	Log(at/1000)
Operating leverage	Ratio of operating expense to total book assets	Datastream	xopr/at
Dividend payer	Indicator dummy variable equal to one if a firm pays dividends in a given year	Datastream	=1 if dv > 0
Asset risk	Unleveraged annualized standard deviation of a firm's daily stock price returns	Datastream	SD(r_t) * (mkval/(at-ceq+mkval)
Price run-up	Stock return over the 12 months immediately preceding the leverage observation	Datastream	-
Macroeconomic variables			
Recession (US)	Indicator dummy variable equal to one if at least six months in a given year are classified as recession months in the USA by the National Bureau of Economic Research	NBER	-

Recession (Shipping)	Indicator dummy variable equal to one during depressed periods in the shipping industry (the years 1998 to 2002 and 2009)	-	-
Term spread	One period lagged term spread between the 10-year interest series and the one-year interest series of US treasuries	Federal Reserve	-
GDP growth	Aggregated growth rate in the G7 countries	Data OECD	Real GDP forecast
Oil price	Annual change in the Brent crude oil price	Datastream	CRUDOIL
Stock market returns	Annual stock market return of the MSCI World Index	Datastream	MSWRLD$
Freight Rates	Annual change in the Clarksea Index (aggregated freight rates denominated in US dollar)	Clarksons Research	-
FX USD	Annual change in the real-trade weighted US dollar index "Major Currencies"	Federal Reserve	-
Secondhand ship price	Annual change in the Clarkson All Ships Second Hand Price Index	Clarksons Research	-

Alternative leverage measures and additional variables (robustness checks)

Book leverage (2)	Ratio of total (non-equity) liabilities to total book assets	Datastream	(at-ceq)/at
Book leverage (3)	Ratio of debt to net book assets	Datastream	(dlc+dltt)/(at-lct+dlc)
Book leverage (4)	Ratio of total debt to book capital	Datastream	(dlc +dltt)/(ceq+dlc+dltt)
Market leverage (2)	Ratio of total (non-equity) liabilities to market value of assets	Datastream	(at-ceq)/(at-ceq+mkval)
Market leverage (3)	Ratio of total debt to the net market value of assets	Datastream	(dlc+dltt)/(at-ceq+mkval-lct+dlc)
Market leverage (4)	Ratio of total debt to market value of capital	Datastream	(dlc+dltt)/(mkval+dlc +dltt)
Firm performance			
Return on assets	Ratio of net profit to total assets	Datastream	ni/at
Tobin´s Q	Ratio of book value of total debts plus market value of equity over book value of total assets	Datastream	(at+(csho * prcc_f)-ceq)/at
Return on sales	Ratio of net income before taxes over net sales	Datastream	ni/sale

