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The 2008 Financial Crisis Impact on Capital Structures Within the Shipping Industry

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Abstract

The shipping industry has traditionally relied on bank loans as a source of financing but the Great Recession resulted in many banks having to exit the market. This study investigates the impact of the 2008 Financial Crisis on the determinants of capital structures within the shipping industry and how this can be explained by established financial theories. A multiple OLS regression is run on 42 globally listed shipping companies between 2003 and 2015. Dummies are used to separate the regression into before-, during- and after the crisis, as well as fixed effects being included to control for omitted variables constant across countries. The results show an increasing significance in the determinants after the crisis, suggesting how increased uncertainty about a company's survivorship resulted in more firm-specific factors being considered when determining financing structures. Moreover, the capital-intensive nature of the industry, along with its historically high leverage, suggests that capital structure choices within the industry can be better explained by the trade-off theory. Consequently, the two most fundamental factors explaining capital structures in the shipping industry are the relationship between the costs and benefits of debt and the availability of financing sources, determined by the market's opinion of the industry.

Keywords: Capital structure, shipping, trade-off, pecking order, financial crisis

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1. Introduction

Maritime transportation is responsible for around 90% of global trade (International Chamber of Shipping, 2017) and its low cost, availability and efficiency makes it difficult to replace with other modes of transportation. Additionally, the industry is exposed to industry- and country-specific tax incentives and ship-owners take advantage of these by registering their firms in countries with the optimal tax regime (Leptos-Bourgi, 2009).

Assuming market frictions, involving taxes as well as information asymmetry and agency issues, a manager's choice of financing affects a firm's valuation and can affect the survivorship of a company in the long-run. However, despite previous studies, it remains ambiguous as to why a company chooses a certain capital structure.

Shipping is commonly referred to as being a very conservative (Grau, et al., 2015) and secretive industry (Cullinane & Lee, 2016). Additionally, shipping is characterized as highly capital-intensive with historically high leverage (Gorgels, 2011). Companies within the industry have primarily relied on bank loans as a source of financing but have gradually been forced to find new financing methods as many banks have either reduced their exposure to the shipping market or exited it entirely. As the shipping industry is greatly dependent on the business cycle, the question arises as to how the industry has managed to cope with the volatile economy. This study analyses the impact that a financial crisis has on capital structures within the shipping industry by analysing the determinants of capital structures before, during and after the 2008 financial crisis.

Existing literature has examined a variety of factors that affect the choice of capital structure but none have explicitly analysed how the relationship between these factors and the choice of capital structures have altered within the shipping industry because of the crisis. This paper contributes to our understanding of capital structure decisions in multiple ways. Firstly, we gain increased understanding of how capital structure choices are industry-dependent, as well as which financial theories are best applicable for financing choices in a shipping company. Secondly, the study provides valuable insight into why financing choices and their drivers are likely to alter during a volatile economy.

Our results indicate that the trade-off theory is most applicable when analysing capital structure choices within the shipping industry. Additionally, we find that the determinants of ship finance increase in importance after the 2008 crisis, which is assumed to be a response to the increased uncertainty of firm performance during the crisis. Liquidity is always observed to be of significance when assessing firm stability, although with consistently lower magnitude

over the periods. However, the variable gaining the most explanatory power after the crisis is growth opportunities, having the highest coefficient. Vessel value is shown to become crucial when deciding financing after the crisis, which is believed to be due to the dependence on vessels acting as collateral.

1.1 Purpose of study

The aim of this study is to examine the drivers of financing within the shipping industry – how they change during a period of financial distress and how this can be explained by established financial theories. This is done by analysing the determinants' relation with capital structure choices and their significance over time:

"How can financial theories help explain the change in determinants of capital structures within the shipping industry that arise as a result of a financial crisis?"

1.2 Outline

This paper is structured as follows. Chapter 2 introduces the 2008 financial crisis and its impact on the shipping industry. In Chapter 3 the two capital structure theories that will be used to help analyse the relationship between capital structures and its determinants are presented. In Chapter 4, the chosen capital structure determinants and their relation to the capital structure theories are described. The methodology and choice of sample is motivated and described in Chapter 5. Chapter 6 presents the summary statistics of the sample as well as an analysis of the regression results. Robustness checks are examined in Chapter 7. Finally, Chapter 8 presents a conclusion of the study, followed by suggestions on future research on the topic.

2. The Global Financial Crisis

The global financial crisis became evident in 2007 and is by many economists considered the worst financial crisis since the Great Depression in 1930. What is believed to have primarily triggered the crisis was the downturn in the U.S. subprime mortgage market in 2007. The mortgage crisis impacted the global economy in several ways. Firstly, it reduced the overall wealth in the economy and increased unemployment, which consequently decreased consumer spending. The decrease in global trade impacted the shipping industry negatively and many vessels were left at sea with no goods to transport (Schulz, 2008).

Additionally, the financial market suffered a great deal from the crisis but this was partly due to central bankers and regulators not having proper oversight of financial institutions. Many banks had around half of their money tied to worthless collateralized debt obligations (CDO), resulting in a great percentage of the banking market experiencing endurable losses. Consequently, the financial sector saw tightening regulations and interbank lending activities minimized as no bank wanted to risk lending to another bank that might go bankrupt. As bank loans have previously satisfied around 75% of the shipping industry's external financing (Gorgels, 2011), the new regulations simultaneously impacted many shipping companies' ability to secure financing. Moreover, the industry's dependence on global demand and supply causes great fluctuations in vessel values and profits. This volatile nature results in many banks reluctant to lend to shipping companies as they considered it too much of a risk.

3. Capital Structure Theories

In this study, the term "capital structure" refers to how a company is financed. The two primary ways in which a firm can finance itself is through debt and equity. In 1958 Modigliani and Miller argued that, in a frictionless market, capital structure decisions don't affect the market value of the firm. However, more recent studies have relaxed Modigliani and Miller's restrictive assumptions by adding market frictions such as taxes, bankruptcy costs and information asymmetry, giving rise to different capital structure theories (Baker & Martin, 2011).

3.1 Static Trade-off Theory

There are two types of trade-off theories – static and dynamic. This paper will only be focusing on the static trade-off theory and will thus be referred to as the trade-off theory for the rest of this paper. This theory states that firms choose their optimal capital structure by balancing the costs of financial distress and bankruptcy with the tax benefits of debt (Kraus & Litzenberger, 1973). If there were no market frictions, as stated by Modigliani and Miller, then the presence of tax shields would result in firms choosing to finance itself only through debt.

The trade-off theory later developed through the introduction of agency costs (Jensen & Meckling, 1976), which can be clarified by the principle-agent problem. It is argued that managers (the agent) may not always act in a value maximizing way that benefits the shareholders (the principles), leading to under- or overinvestment problems. These problems

can be reduced through incentives or by shareholders demanding higher risk premium (Jensen & Meckling, 1976). Jensen (1986) further introduced the free cash flow hypothesis and how higher leverage disciplines managers by forcing them to make fixed interest payments, reducing negative NPV projects. These agency costs need to be weighed with the tax benefits of debt to decide on the optimal capital structure that will maximize firm value.

3.2 Pecking Order Theory

The pecking order theory is based on asymmetric information within the market and the resulting adverse selection problems (Majluf & Myers , 1984). In contrast to the trade-off theory, the pecking order theory does not assume an optimal capital structure but argues that managers choose capital structure with the aim to minimize adverse selection costs (Baker & Martin, 2011). Firm insiders, such as managers, have more information about their company – in terms of firm value and future performance – compared to external parties. Consequently, when a firm issues equity the managers are signalling that the company is overvalued, leading to a decrease in share price. Firm outsiders demand a discount for the risk involved with asymmetric information, which could result in dilution of existing shareholder's shares. This reflects the adverse selection problem and results in companies trying to minimize this problem by primarily using internal financing, then debt and to use equity as a last resort (Majluf & Myers , 1984).

