Determinants of Capital Structure for Oil Tanker Shipping Companies

An Empirical Study

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ABSTRACT

Tanker shipping is the primary means of transporting crude oil, which is a necessary energy source for modern society. As a result, the oil tanker shipping industry has grown to be a vital link in the worldwide economy. The crude tanker sector is a capital-intensive industry, and the choices of capital structure of tanker firms directly impact their operating performance and future development. Therefore, examining the determinative elements of capital structure is valuable for oil tanker enterprises. By combining the current state of the global oil tanker industry with the characteristics of the capital structure of shipping enterprises, this thesis conducts an empirical study of the elements that decide the capital structure of an oil tanker company based on the relevant capital structure theories. We used the firm fixed effect panel regression method to generate results by selecting the financial data of 14 listed tanker companies from 2000 to 2021 and the relevant shipping statistics as samples, we also combined some latest data to present the condition of the entire tanker industry.

According to our research, the oil tanker firm's capital structure is mainly determined by size and nondeductible tax shield. Debt ratios have a positive relationship with Size, while a negative relationship with Nondeductible Tax Shield. However, the BDTI index and Asset Tangibility have not had any effect upon the capital structure of oil tanker enterprises. We also demonstrate that Efficiency has a positive association, while Profitability and Z-score are adversely correlated with total and long-run debt level but barely affects short-run debt level. Moreover, Liquidity has an adverse connection with total and short-run leverage. We especially discover that Growth has an effect upon oil tanker shipping companies' short-term debt level and the direction is positive. We also identify some industrial elements, such as Oil Price and Orderbook-to-Fleet Ratio are necessary to be considered.

Our research about the capital structure of oil tanker enterprises addresses a gap within the previous knowledge, meanwhile validating and complementing existing determinative elements of capital structure for the shipping industry. Core findings have guiding significance for decision-making related to the capital structure of oil tanker shipping companies.

Keywords: Capital structure, determinants, oil tanker shipping company

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1 Introduction

Oil is an indispensable energy source for most social sectors, and the primary mode of oil transportation is marine shipping. Therefore, as a crucial element of oil transportation, the oil tanker shipping industry has become a significant link in the global economy. However, the characteristics of the oil shipping industry, such as the high cost of vessels and equipment, the instability of oil supply and demand, and the fluctuation of freight rates, have created both risks and challenges for global oil tanker shipping companies under the current economic situation. On the other hand, as the world economy is often affected by uncertain factors such as diseases, wars, and other events, which directly influence oil prices, oil tanker shipping companies will take a hit as well.

Since the oil tanker shipping industry is a capital-intensive sector, the capital structure decision of a company in the industry will directly affect the company's operating performance and future development. Based on Akeem et al. (2014), capital structure is known as the proportion of debt and equity of an enterprise. A reasonable capital structure enables the company to effectively use financial leverage to reduce the cost of capital and to survive in the fluctuating global economic cycle and the rapidly changing market, while maintaining a stable and healthy operation. The drivers of capital structure for oil tanker enterprises must be understood as a result.

The capital structure theories serve as the foundation for our study of the capital framework of a business. Combining these theories provides a theoretical foundation for comprehending the variables affecting a company's capital structure. We focus on introducing four capital structure theories in this thesis. First off, MM(Modigliani and Miller) theory is the beginning of modern capital structure theory, which holds that in the absence of tax and market friction, a company's capital structure will not alter its market value(Modigliani and Miller, 1958a). The trade-off theory has been developed on the foundation of MM theory. According to this theory, an enterprise's leverage is decided by the balance between financial risk, together with the corporation tax shelter (Kraus and Litzenberger, 1973). While the impact of the tax shield is influenced by the environment of the company, the risk faced by oil tanker shipping companies is affected by changes in the price of oil and supply and demand. As a result, the trade-off theory

aids us in better understanding the determiners. Interest conflicts between a company's owners and management are mentioned in agency theory (Jensen and Meckling, 1976), which impacts a company's capital structure, and the same conflict exists in the case of the oil shipping industry. In order to ensure that management makes decisions that are in the shareholders' best interests, the company's leverage must consider the management's incentives and limitations. The pecking order hypothesis asserts many oil tanker shipping firms prioritize debt finance above internal financing when obtaining capital.