Table A3 - Standard leverage regressions with lagged independent variables

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Dependent variable: Book leverage								
$Tangibility_{t-1}$	0.397***	0.284***	0.269***	0.164***	0.404***	0.275***	0.232***	0.131*
	(0.054)	(0.057)	(0.060)	(0.060)	(0.017)	(0.024)	(0.066)	(0.069)
$Market\text{-}to\text{-}book_{t-1}$	0.024	0.136***	-0.000	0.050**	0.020	0.129***	0.010	0.051**
	(0.026)	(0.034)	(0.019)	(0.021)	(0.018)	(0.021)	(0.025)	(0.024)
$Profitability_{t-1}$	-0.483***	-0.322***	-0.302***	-0.171**	-0.534***	-0.368***	-0.286***	-0.167**
	(0.109)	(0.095)	(0.072)	(0.068)	(0.064)	(0.061)	(0.079)	(0.082)
$Size_{t-1}$	0.024***	0.012	0.011	0.000	0.025***	0.010***	0.037**	0.019
	(0.008)	(0.007)	(0.018)	(0.015)	(0.002)	(0.003)	(0.018)	(0.019)
Operating $Lev._{t-1}$		-0.093***		-0.042		-0.094***		-0.026
		(0.024)		(0.035)		(0.010)		(0.037)
Dividend $payer_{t-1}$		-0.053*		-0.041**		-0.057***		-0.043**
		(0.027)		(0.018)		(0.015)		(0.020)
Asset $risk_{t-1}$		-0.654***		-0.290***		-0.726***		-0.306***
		(0.089)		(0.079)		(0.067)		(0.097)
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Year fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	1284	1136	1284	1136	1284	1136	1284	1136
Adj. R^2	0.267	0.406	0.683	0.724	0.272	0.418	0.695	0.735
Dependent variable: Market leverage								
$Tangibility_{t-1}$	0.448***	0.361***	0.269***	0.213***	0.441***	0.333***	0.224***	0.154**
	(0.051)	(0.055)	(0.055)	(0.060)	(0.020)	(0.027)	(0.062)	(0.069)
$Market\text{-}to\text{-}book_{t-1}$	-0.108***	-0.029	-0.059***	-0.036**	-0.119***	-0.035**	-0.061***	-0.029
	(0.022)	(0.028)	(0.015)	(0.016)	(0.012)	(0.016)	(0.020)	(0.019)
$Profitability_{t-1}$	-0.608***	-0.501***	-0.492***	-0.405***	-0.550***	-0.435***	-0.371***	-0.274***
	(0.099)	(0.101)	(0.075)	(0.082)	(0.072)	(0.088)	(0.078)	(0.089)
$Size_{t-1}$	0.017**	-0.008	0.015	0.010	0.017***	0.003	0.035**	0.024
	(0.007)	(0.007)	(0.016)	(0.014)	(0.002)	(0.004)	(0.018)	(0.018)
Operating Lev_{t-1}		-0.090***		-0.042		-0.090***		-0.025
		(0.022)		(0.034)		(0.011)		(0.039)
Dividend $payer_{t-1}$		-0.050*		-0.048**		-0.052***		-0.045**
		(0.027)		(0.019)		(0.015)		(0.018)
Asset $risk_{t-1}$		-0.508***		-0.154**		-0.656***		-0.253***
		(0.090)		(0.074)		(0.089)		(0.084)
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Year fixed effects	No	No	No	No	Yes	Yes	Yes	Yes
Observations	1284	1136	1284	1136	1284	1136	1284	1136
Adj. R^2	0.363	0.446	0.685	0.705	0.384	0.490	0.721	0.748

Table A2 displays results of standard regression model with a one period lagged independent variable. The sample consist of 115 globally listed shipping companies for the period 1996 - 2016, on an annual basis. All variables except dividend payer are winsorized at the upper and lower two percentile. See Table A2 in appendix for definitions of variables. Clustered, robust standard errors at firm level are given in parentheses. Firm fixed effects and years fixed effects indicate whether firm or year specification is used.

* Statistical significance at 10% level.

** Statistical significance at 5% level.

*** Statistical significance at 1% level.

Table A4 - Standard leverage regressions with alternative leverage measures

	Book leverage (2)	Book leverage (3)	Book leverage (4)	Market leverage (2)	Market leverage (3)	Market leverage (4)
Dependent variable: Alternative leverage measures						
Tangibility	0.157**	0.280***	0.291***	0.128*	0.247***	0.223***
	(0.074)	(0.082)	(0.081)	(0.068)	(0.072)	(0.070)
Market-to-book	0.134***	0.097***	0.101***	-0.125***	-0.121***	-0.107***
	(0.027)	(0.029)	(0.034)	(0.023)	(0.022)	(0.024)
Profitability	-0.411***	-0.419***	-0.428***	-0.239***	-0.248**	-0.251**
	(0.071)	(0.092)	(0.089)	(0.075)	(0.078)	(0.080)
Size	0.024	0.011	0.052**	0.017	0.000	0.018
	(0.021)	(0.018)	(0.022)	(0.020)	(0.016)	(0.017)
Operating Leverage	0.140**	0.010	0.101*	0.135**	0.047	0.090**
	(0.053)	(0.061)	(0.053)	(0.060)	(0.054)	(0.041)
Dividend payer	-0.053***	-0.063***	-0.059**	-0.059***	-0.062***	-0.064***
	(0.019)	(0.022)	(0.025)	(0.016)	(0.016)	(0.017)
Asset risk	-0.631***	-0.506***	-0.574***	-0.788***	-0.688***	-0.816***
	(0.097)	(0.113)	(0.121)	(0.083)	(0.084)	(0.088)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1153	1122	1153	1153	1122	1153
Adj. R^2	0.777	0.721	0.741	0.827	0.803	0.824

The table above displays alternative leverage measures. Both firm and year fixed effects have been used. Datastream provided us with a sample of 115 shipping companies for the period 1996 to 2016, on an annual basis. All variables except dividend payer are winsorized at the upper and lower two percentile. See Table A2 in the appendix for definitions of variables (book and market leverage (2)-(4)). Clustered, robust standard errors are given in parentheses.
* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