Table 1: Impact of firm-specific factors on capital structure

Variable Name	Label	Trade-off	Pecking order
Tangibility of Assets	TAN	+	-
Profitability	PROFIT	+	-
Firm Size	SIZE	+	-
Growth Opportunity	GROWTH	- / +	- / +
Liquidity	LIQ	+	-

The table shows the relationship between the variables of interest with the debt-to-equity ratio with regards to the trade-off and the pecking order theory of capital structures.

4. Determinants of Capital Structure

Not only can the trade-off and the pecking order theory be used to explain the relationship between different sources of financing but they can also explain how the underlying intuition

behind capital structure choices can be related to firm-specific factors. For this paper, the dependent variable used to reflect capital structure is the debt-to-equity ratio (DE). The independent variables are asset tangibility (TAN), firm profitability (PROF), firm size (SIZE), growth opportunities (GROWTH) and liquidity (LIQ). The independent variables were chosen since they are the variables most frequently studied in previous literature (Rajan & Zingales, 1995) (Harris & Raviv, 1991) (Frank & Goyal, 2009) (Titman & Wessels, 1988) and since they are considered to be applicable for the shipping industry.

4.1 Tangibility

Shipping is a very capital-intensive industry and a large proportion of a firms' total assets consists of vessels with acquisition values that could range up to millions of dollars. Additionally, the industry suffers from great fluctuations in asset prices, as vessel values can drop substantially during a recession (Harwood, 2006). Since the vessels can be used as collateral for a loan, a firm's tangibility is thought to be of significant interest for capital structure decisions within the industry.

The relationship between the nature of a company's assets and its capital structure choice is related to the ability of using its assets as collateral as well as its transparency to external parties. According to theory, tangibility has a mixed relationship with leverage. The trade-off theory argues that higher tangibility increases the value of assets used as collateral, which acts as increased security for a loan. As more assets are used for collateral, the company decreases the risk of bankruptcy and thus lowers the required risk premium demanded by the creditors (Rajan & Zingales, 1995). Therefore, tangibility decreases the cost of debt, enabling increased leverage to reach the optimal capital structure.

However, Harris and Raviv (1991) argue that the lower information asymmetry related to tangibility decreases the costs associated with equity issuance and thus increases the attractiveness of equity financing. This therefore leads to a negative relationship between tangible assets and leverage under the pecking order theory. Additionally, since the market value of a company is often closely related to the value of the tangible assets (Gounopoulos, et al., 2009) it proves how important tangibility is for shareholders.

Previous studies analysing the determinants of capital structures have found a positive relationship between asset tangibility and leverage (Harrison & Wisnu Widjaja, 2014) (Frank & Goyal, 2009) (Baker & Wurgler, 2002) implying that increased tangibility should lead to more debt.

In this study, property, plant and equipment divided by total average assets will be used as a proxy for tangibility.

4.2 Profitability

Profitability is widely used across industries as a measure of how attractive a company is to potential investors and financiers. We believe that the shipping industry is interesting to analyse from a profitability perspective during the crisis due to its highly volatile nature. The industry's dependence on the business cycle leaves it more affected by a crisis compared to other industries, thus increasing the risk of exceptionally low or negative profitability levels.

According to the trade-off theory, more profitable firms reduce the cost of financial distress and risk of bankruptcy, decreasing the cost of debt. Furthermore, leverage helps to control agency problems by forcing firms to reduce wasteful spending (Jensen & Meckling, 1976) (Jensen, 1986). This results in a positive relationship between profitability and leverage according to the trade-off theory.

In contrast to the trade-off theory, the pecking order theory states that there is an inverse relationship with leverage (Rajan & Zingales, 1995). According to the pecking order theory, the company will prefer to use self-financing when profitability is high and retained earnings exceeds investments. However, when retained earnings are smaller than investments, then the company will move on to debt financing (Baker & Martin, 2011), having equity as the last resort. Most studies are found to agree with this negative relationship (Harrison & Wisnu Widjaja, 2014) (Baker & Wurgler, 2002) (Frank & Goyal, 2009), implying that higher profitability often results in decreased debt.

This paper defines profitability as EBITDA divided by total average assets.

4.3 Firm Size

The impact of firm size on a company's leverage is yet another ambiguous factor amongst established capital structure theories. Larger firms are often older and thus more well known. Hence, they often have a reputation to rely on when seeking financing within debt capital markets (Frank & Goyal, 2009). This results in larger firms being more dependent on their reputation and relations with creditors. In addition, larger firms are often more diversified than smaller firms, resulting in lower earnings volatility and thus decreased cost of debt (Titman & Wessels, 1988) (Warner, 1977). Subsequently, the trade-off theory states a positive relationship between size and leverage. Jensen and Meckling (1976) argue that larger firms need more

external financing, resulting in higher agency costs. However, increased leverage helps lower these agency costs as stakeholders are more observant of the manager's actions (Jensen, 1986), further supporting the positive correlation with leverage.

According to the pecking order theory, larger firms have lower information asymmetries between capital markets and firm insiders. Thus, larger firms can more easily issue informationally sensitive equity, leading to an inverse relationship between size and leverage (Rajan & Zingales, 1995).

Banks have been seen to favour shipping companies that have more diversified cash flows and with a conservative business philosophy (Grau, et al., 2015). Consequently, it is interesting to analyse how the shipping industry has been able to cope during a period when financial institutions are more restrictive in their choice of debtors.

Previous research has found mixed results with regards to firm size and leverage (Harrison & Wisnu Widjaja, 2014) (Baker & Wurgler, 2002) (Frank & Goyal, 2009), implying the ambiguity of the relationship.

As a proxy for firm size, the natural logarithm of total average assets is used in this paper.

4.4 Growth Opportunities

Previous research agrees that growth opportunities ought to be significant for companies' capital structure decisions. The volatile nature of the shipping industry and its dependence on the business cycle makes the relationship between capital structure and growth opportunities interesting to investigate.

There are different views within the capital structure theories on how growth opportunities affect financing choices. Myers (1984) argues that higher growth within a company could indicate a lower risk of bankruptcy, which leads to lower costs of debt. This indicates a positive relationship between growth opportunities and the leverage ratio according to the trade-off theory.

However, Titman and Wessels (1988) argues that growth opportunities can be considered capital assets that increase firm value but, as opposed to tangible assets, cannot be collateralized. For the reverse reasons argued for tangibility, higher growth opportunities indicate decreased company transparency as well as higher volatility of firm value. Subsequently, growth opportunities and the leverage ratio should be negatively correlated with

each other. Conclusively, the correlation between growth opportunities and leverage is ambiguous when considering the trade-off theory.

The pecking order theory also results in an uncertain relationship with leverage. On the one hand, Frank and Goyal (2011) and Aivazian et al. (2001) argue that, holding profitability constant, firms with higher growth will need substantially more external financing to cover their investments, and thus accumulate more leverage. Subsequently, they argue that growth opportunities should be positively related to the debt-to-equity ratio.

However, Aivazian et al. (2001) also states that if the current profitability is highly related to investment opportunities, a high-growth firm will have higher agency costs. Consequently, high growth firms will prefer to finance their investments with retained earnings instead of external financing. This means that growth opportunities and leverage would instead be negatively related according to the pecking order theory.

Most studies have found a negative correlation between growth opportunities and leverage (Harrison & Wisnu Widjaja, 2014) (Frank & Goyal, 2009). However, due to theories having different intuitions of the expected relationship, one cannot be sure about how growth opportunities are most widely explained to affect capital structure choices.

This paper uses the growth in total assets to act as a proxy for growth opportunities.

4.5 Liquidity

Liquidity is a measure for a company's ability to meet its short-term debt obligations (Broihahn, et al., 2015). This study uses the current ratio as a proxy for liquidity as it is a good financial liquidity indicator that is useful to predict financial failure of companies (Perinpanathan, 2015).

Being able to sustain an adequate liquidity level is even more relevant in a highly volatile industry such as shipping, since firms are more exposed to low profitability levels.
Since the financial crisis was a period of massive liquidity contraction, we believe it is especially interesting to study the relationship between liquidity and leverage in the industry with respect to the crisis.

According to the trade-off theory, higher liquidity leads to lower risk of default and thus lower debt-related agency costs. Hence, more liquid firms should increase their usage of debt with respect to equity (Mirza & Zhang, 2015).

On the other hand, the pecking order theory argues that firms with higher levels of liquidity use their liquid assets for financing, as they prefer internal funding over debt and

equity (Harrison & Wisnu Widjaja, 2014). Thus, a higher level of liquidity is negatively related to the debt-to-equity ratio according to the pecking order theory. This is also the relationship that is mostly supported by previous studies (Harrison & Wisnu Widjaja, 2014) (Lipson & Mortal, 2009).

5. Methodology

5.1 Data

For this paper, annual financial statement data was retrieved for a selection of firms from Compustat Global via Wharton Research Data Services. The initial set of firms was collected using the NAICS code 483111 for the Deep-Sea Freight Transportation Industry, which will be referred to as the shipping industry for the rest of this paper, and contained 137 companies in 32 different countries between the years 2003 and 2015. The following criteria was used to select the final sample. Firstly, despite their NAICS code, companies that were registered as operating in other industries than shipping or did not have a minimum revenue of 80% within shipping on Bloomberg were excluded from the sample. Secondly, observations with missing values for either independent or dependent variables in the sample set were dropped. Lastly, companies that didn't have data for the whole sample periods (2003-2015) were dropped, resulting in a balanced panel. This selection process resulted in the final sample containing 42 companies in 19 countries, which represents around 10-13% of the industry as of 2015. The list of firms included in the sample can be seen in Appendix 1.

5.2 Methodology

We conduct the analysis of the determinants of capital structure decisions by running a multiple linear regression and estimating coefficients using Ordinary Least Squares (OLS). The OLS-method for estimation determines the relationship between a predictor and a number of regressors by minimizing the sum of squares in the difference between the values of the predictor and the line of best fit. The OLS-technique is built on several fundamental assumptions that must hold to give meaningful results. Firstly, the sample data is assumed to be random and to follow a linear model. Secondly, the standard errors are expected to be homoscedastic, uncorrelated and have an expected value of zero. Lastly, it is assumed that the standard errors are independently normally distributed (Wooldridge, 2009).

To be able to investigate the impact of the financial crisis on the determinants, the sample is divided into three separate periods: pre-crisis (2003-2007), crisis (2008-2010) and post-crisis (2011-2015). The periods will be referred to as PRIOR, CRISIS and POST for the rest of this paper. To define CRISIS, we use a corresponding method to Zhang and Mirza (2015), by observing the impact on the Baltic Dry Index (BDI) over the total sample period. The BDI, created by the Baltic Exchange, measures changes in the cost of transporting raw materials by sea and is commonly referred to as an indication of the health in the shipping industry (Quandl, 2017). Figure 1 shows the evolution of the BDI between the years 2003 to 2015. As can be observed in the graph, the BDI started to decrease in the beginning of 2008 and settled at a constant low at the end of 2010. Thus, the years that are most widely referred to as the crisis period in previous literature are also the years that we classify as the crisis period in the shipping industry. To measure the change in the coefficients for the crisis and the post crisis with respect to PRIOR, we create two dummy variables. The generated dummy CRISIS takes the value 1 during the crisis period (2008-2010), else 0. The generated dummy POST takes the value 1 during the post-crisis period (2011-2015), else 0.

Figure 1: The Baltic Dry Index (BDI) over time

This graph shows The BDI over the three time periods - PRIOR (2003-2007), CRISIS (2008-2010) and POST (2011-2015). The red lines represent the start and end of the crisis period (2008-2010).

We conduct the following tests to investigate the validity of the assumptions of the OLS regression.

Firstly, OLS assumes homoscedasticity in standard errors, meaning that the variance of the error terms, ε, is constant. However, if the standard error variance changes across different

segments of the obtained sample, the standard errors are said to be heteroscedastic (Wooldridge, 2009). Heteroscedasticity does not cause bias or inconsistency in the OLS estimator, but causes the OLS estimator to no longer be the best linear unbiased estimator (Wooldridge, 2009). We conduct two tests for heteroscedasticity in the sample – a Breusch-Pagan/Cook-Weisberg test and a White test. The Breusch-Pagan/Cook-Weisberg tests the null hypothesis that the error variances are all equal (homoscedastic) versus the alternative hypothesis that the error variances are a function of one or more variables (heteroscedastic). Our results yield a χ^2-value of 22.20 and a p-value of 0.0000, indicating that heteroscedasticity is present. The White test is implemented to test for a non-linear form of heteroscedasticity and the resulting χ^2-value of 80.84 and p-value of 0.0000 is seen to agree with the Breusch-Pagan/Cook-Weisberg test, about heteroscedasticity being present. Consequently, we run the OLS regression using robust standard errors to correct for heteroscedasticity.

Secondly, OLS assumes that there is no serial correlation in standard errors, which means that the errors terms correlate across time. If serial correlation exists within the data set, this must be corrected for to avoid dynamic misspecification (Wooldridge, 2009). Hence, we perform a Wooldridge test on our regression and can strongly reject the null-hypothesis of no autocorrelation in standard errors since F(1,41)=22.444 and p-value=0.0000. Consequently, we correct for the violation of no serial correlation. Firstly, to control for omitted variables that are constant between the different time periods, we include time-period dummy variables – defined as CRISIS and POST in the regression. In addition, to control for omitted variables that are constant on a country level, we include country-fixed effects in our regression (1). Each company's Incorporation Code was collected and used when conduct the country-fixed effect in the regression model.

Lastly, the regressors are tested for multicollinearity. Multicollinearity exists when multiple independent variables in the regression are highly correlated, meaning that the variation in one variable can be predicted from the variation in the other variable. Even if the assumptions of OLS are only violated under the occurrence of perfect multicollinearity (Wooldridge, 2009) a sufficiently high correlation between independent variables could still result in a less efficient model. Both a Pearson Correlations test and a Variance Inflation Factor (VIF) test are computed to test for the occurrence of multicollinearity. According to previous research, the highest acceptable absolute value of pairwise correlation, without risking the occurrence of multicollinearity within the regression, should be 0.8 (Harrison & Wisnu Widjaja, 2014). The Pearson correlation between independent variables is tested both for the

whole timespan and for all separate sub-periods. We can observe that all pairwise correlations have absolute values below 0.8, highlighting that multicollinearity is not present within the whole sample period (Appendix 6). For a VIF test, the highest tolerated value on VIF for each variable is 5 (Zhang and Mirza, 2015). The VIF test is also tested both for the whole timespan and for all separate sub-periods and shows values well below 5 in all cases, indicating the absence of multicollinearity within the selected sample set (Appendix 7). The highest absolute pairwise correlation found for tangibility and liquidity prior to the crisis, with a value of -0.4176. This high negative correlation is not very surprising since a company that has a relatively larger share of its total capital being tangible assets, such as vessels, will automatically have a lower share of liquid assets and vice versa. The somewhat lower correlations during and after the crisis could be the cause of liquid assets decreasing – through paying off debt obligations or negative profit rather than an increased investment in tangible assets.

In addition, to mitigate the effect of extreme outliers on the regression result, the variables are winsorized at the 1% and 99% levels in accordance with previous literature (Halling, et al., 2016) (Frank & Goyal, 2009). All variables within the sample contains several observations that would be classified as extreme outliers and if kept, these would thus affect the robustness of the results. Even though most extreme values most likely occur because of the industry's volatile nature, rather than representing data mistakes, these values would not be representative for the common trend in the industry. Since the study aims to investigate common trends in the shipping industry, these are thus adjusted to achieve more representative results.