Table A5 - F-test for all companies with book leverage as dependent variable

Variables: 4

Number of observations	=	1398
F	=	139.99
Prob. > F	=	0.0000

Variables: 7

Number of observations	=	1153
F	=	150.21
Prob. > F	=	0.0000

Table A6 - F-test for all companies with market leverage as dependent variable

Variables: 4		
Number of observations	=	1398
F	=	242.26
Prob. > F	=	0.0000

Variables: 7		
Number of observations	=	1153
F	=	242.08
Prob. > F	=	0.0000

Table A7 - Woolridge test for book leverage

Variables: 7		
H0: no first-order autocorrelation	=	
F	=	20.223
Prob. > F	=	0.0000

Table A8 - Woolridge test for market leverage

Variables: 7		
H0: no first-order autocorrelation	=	
F	=	43.060
Prob. > F	=	0.0000

Table A9 - Hausman's test

	(b) FE	(B) RE	(b-B) Difference	Sqrt(diag(V_b-V_B)) Standard Error
Tangibility	0.337	0.339	-0.002	0.017
Market-to-book	0.079	0.102	-0.022	0.005
Profitability	-0.330	-0.314	-0.016	0.011
Size	-0.016	-0.003	-0.012	0.004
Operating leverage	0.001	-0.019	0.020	0.007
Dividend payer	-0.045	-0.047	0.001	0.003
Asset risk	-0.430	-0.498	0.068	0.012

H_0: Difference in coefficients not system systematic
Chi2(7) = 46.12
Prob>chi2 = 0.000

Table A10 - VIF test

Variable VIF	VIF	VIF/1
Tangibility	1.38	0.724
Operating Leverage	1.25	0.798
Asset Risk	1.25	0.799
Market-to-book	1.22	0.818
Profitability	1.14	0.874
Dividend payer	1.09	0.920
Size	1.08	0.925
Mean	1.20	

Table A11 - White's test book leverage

Variables: 7		
H0: homoskedasticity	=	
F	=	259.06
Prob. > F	=	0.0000

Table A12 - White's test market leverage

Variables: 7		
H0: homoskedasticity	=	
F	=	135.34
Prob. > F	=	0.0000

Table A13 - Descriptive Statistics for all variables

					Percentiles			
Standard variables	Obs.	Mean	Std. Dev.	Median	25th	75th	Min	Max
Book Leverage	1624	0.405	0.217	0.401	0.256	0.565	0.000	0.861
Market Leverage	1416	0.413	0.230	0.423	0.225	0.591	0.000	0.845
Book assets(m$)	1600	1955.551	3697.88	659.013	194.755	1969.857	6.617	19614.69
Tangibility	1620	0.631	0.239	0.679	0.517	0.812	0.003	0.948
Market-to-book	1417	1.092	0.452	0.989	0.832	1.212	0.514	2.907
Profitability	1594	0.097	0.093	0.096	0.054	0.146	-0.212	0.327
Size	1626	6.608	1.611	6.65	5.572	7.734	3.087	10.126
Operating Leverage	1470	0.475	0.447	0.318	0.131	0.695	0.025	2.026
Asset risk	1314	0.191	0.138	0.151	0.093	0.248	0.023	0.670
Price run-up	1469	0.161	0.783	0.000	-0.288	0.340	-0.845	3.370
Dividend payer	1547	0.669	0.471	0	0	1	0	1
Age	1501	13.052	5.010	13	9	18	3	20
Macroeconomic variables								
Recession US	2415	0.143	0.350	0	0	0	0	1
Recession (Shipping)	2415	0.286	0.452	0	0	1	0	1
Inflation	2415	0.017	0.007	0.189	0.013	0.022	-0.001	0.032
Term Spread$_{t-1}$	2300	1.525	1.033	1.721	0.615	2.512	-0.141	2.896
GDP Growth	2415	0.016	0.015	0.018	0.014	0.024	-0.042	0.038
Oil Price	2415	0.111	0.411	0.068	-0.253	0.325	-0.535	1.122
Stock market returns	2415	0.066	0.180	0.117	-0.027	0.187	-0.421	0.308
Freight rates	2415	0.044	0.353	-0.093	-0.158	0.227	-0.653	0.791
FX USD	2415	0.004	0.061	-0.005	-0.029	0.043	-0.123	0.161
Secondhand ship price	2415	0.001	0.220	0.010	-0.167	0.153	-0.480	0.448
Speed of adjustment variables								
Book leverage$_{t-1}$*Recession (US)	1527	0.060	0.164	0	0	0	0	0.861
Market leverage$_{t-1}$*Recession (US)	1319	0.051	0.146	0	0	0	0	0.836
Firm Performance variables								
Return on assets	1620	0.025	0.095	0.026	-0.002	0.067	-0.334	0.255
Tobin´s Q	1416	1.079	0.458	0.967	0.814	1.204	0.506	2.929
Return on sales	1623	0.135	0.390	0.122	0.032	0.287	-1.510	1.148