After adjusting for possible violations of the OLS assumptions and including dummy variables to be able to analyse the impact of the financial crisis, we the following regression:

$$DE_t = \beta_0 + \beta_1 TAN_i + \beta_2 PROFIT_{it} + \beta_3 SIZE_{it} + \beta_4 GROWTH_{it} + \beta_5 LIQ_{it} + \beta_6 CRISIS + \beta_7 TAN_{it} CRISIS + \beta_8 PROFIT_{it} CRISIS + \beta_9 SIZE_{it} CRISIS + \beta_{10} GROWTH_{it} CRISIS + \beta_{11} LIQ_{it} CRISIS + \beta_{12} POST + \beta_{13} TAN_{it} POST + \beta_{14} PROFIT_{it} POST + \beta_{15} SIZE_{it} POST + \beta_{16} GROWTH_{it} POST + \beta_{17} LIQ_{it} POST + \eta_j + \varepsilon_{it} \quad (1)$$

Where:

DE: Debt-to-equity ratio

TAN: Tangibility of assets

$PROFIT$: Profitability

$SIZE$: Firm size

$GROWTH$: Growth

LIQ: Liquidity

$CRISIS$: Dummy variable for crisis period

$POST$: Dummy variable for post-crisis period

i: Firm-identifier for each observed value of the variable

t: Year-identifier for each observed value of the variable

η: Country-fixed effects

ε: Error term

The regression is thus computed with PRIOR as a base case. Therefore, each interaction term represents the change in the coefficient for the explanatory variable when moving from PRIOR to CRISIS and PRIOR to POST. For each of the time periods investigated, the following abridged regressions can be computed:

Abridged regression for prior period (CRISIS=0, POST=0):

$$DE_t = \beta_0 + \beta_1 TAN_i + \beta_2 PROFIT_{it} + \beta_3 SIZE_{it} + \beta_4 GROWTH_{it} + \beta_5 LIQ_{it} + \eta_j + \varepsilon_{it} \quad (2)$$

Abridged regression for crisis period with respect to prior period (CRISIS=1, POST=0):

$$DE_t = (\beta_0+\beta_6) + (\beta_1 + \beta_7)TAN_{it} + (\beta_2 + \beta_8)PROFIT_{it} + (\beta_3 + \beta_9)SIZE_{it} + (\beta_4 + \beta_{10})GROWTH_{it} + (\beta_5 + \beta_{11})LIQ_{it} + \eta_j + \varepsilon_{it} \quad (3)$$

Abridged regression for post period with respect to prior period (CRISIS=1, POST=0):

$$DE_t = (\beta_0+\beta_{12}) + (\beta_1 + \beta_{13})TAN_{it} + (\beta_2 + \beta_{14})PROFIT_{it} + (\beta_3 + \beta_{15})SIZE_{it} + (\beta_4 + \beta_{16})GROWTH_{it} + (\beta_5 + \beta_{17})LIQ_{it} + \eta_j + \varepsilon_{it} \quad (4)$$

Moreover, to calculate the significance for the summed coefficients of each explanatory variable in the respective time periods, we use the following formula:

$$t = \frac{\widehat{\beta_1} + \widehat{\beta_2}}{\sqrt{\hat{var}(\widehat{\beta_1}) + \hat{var}(\widehat{\beta_2}) + \hat{cov}(\widehat{\beta_1}\widehat{\beta_2})}} \quad (5)$$

6. Results and analysis

The findings and results of the analysis is presented below in 3 sections. Summary statistics of the variables are reported in 6.1. In 6.2 the results from the regression are analysed. Finally, section 6.3 provides a summary of our findings and financial implications.

6.1 Summary Statistics

The summary statistics in Table 2 shows the impact that the 2008 crisis had on the capital structures within the shipping industry.

Table 2: Summary statistics

PRIOR							
	mean	median	sd	min	max	range	N
DE	1.75	1.30	1.89	0.04	12.45	12.41	210
TAN	0.62	0.64	0.25	0.00	1.11*	1.11*	210
PROFIT	0.17	0.14	0.11	-0.10	0.53	0.63	210
SIZE	8.52	7.73	2.83	4.05	15.64	11.59	210
GROWTH	1.02	1.01	0.04	0.86	1.14	0.29	210
LIQ	2.41	1.48	3.13	0.09	17.65	17.56	210
CRISIS							
	mean	median	sd	min	max	range	N
DE	1.50	1.33	1.16	0.04	7.54	7.50	126
TAN	0.63	0.67	0.24	0.00	1.11*	1.11*	126
PROFIT	0.09	0.07	0.08	-0.10	0.37	0.47	126
SIZE	8.94	8.11	2.80	4.58	15.90	11.32	126
GROWTH	1.01	1.01	0.03	0.86	1.14	0.29	126
LIQ	2.51	1.37	3.38	0.09	17.65	17.56	126
POST							
	mean	median	sd	min	max	range	N
DE	2.04	1.67	2.08	0.04	12.45	12.41	210
TAN	0.65	0.68	0.22	0.00	1.11*	1.11*	210
PROFIT	0.04	0.05	0.05	-0.10	0.20	0.30	210
SIZE	8.80	8.19	2.76	4.36	15.90	11.54	210
GROWTH	1.00	1.00	0.03	0.86	1.06	0.20	210
LIQ	1.46	1.13	1.29	0.09	8.19	8.10	210

This table presents descriptive statistics for all main variables during the periods PRIOR (2003-2007), CRISIS (2008-2010) and POST (2011-2015). DE is the debt-to-equity ratio, reflecting capital structure choice, defined as 'Total Liabilities to Total Equity'. DE is the dependent variables in the regression. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets).

* Ratios above 1 present due to Compustat defining Net Property, Plants and Equipment as "The cost, less accumulated depreciation, of tangible fixed property used in the production of revenue".

The debt-to-equity (DE) ratio for the firms in the sample set is observed to be less volatile and having a smaller range during the crisis period, implying that firms are more cautious when borrowing money during times of distress. The summary statistics for tangibility is almost the

same for all periods, suggesting the consistent importance of assets within a shipping firm. Additionally, the standard deviation of 22-25% proves the fluctuations in the underlying value of tangibility, which is also implied in the evolution of the average tangibility seen in Appendix 8. Profitability is seen to decrease over the periods, which is due to a decrease in the maximum profit within the industry rather than a decrease in the minimum profit. This signifies the decreased activity within the shipping market during the crisis, causing the industry to converge to a similar profit level. Additionally, the substantial decrease in the maximum profit proves that a firm's profitability is very sensitive to a recession, reflecting the volatile earnings in the industry. The decrease in LIQ from CRISIS to POST is also due to a decrease in the maximum liquidity within the industry, resulting in a lower standard deviation of liquidity for the sample set. GROWTH and LIQ are seen to react slowly to the crisis, not experiencing a clear change until POST, which insinuates that global trade is slow at reacting to recession, resulting in less growth opportunities and decreased cash flow.

6.2 Regression Results

The final results from our regression is shown in the table below.

Table 3: Regression results

	PRIOR	**CRISIS**	**POST**
TAN	-1.143	1.133***	1.722***
PROFIT	-1.848	-1.365	-4.782**
SIZE	-0.168***	-0.0786	0.112**
GROWTH	2.871	-6.544	-13.249**
LIQ	-0.204***	-0.095***	-0.359***
Constant	1.778	8.448**	13.848**
Observations	210	126	210
R-squared	28.2%	38.0%	46.3%
Country FE	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

This table shows the results from an OLS regression of the debt-to-equity ratio on 5 variables of interest during three time periods – PRIOR (2003-2007), CRISIS (2008-2010) and POST (2011-2015). DE is the debt-to-equity ratio, reflecting capital structure choice, defined as 'Total Liabilities to Total Equity'. DE is the dependent variables in the regression. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). All variables are winsorized on a 1% level. Country-fixed effects have been applied to control for omitted variables that are constant on a country level. The OLS regression was run using robust standard errors.

Adequate R^2-values are observed compared to previous studies (Rajan & Zingales, 1995) (Harrison & Wisnu Widjaja, 2014), implying that a regression model like the one in this study might be more relevant in explaining capital structures within the shipping industry. The R^2-value is also seen to increase over the periods, indicating that the model has become more relevant in explaining capital structure choices after the 2008 crisis.

All coefficients are found to be significant in POST at the 1% or 5% level, whilst only two variables are significant in PRIOR and CRISIS. This lack of significance results in that there does not exist enough evidence to conclude any specific relationship between the insignificant factors in PRIOR and CRISIS.

6.2.1 Tangibility

The coefficient of tangibility is seen to significantly impact capital structures during and after the crisis. The positive relationship with the debt-to-equity ratio in these periods agrees with previous studies (Harrison & Wisnu Widjaja, 2014) (Baker & Wurgler, 2002) (Frank & Goyal, 2009) (Drobetz, et al., 2013)and simultaneously agrees with the trade-off theory of capital structures. Thus, the relationship between tangibility of assets and the leverage ratio can be explained by the possibility of vessels to act as a collateral, decreasing the expected costs of distress and agency costs.

The increase in magnitude of the coefficient from CRISIS to POST signifies an increase in importance of tangibility after the crisis when deciding financing. However, when examining tangibility with respect to the other variables, it was expected that tangibility would increase substantially more and become the variable with the greatest magnitude after the crisis due to creditors demanding more collateral to act as compensation for their increased risk. An explanation for the more modest increase could be the volatile nature of vessel values. Since the values of vessels have a tendency of decreasing significantly during recessionary periods, the financial crisis might have increased the awareness of the fluctuations in vessel values amongst institutional investors.

6.2.2 Profitability

The variable profitability is found to gain significance first after the crisis. The negative relationship between profitability and capital structure indicates that more profitable firms will have a lower debt-to-equity ratio, which could initially be thought to reflect the pecking order theory. According to the pecking order theory, firms prefer to finance themselves first through retained earnings, then debt and lastly equity. However, due to the high construction costs and

acquisition values of vessels it is not always possible to finance an entire ship internally, meaning that either debt or equity is necessary to be able to finalise the investment. As self-financing is not very common within the shipping industry (Institute of Chartered Shipbrokers, 2011/2012), we believe that another explanation to the negative relationship is an increased equity value rather than a decrease in debt. Profitability increases the likelihood of the firm being able to pay out dividends, which attracts equity holders and in turn increases equity value and decreases the debt-to-equity ratio. Additionally, a higher profitability level could be of comfort for equity holders, increasing their perceived value of the company.

Moreover, even though the negative relationship is consistent with previous studies (Harrison & Wisnu Widjaja, 2014) (Baker & Wurgler, 2002) (Frank & Goyal, 2009) (Drobetz, et al., 2013), our coefficients are found to be higher in magnitude, denoting the extra risk involved with the industry's volatile earnings. This leads to more observant analysis on firm profitability when deciding capital structure compared to other more stable industries.

6.2.3 Firm Size

Firm size is found to be significant in PRIOR and POST. Moreover, these values have very small magnitudes, implying that a substantial change in this factor will have a relatively modest impact on financing decisions.

The coefficient changes signs, from being negative in PRIOR to positive in POST, underlying that it agrees more with the trade-off theory after the crisis. Previous studies have found varied coefficients from -0.098 to 3.31 (Harrison & Wisnu Widjaja, 2014) (Baker & Wurgler, 2002) (Frank & Goyal, 2009) (Drobetz, et al., 2013)and thus our results fall in line with prior literature. The pecking order theory states that the lower information asymmetry that comes with increasing firm size results in a lower cost of equity and thus a decrease in leverage. One explanation to the conversion from the pecking order theory to the trade-off theory could be that firms are limiting the amount of public information about the industry by avoiding equity issuance. Firms are doing this by focusing more on their long-term relations with creditors to gain better access to loans, rather than taking advantage of the low cost of equity that comes with firm size.

6.2.4 Growth Opportunity

Growth opportunities gains significance as an estimator for capital structure choices after the crisis. The observed coefficient in this study is much larger than the one found in previous

studies, implying that firm size has a greater effect on capital structure choices within shipping. Previous literature has found coefficients ranging from -0.057 to -0.159 (Harrison & Wisnu Widjaja, 2014) (Frank & Goyal, 2009) (Drobetz, et al., 2013)but many have also used market value to book value as a proxy for growth opportunities. Therefore, the great difference in magnitude could be the result of this study choosing to define GROWTH with assets, due to the industry being so capital intensive, and thus having a greater effect on the capital structures. As theories are shown to have ambiguous results, the negative sign can be explained in two different ways. According to the trade-off theory, higher growth opportunities would indicate higher volatility of firm value and thus increase the cost of debt. On the other hand, the pecking order theory argues that the negative relationship is the result of profitability being more related to investment opportunities, resulting in higher agency costs. Consequently, higher profitability results in retained earnings to be preferred over debt and equity in the pecking order theory.

As self-financing is not so common within the industry, it is believed that the trade-off theory is more applicable in explaining the relationship between growth opportunities and capital structures.

6.2.5 Liquidity

The coefficient of liquidity is found to be negative and significant at the 1% level in all periods. This denotes that liquidity consistently has explanatory value when deciding financing, which is not surprising since the ability of a firm to meet its short-term obligations is relevant regardless of what type of financing the firm chooses (Broihahn, et al., 2015). The negative relationship is consistent with previous research (Harrison & Wisnu Widjaja, 2014) (Lipson & Mortal, 2009) but is believed to be the result of a direct effect on debt or an indirect effect on equity rather than self-financing through internal funds. The direct impact involves owners using their excess cash to pay off their debt, thereby decreasing the debt-to-equity ratio. The indirect impact refers to the idea that increased liquidity attracts equity holders, as it leads to greater confidence of dividend being paid out, leading to an increased equity value and an indirect decrease of the leverage ratio.

Another interesting observation is the magnitudes of the coefficient. The sizes of the coefficients are low, indicating that even though liquidity is estimated to have an explanatory value in determining capital structure, its relative impact is modest.

6.3 Primary Findings

One can conclude that the shipping industry is more naturally connected to the trade-off theory due to its capital-intensive nature as well as its dependency on the business cycle. As internal funding is not common in the industry, the variables that are seen to follow the pecking order theory are chosen to be explained by an increase in equity value rather than using retained earnings to finance their ships. Another explanation as to why the trade-off theory has become more relevant is the industry's preference of remaining secretive. The industry's secretive nature has caused it to go against the pecking order theory by ignoring the lower cost of equity and prioritising the use of debt.

7. Robustness

The robustness checks are divided into two sections. First, we test the sensitivity of the variable definitions and thereafter we test the sensitivity of the sample.

7.1 Variable Sensitivity

The choice and definition of the determinants can have great effects on the regression results, which is why additional proxies have been generated to check the validity of our findings. Due to limited data, it was only possible to create additional proxies for the three variables PROFIT, SIZE and GROWTH. All robustness tests result in the same firms as the original regression, as well as the same signs for PRIOR, CRISIS and POST.

PROFIT, originally defined as EBITDA to total average assets, was redefined as EBIT to total average assets (Appendix 9). As the coefficients remain similar in magnitude and sign we conclude that our results are robust and that the decreased explanatory power during the crisis can be the result of decreased income and increased earnings volatility. In this study, we have chosen to define PROFIT as EBITDA to total average assets, as EBITDA is more frequently used in capital-intensive industries (Henry, et al., 2015).

For SIZE, an additional proxy was generated – defined as the natural logarithm of total average sales – resulting in similar coefficients to the original regression (Appendix 10). This leads us to believe these results in the original regression are robust.

Finally, we redefine GROWTH with the change in total sales. As a result, GROWTH is found to not have any significance in POST. Additionally, TAN is observed to lose

significance in CRISIS and POST (Appendix 11). The loss in significance in GROWTH could reflect that ship financing is more driven by a company's assets rather than its sales. Additionally, the magnitude in the coefficients are found to be a lot smaller when using the new proxy for GROWTH, proving that a company's underlying asset value is greater than its sales value. An additional explanation to the difference in the results could be the cause of sales signalling the fluidity of the business, whilst assets indicate the potential growth in size of the company. Conclusively, due to the capital-intensive nature of the industry, we have chosen to define GROWTH as the change in total assets.