The descriptive statistics display number of firm year observation (Obs.), the mean, the standard deviation (SD), the median, the 25th and 75th percentile, and the minimum and the maximum value of each variable. Datastream provided us with a sample of 115 shipping companies for the period 1996 to 2016, on an annual basis. All variables except the dummy variables are winsorized at the upper and lower two percentile. See Table A2 in the appendix for definitions of variables.

Table A14 - Correlations matrix firm performance

	Return on assets	Tobin's Q	Return on sales	$Leverage_{t-1}$	$Tangibility_{t-1}$	$Profitability_{t-1}$	$Size_{t-1}$	Asset $risk_{t-1}$	Dividend payer
Return on assets	1.000								
Tobin's Q	0.098	1.000							
	0.000								
Return on sales	0.731	0.012	1.000						
	0.000	*0.661*							
$Leverage_{t-1}$	-0.169	-0.035	-0.041	1.000					
	0.000	*0.194*	*0.111*						
$Tangibility_{t-1}$	-0.053	-0.095	-0.071	0.462	1.000				
	0.040	*0.000*	*0.006*	*0.000*					
$Profitability_{t-1}$	0.465	0.118	0.309	-0.169	0.069	1.000			
	0.000	*0.000*	*0.000*	*0.000*	*0.008*				
$Size_{t-1}$	-0.039	-0.086	-0.009	0.232	0.191	0.018	1.000		
	0.131	*0.002*	*0.735*	*0.000*	*0.000*	*0.494*			
Asset $risk_{t-1}$	0.100	0.244	0.066	-0.207	-0.207	0.096	-0.271	1.000	
	0.000	*0.000*	*0.017*	*0.000*	*0.000*	*0.001*	*0.000*		
Dividend payer	0.216	-0.028	0.195	0.039	0.039	0.283	0.145	-0.029	1.000
	0.000	*0.312*	*0.000*	*0.146*	*0.146*	*0.000*	*0.000*	*0.310*	

The table above displays pairwise correlation coefficients for all firm performance measures as well as for the (lagged) firm-specific variables. Datastream provided us with a sample of 115 shipping companies for the period 1996 - 2016, on an annual basis. All variables except dividend payer are winsorized at the upper and lower two percentile. See Table A2 in the appendix for definitions of variables. Numbers in italics below the coefficients represent the coherent p-values.

Table A15 - Company name and country list

Company-number	Company name	Country/Marked	Datastream code
1	CMD	Belgium	B:CMB
2	Euronav	Belgium	B:EURN
3	Exmar	Belgium	B:EXM
4	Bulgarian river shipping	Bulgaria	BL:BRI
5	Globus maritime	Channels Island	@GLBS
6	Compania chilena de navigacion interoceanica	Chile	CL:ITO
7	Marinsa	Chile	CL:MRS
8	Sipsa	Chile	CL:SPS
9	Antong holdings «a»	China	CN:HHC
10	Chang jiang ship. Gp. Phnx “a”	China	CN:WPC
11	China merchants energy shipping «a»	China	CN:CME
12	Cosco shipping energy transportation «a»	China	CN:CSD
13	Cosco shipping specialized carriers. 'A'	China	CN:COS
14	Cosco shipping holdings 'a'	China	CN:CSO
15	Cosco shipping development 'a'	China	CN:DSD
16	Hainan strait shipping 'a'	China	CN:QSP
17	Ap moller - maersk 'a'	Denmark	@AMKAF
18	Ap moller - maersk 'b'	Denmark	DK:DSB
19	Dmpkbt.norden	Denmark	DK:DNO
20	Erria	Denmark	DK:ERR
21	Hammonia shipping	Germany	D:HHX
22	Hci hammonia ship	Germany	D:HHXX
23	Stealth gas	Greece	@GASS
24	Pacific basin ship	Hong Kong	K:PBSH
25	Sinotrans shipping	Hong Kong	K:SINT
26	Sitc international hdg	Hong Kong	K:SIH
27	Essar shipping	India	IN:EPL
28	Great eastern shipping	India	IN:GES
29	Shahi shipping	India	IN:SHH
30	Shipping corp.of india	India	IN:SHI
31	Shreyas shipping and logistics	India	IN:LSS
32	Varun shipping	India	IN:VAU
33	Irish cont. Gp. Unt	Ireland	IR5B
34	Premuda	Italy	I:PR
35	Azuma shipping	Japan	J:AZUM
36	Kawasaki kisen kaisha	Japan	J:KK@N
37	Meiji shipping	Japan	J:MSHI
38	Mitsui osk lines	Japan	J:MO@N
39	Nippon yusen kk	Japan	J:NY@N
40	Jordan nat.shpping ltn.	Jordan	JO:SHL
41	D'amico international shipping	Luxembourg	I:DAI
42	Grupo tmm	Mexico	MX:MMA
43	Actinor shipping	Norway	N:ACS