7.2 Sample Sensitivity

Some studies amongst previous literature have chosen to winsorize the data to mitigate the effect of extreme outliers on the result (Halling, et al., 2016) (Frank & Goyal, 2009). To test if winsorizing makes our regression more robust, we compare the results obtained from the original regression to the results obtained when the sample data is not winsorized (Appendix 12). Neither the signs nor the significance of the coefficients alter greatly between the two regressions, proving that our underlying explanations to capital structure choices are robust. However, some coefficients – for example SIZE – are seen to change by around 50% in magnitude, highlighting that the outliers in the original data impact the regression result. Since this study fundamentally intends to analyse common trends in the shipping industry, the choice was made to winsorize the data in the main regression.

As another robustness check, the regression was run with the full NAICS 483111 sample set – without dropping any irrelevant firms (Appendix 13). Some coefficients are observed to change substantially when not dropping the companies. Additionally, the coefficient of TAN in PRIOR changes sign and significance between the two regressions. This indicates that the dropped companies have an impact on the result and since this study fundamentally aims to investigate the capital structure decisions for firms with its core operations within shipping, the assessment was made to drop any firms that didn't fulfil our core requirements in our sample set.

8. Conclusion

This study investigates financing choices within the shipping industry during a period of financial instability. More specifically, it analyses the change in capital structures choices over the 2008 financial crisis and whether they can be explained by finance theories such as the trade-off and pecking order theories.

The lack of significance in PRIOR and CRISIS suggests that there is no convincing evidence to conclude any clear relationship between the insignificant factors and capital structure choices in these periods. However, amongst the significant regression coefficients, most variables appear to support the trade-off theory. The few coefficients that are observed to contradict the trade-off theory are not believed to be best justified by the pecking order theory. The trade-off theory is believed to be more applicable to the shipping industry due to certain distinctive characteristics. These characteristics include the irregularity of self-financing, causing retained earnings to infrequently be used when financing ships. Additionally, the industry has historically been opposed to use equity, which can be explained by the third characteristics of secrecy. It is assumed that the industry prioritizes secrecy over the benefits of a lower cost of equity, as it would risk information asymmetry in the shipping market to decrease. For these reasons, we find that the pecking order theory is not as relevant as the trade-off theory within the shipping industry. Consequently, the most fundamental factors explaining capital structures within the industry is two-fold. Firstly, the relationship between the costs and benefits of debt is important to consider. Secondly, the market's opinion of the industry determines the availability of financing sources – also denoted as the supply of debt. Therefore, capital structures in shipping companies are affected by internal preferences of financing methods as well as by external parties' perception of the industry.

It is observed that the crisis changed the way the market analysed the determinants of capital structure, which is supported by the increased significance in the variables after the crisis. Whilst liquidity is always observed to be a good indication of financial stability, the uncertainty about a company's survivorship that arose after the crisis resulted in external parties to consider all firm-specific factors when choosing financing. Growth opportunities are observed to be of great importance in capital structure decisions as it symbolises firm value volatility. Additionally, the underlying vessel values are believed to determine collateral possibilities and are thus seen to be vital when deciding capital structures. Finally, the volatile earnings that shipping companies experience have caused more analysis to be put on profitability compared to other industries.

The above findings suggest that a company's capital structure decisions are very much related to which industry the company is active in, as well as being affected by global financial conditions. Consequently, when investigating companies and their capital structures decisions one must first determine the core elements of the industry that they are present in and thereafter the prevailing wealth of the global economy.

8.1 Limitations

There are certain limitations in our study that might impair the conclusions drawn about capital structure choices within the shipping industry during financial instability. Firstly, limitations exist as to how well our analysis represents the entire industry's capital structure. The final sample of firms only represents 10-13% of the industry, which may not be enough to explain capital structures within the whole industry. The robustness test in Appendix 13 proves that the regression results will change if we alter the companies included in the dataset. The subjective requirements applied to the dataset can thus lead to a biased sample. Additionally, the balanced panel data could lead to a survivorship bias as it doesn't capture the behaviour of firms that are not active during the whole sample period.

Secondly, there might be certain disadvantages of using Compustat that might limit our results. Potential measurement errors in the generation of proxies could occur due to Compustat's definitions of the financial statement posts.

Thirdly, the choice to winsorize the data was based on the aim to capture the overall trend within the industry. However, due to the limited representation of the industry, it is uncertain whether the outliers observed in the raw data are consistent within the whole industry. Therefore, one cannot conclude how biased our results are.

Finally, we only analyse capital structure choices during one crisis and it is unsure if these results would be persistent in other crises. Therefore, limitations exist in terms of how well our results reflect capital structure choices during all periods of financial distress.

8.2 Suggestions for Further Research

Our study aims to analyse how shipping firms adjust their capital structure choices during a financial crisis and our results are of interest for future investigations of the topic. Firstly, it would be interesting to obtain a longer data set to examine whether the determinants' reactions to the 2008 crisis is consistent with other financial crises. Additionally, many results were explained by the capital-intensive nature of the industry. It would thus be interesting to analyse

any similarities or differences within other industries with similar characteristic to the shipping industry – such as high value of tangible assets.

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Appendix

A.1 Sample List

Appendix 1: List of shipping companies in the sample set

Nordic American Tankers Ltd	Yang Ming Marine Transport Corp
Hapag-Lloyd AG	Chowgule Steamships Ltd
Mitsui OSK Lines Ltd	Cosco Shipping Energy Transportation Co Ltd
Kawasaki Kisen Kaisha Ltd	Hyundai Merchant Marine Co Ltd
Torm PLC	EOX Group Berhad
Belships ASA	Grupo Empresas Navieras SA
Odfjell SE	Concordia Maritime AB
NS United Kaiun Kaisha Ltd	Orient Overseas (International) Ltd
A.P. Moller - Maersk A/S	Viking Supply Ships AB
Sloman Neptun Schiffahrts-Ag, Bremen	Premuda SPA, Trieste
Regional Container Lines Public Co Ltd	PDZ Holdings Berhad
Finnlines OY	Dampskibsselskabet Norden A/S
Evergreen Marine Corp (Taiwan) Ltd	PT Samudera Indonesia TBK
Jutha Maritime Public Co Ltd	Golar LNG Ltd
IM Skaugen SE	Siem Shipping Inc
Kyoei Tanker Co Ltd	Exmar SA
Compania Sud Americana De Vapores Sa Vapores	Shin Wei Navigation Co Ltd
Tamai Steamship Co Ltd	COSCO SHIPPING Specialized Carriers Co Ltd
Solvang ASA	China Shipping Haisheng Co Ltd
Precious Shipping Public Co Ltd	Wilson ASA
U-Ming Marine Transport Corp	Courage Marine Group Ltd

The table shows the names of the companies included in the final sample set, consisting of 42 firms in 19 countries.

A.2 Variable Definitions and Codes

Appendix 2: List of variable definitions

Dependent variable	**Definition**	**Source**
Debt-to-equity ratio	Total Liabilities/Total Equity	Compustat
Independent variable		
Tangibility	Net Property, Plant and Equipment/Average Total Assets	Compustat
Profitability	EBITDA/Average Total Assets	Compustat
Firm Size	Log of Average Total Assets	Compustat
Growth Opportunities	Change in Assets	Compustat
Liquidity	Current Assets/Current Liabilities	Compustat

This table shows the regression variables and their proxies used.