44	American shipping co.	Norway	N:AMSC
45	Avance gas	Norway	N:AVAN
46	Frontline	Norway	N:FRO
47	Jason shipping	Norway	N:JSHI
48	Jinhui ship.& trsp.	Norway	N:JIN
49	Nts asa	Norway	N:NTS
50	Tts group	Norway	N:NULL
51	Odfjell ‘a’	Norway	N:ODF
52	Siem shipping inc.	Norway	N:SSI
53	Solvang	Norway	N:SOLV
54	Waterfront shipping	Norway	N:WAT
55	Wilson	Norway	N:WILS
56	Paksitan nat.ship	Pakistan	PK:PNS
57	Lorenzo shipping	Philippines	PH:LOR
58	Qatar navigation	Qatar	QA:QNN
59	Qatar shipping	Qatar	QA:QSH
60	Far eastern ship	Russia	RS:FES
61	North-western river shipping	Russia	RS:SZR
62	Primorsky sea shpping	Russia	RS:PRI
63	Sakhalin sea ship	Russia	RS:SII
64	Samudera ship.line	Singapore	T:SAMU
65	Hanjin shipping	Sør-Korea	KO:HJH
66	Heung-a shipping	Sør-Korea	KO:HHB
67	Hyundai merchant marine	Sør-Korea	KO:HMA
68	Kuang ming shipping	Taiwan	TW:KMQ
69	Yang ming mar.tran	Taiwan	TW:YMM
70	Wan hai lines	Taiwan	TW:WHL
71	Precious shipping	Thailand	Q:PSL
72	Regional containers line	Thailand	Q:RCCT
73	International gas product shipping	Vietnam	VT:GSP
74	Vietnam ocean shipping	Vietnam	VT:VOS
75	Ardmore shipping	United States	U:ASC
76	Box ships	United States	@TEUFF
77	Capital product partners	United States	@CPLP
78	Costamare	United States	U:CMRE
79	Danaos	United States	U:DAC
80	Dht holdings	United States	U:DHT
81	Diana containerships	United States	@DCIX
82	Diana shipping	United States	U:DSX
83	Dorian lpg	United States	U:LPG
84	Dryships	United States	@DRYS
85	Euroseas	United States	@ESEA
86	Gaslog	United States	U:GLOG
87	Genco shipping and trading	United States	U:GNK

88	Golar lgn	United States	@GLNG
89	Golden ocean group	United States	@GOGL
90	Global ship lease	United States	U:GSL
91	International shipholding corporation	United States	992142
92	Kirby	United States	U:KEX
93	Matson	United States	U:MATX
94	Navigator holdings	United States	U:NVGS
95	Navios maritime acq.	United States	U:NNA
96	Navios maritime hdg.	United States	U:NM
97	Navios maritime ptns.	United States	U:NMM
98	Newlead holdings	United States	@NEWLF
99	Nordic amer.tankers	United States	U:NAT
100	Paragon shipping class a	United States	@PRGNF
101	Safe bulkers	United States	U:SB
102	Scorpio tankers	United States	U:STNG
103	Seaboard	United States	U:SEB
104	Seacor holdings	United States	U:CKH
105	Seaspan	United States	U:SSW
106	Seanergy	United States	@SHIP
107	Ship finance intl.	United States	U:SFL
108	Sino-global shipping	United States	@SINO
109	Star bulk carriers	United States	@SBLK
110	Stelmar shipping	United States	13665U
111	Teekay	United States	U:TK
112	Top ships	United States	@TOPS
113	Tsakos energy nav.	United States	U:TNP
114	Us shipping partners uts.	United States	29374E
115	Winland ocean shipping	United States	@WLOLQ