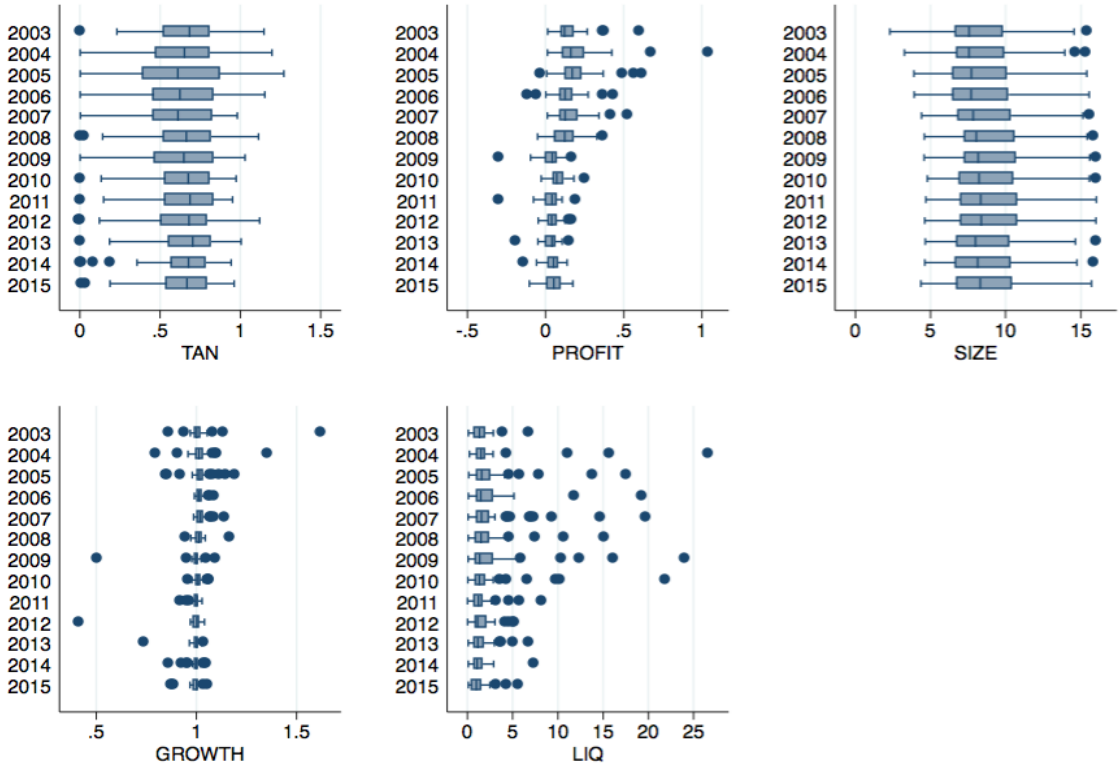
Appendix 3: Database codes

Database Codes	**Database Codes**
Current Assets	act
Total Assets	at
EBIT	ebit
EBITDA	ebitda
Current Liabilities	lct
Total Liabilities	lt
Net property, plant and equipment	ppent
Sales	sale
Total Equity	seq

This table shows all variables used in the regressions and their Compustat database codes.

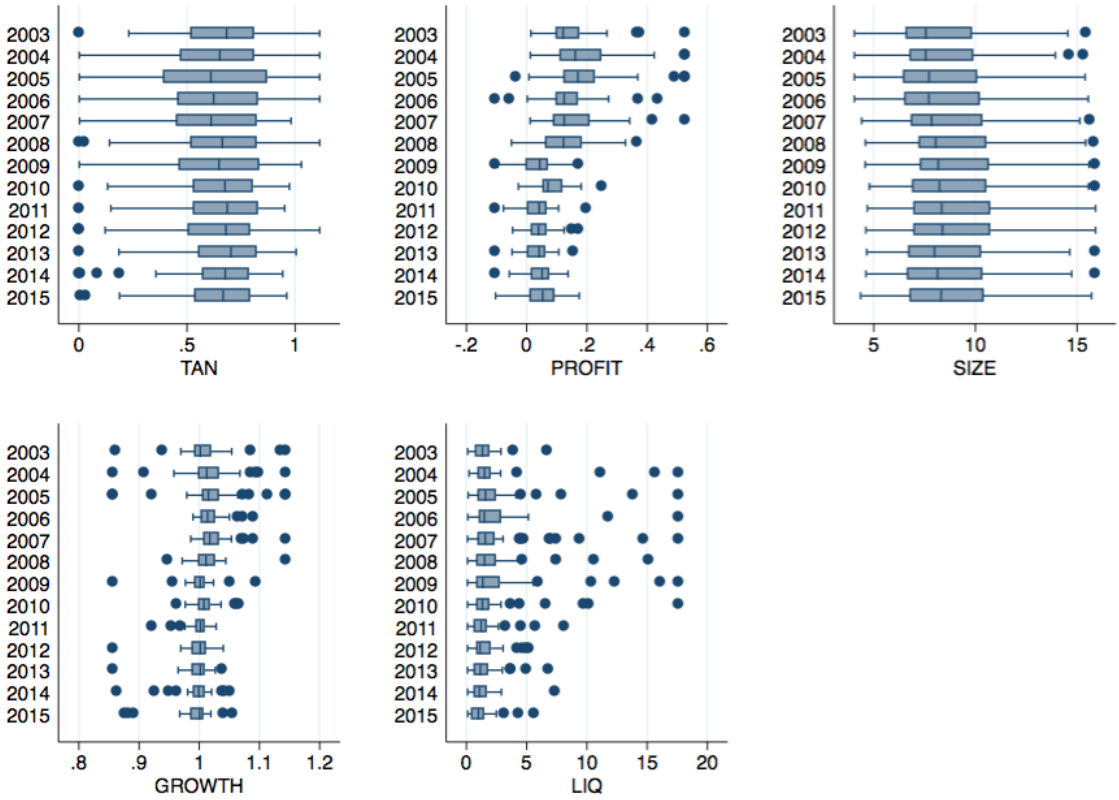
A.3 Box Plots

Appendix 4: Box plots of the independent variables before winsorizing



This figure shows box plots of the independent variables over time, based on the raw data from our sample. This was used to determine the existence of outliers in the sample set. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities).

Appendix 5: Box plots of the independent variables winsorized at the 1% and 99%



This figure shows box plots of the independent variables over time, winsorized at the 1% and 99% level. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities).

A.4 Tests for Methodology

Appendix 6: Pearson's pairwise correlation

Whole Sample Period (2003-2015)					
	TAN	PROFIT	SIZE	GROWTH	LIQ
TAN	1				
PROFIT	0.1657	1			
SIZE	-0.0251	0.0038	1		
GROWTH	0.258	0.3385	-0.0675	1	
LIQ	-0.2988	0.079	-0.1804	0.1478	1

PRIOR (2003-2007)					
	TAN	PROFIT	SIZE	GROWTH	LIQ
TAN	1				
PROFIT	0.2703	1			
SIZE	-0.0615	-0.0207	1		
GROWTH	0.2507	0.27	-0.1712	1	
LIQ	-0.4176	-0.0777	-0.2254	0.1738	1

CRISIS (2008-2010)					
	TAN	PROFIT	SIZE	GROWTH	LIQ
TAN	1				
PROFIT	0.078	1			
SIZE	0.0361	0.1223	1		
GROWTH	0.3366	0.1993	-0.0727	1	
LIQ	-0.1743	0.1785	-0.1588	0.0361	1

POST (2011-2015)					
	TAN	PROFIT	SIZE	GROWTH	LIQ
TAN	1				
PROFIT	0.3315	1			
SIZE	-0.0292	0.0872	1		
GROWTH	0.3128	0.207	0.1164	1	
LIQ	-0.2505	-0.0479	-0.1634	0.0241	1

This table shows the Pearson correlation coefficients for the whole sample period, as well as for the three sub-periods – PRIOR (2003-2007), CRISIS (2008-2010) and POST (2010-2015). TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities). This study uses 0.8 as the highest acceptable absolute value for pairwise correlation and above this value the model is seen to suffer from multicollinearity.

Appendix 7: VIF tests

Whole sample period (2003-2015)		
Variable	VIF	1/VIF
TAN	1.24	0.803509
GROWTH	1.24	0.80428
LIQ	1.22	0.82198
PROFIT	1.14	0.873427
SIZE	1.04	0.95861
Mean VIF	1.18	

CRISIS		
Variable	VIF	1/VIF
GROWTH	1.19	0.843218
TAN	1.18	0.849326
LIQ	1.11	0.899027
PROFIT	1.11	0.901628
SIZE	1.06	0.94086
Mean VIF	1.13	

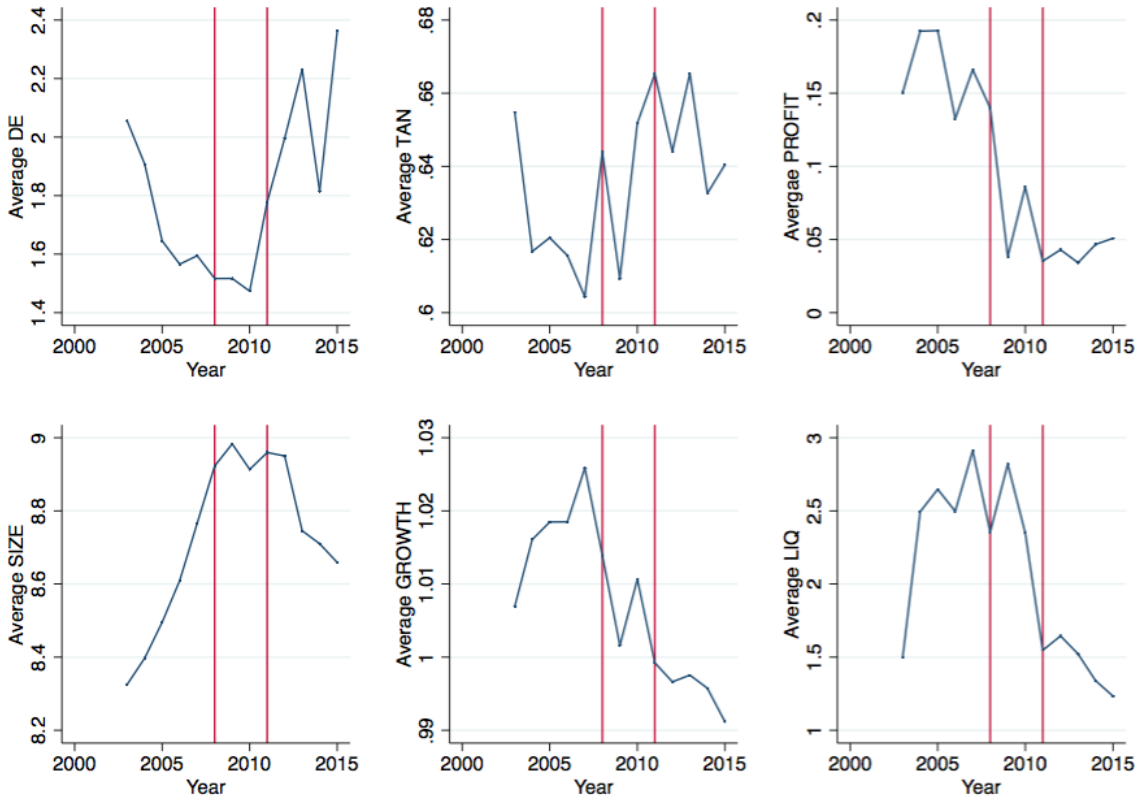
PRIOR		
Variable	VIF	1/VIF
TAN	1.47	0.681839
LIQ	1.43	0.699189
GROWTH	1.25	0.798322
PROFIT	1.13	0.88193
SIZE	1.09	0.91328
Mean VIF	1.28	

POST		
Variable	VIF	1/VIF
TAN	1.33	0.752587
GROWTH	1.16	0.861405
PROFIT	1.15	0.869611
LIQ	1.12	0.889017
SIZE	1.07	0.936047
Mean VIF	1.17	

This table shows the Pearson correlation coefficients for the whole sample period, as well as for the three sub-periods – PRIOR (2003-2007), CRISIS (2008-2010) and POST (2010-2015). TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities). This study uses 0.8 as the highest acceptable absolute value for pairwise correlation and above this value the model is seen to suffer from multicollinearity.

A.5 Summary Statistics

Appendix 8: Graphs of the average value of the variables over time



This figure presents graphs of the average values of each variable over time, winsorized at the 1% and 99% level. The graphs are based on the final sample used, consisting of 42 firms in 19 countries, and the red lines represent the start and end of the crisis period (2008-2010). TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities).

A.6 Robustness tests

Appendix 9: Robustness regression for profitability - PROFIT (EBIT/TA)

	PRIOR	CRISIS	POST
TAN	-1.224	1.069**	1.545**
PROFIT	-1.953	-1.241	-6.633***
SIZE	-0.166***	-0.0778	0.113**
GROWTH	3.061	-6.53	-12.339**
LIQ	-0.204***	-0.096***	-0.358***
Constant	1.538	8.406**	12.848**
Observations	210	126	210
R-squared	28.2%	38.0%	46.8%
Country FE	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

This table presents the observed relationships between the debt-to-equity ratio and the variables of interest during the periods PRIOR (2003-2007), CRISIS (2008-2010) and POST (2011-2015). As a robustness check, PROFIT is defined as EBIT to Total Average Assets - reflecting firm profitability - whilst the other variables keep the same definition as in the original regression. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities).

Appendix 10: Robustness regression for firm size - SIZE (natural logarithm of sales)

	PRIOR	CRISIS	POST
TAN	-1.094	0.896**	1.273**
PROFIT	-1.959	-1.066	-5.47**
SIZE	-0.164***	-0.0735	0.101**
GROWTH	1.951	-2.738	-1.417
LIQ	-0.199***	-0.114***	-0.393***
Constant	2.641	4.683**	2.522
Observations	210	126	210
R-squared	27.6%	37.5%	44.2%
Country FE	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

This table presents the observed relationships between the debt-to-equity ratio and the variables of interest during the periods PRIOR (2003-2007), CRISIS (2008-2010) and POST (2011-2015). As a robustness check, SIZE is defined as the Natural Logarithm of Sales - reflecting firm size - whilst the other variables keep the same definition as in the original regression. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities).

Appendix 11: Robustness regression for growth opportunities - GROWTH (change in sales)

	PRIOR	CRISIS	POST
TAN	-1.35	1.081***	1.758***
PROFIT	-1.522	-1.125	-5.025**
SIZE	-0.13***	-0.0702	0.12**
GROWTH	3.465	-5.65	-13.935***
LIQ	-0.221***	-0.104***	-0.347***
Constant	0.915	7.451	14.565***
Observations	210	126	210
R-squared	27.5%	39.2%	45.9%
CountryFE	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

This table presents the observed relationships between the debt-to-equity ratio and the variables of interest during the periods PRIOR (2003-2007), CRISIS (2008-2010) and POST (2011-2015). As a robustness check, GROWTH is defined as the Change in Sales - reflecting growth opportunities - whilst the other variables keep the same definition as in the original regression. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities).

Appendix 12: Robustness regression for winsorizing

	PRIOR	CRISIS	POST
TAN	-1,791*	1,356***	1,639**
PROFIT	-0,025	-1,073	-6,423***
SIZE	-0,0883***	-0,0464	0,2047**
GROWTH	3,128	-5,141***	-3,067
LIQ	-0,154***	-0,0662**	-0,375***
Constant	0,652	6,493***	3,079
Observations	210	126	210
R-squared	9.9%	33.2%	38.3%
Country FE	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

This table presents the observed relationships between the debt-to-equity ratio and the variables of interest during the periods PRIOR (2003-2007), CRISIS (2008-2010) and POST (2011-2015). As a robustness check, the independent variables are not winsorized in the regression for these results. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities).

Appendix 13: Robustness regression for dropping firms

	PRIOR	CRISIS	POST
TAN	1.411*	2.128***	2.096***
PROFIT	-3.009	-3.229**	-4.346***
SIZE	-0.151***	-0.1066*	0.029
GROWTH	0.378	-3.361	-7.558**
LIQ	-0.0718***	-0.06411***	-0.4698***
Constant	2.454	5.229	9.01**
Observations	315	189	315
R-squared	25.9%	29.4%	42.1%
Country FE	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

This table presents the observed relationships between the debt-to-equity ratio and the variables of interest during the periods PRIOR (2003-2007), CRISIS (2008-2010) and POST (2011-2015). As a robustness check, the independent variables are not winsorized in the regression for these results. TAN is the proxy used for firm tangibility (Property Plant and Equipment to Total Average Assets). PROFIT is the proxy used for firm profitability (EBITDA to Total Average Assets). SIZE is the proxy for firm size (Natural Logarithm of Total Average Assets). GROWTH is the proxy for growth opportunities (Change in Total Assets). LIQ is the proxy for liquidity (Current Assets to Current Liabilities).