Furthermore, we concur with Kumar et al. (2017)'s opinion that macro, industrial, and micro variables may be used to categorize the elements that influence capital structure. How these factors interact with one another has an effect upon the capital structure of oil tanker companies. The capital structure of tanker shipping companies will be susceptible to changes in the global economy and oil prices from a macro perspective. Market supply and demand, industry leverage are all industry-related aspects. These factors have an impact on the company's risks and profits and thus affect the company's decision on capital structure. Micro-factors are also called firm-specific factors. Our research primarily focuses on this area, which covers the size, profitability, and other aspects of oil shipping companies. These factors usually directly affect corporate debt and equity financing decisions.

Numerous academics have previously identified various determinants for capital structure and examined how they might affect it through empirical research. However, we note that the results of these studies are contradictory as a consequence of different research methodologies and sample selections made by researchers. The capital structure is also shifting throughout time. There are certain major macro, industry, and company-specific factors that are also relevant for investigating but frequently overlooked. Additionally, we discovered that very few scholars looked into the capital structure of tanker shipping companies. Therefore, determining if these elements are related to the company's capital structure in an oil tanker shipping company, and introducing other possible influencing factors like the Baltic Dirty Tanker Index are challenging yet innovative points during our research.

We establish three models to investigate the determiners of capital structure for oil tanker shipping enterprises. As determining proxies for our models we used total debt ratio,

long-term debt ratio, and short-term debt ratio. We kept the independent variables constant for all three models. We used both standard corporate finance variables and industry-specific variables.

This paper investigates several potential capital structure determinants for oil tanker shipping companies via empirical analysis based on the capital structure theory and the established model. This makes it easier for companies to take advantage of opportunities and overcome obstacles in the rapidly evolving technology and market environment. Additionally, it offers guidance regarding financing and investment for such companies along with references for their capital structure adjustments and enterprise value optimization.

The remaining thesis is divided into seven chapters. First, we provide an overview of the oil shipping industry, including the different types of tankers, the value chain, and the financing options available to shipping firms. Then, by analyzing relevant literature on capital structure and capital structure determinants, we identify the question that needs to be solved-what are the determiners of the capital structure of oil tanker shipping enterprises. In the following chapters, we make a description of how we conduct the data collecting and data processing of marine shipping and financial data, which from 14 listed tanker shipping companies. After that, we build three fixed effect panel regression models, which are then analyzed and discussed. Finally, we draw a conclusion based on the findings of the empirical analysis, talk about the limitations of our research, and offer potential directions for future research.

2 The Tanker Industry

We will in this chapter give a brief explanation of the oil tanker shipping market, the value chain, and an overview of ship finance and risks.

2.1 Overview of the Tanker Market

A tanker is a vital shipping instrument and is designed to transport liquid or gas cargo. The history of oil tankers can be traced back to the early twentieth century. With the rapid development of the oil industry, tankers have gradually become one of the main transportation tools for oil and oil products.

There are four types of tankers: crude oil tankers, product tankers, chemical tankers, and liquefied gas carriers. They are categorized by cargo type. Crude oil tankers are the largest ones and are mainly used to transport unprocessed crude oil. Product tankers are commonly used for shipping refined oil products. Chemical tankers transport explosive, toxic, and harmful chemicals. Liquefied gas carriers can transport liquefied natural gas (LNG), liquefied petroleum gas (LPG), and other gas products.

Crude oil tankers are notable for their load capacity and transportation field. Panamax is the smallest type, then Aframax, Suezmax, VLCC, and ULCC, ULCC is the largest type. Additionally, crude oil tankers have high safety and stability, enabling them to transport petroleum products securely, even under adverse sea conditions, to their intended destinations. Product tankers are prevalent since they are specialized in transporting refined oil and other liquid petroleum products, including gasoline, diesel oil, and kerosene. Compared to other tankers, product tankers tend to have a smaller size and require specific technical standards for loading, unloading, and transportation.

Tanker shipping is measured by several indicators, such as deadweight, ship speed, tanker volume, fuel efficiency, shipping routes, and transportation costs. Deadweight is a crucial metric that measures the carrying capacity of a tanker and is often expressed as "DWT". Speed is a significant factor as well since it affects route design and transportation time. Transportation cost is another critical aspect to consider, and it can be affected by many factors such as oil prices, labor costs, insurance premiums, and other expenses.

2.2 The Oil Tanker Value Chain

Crude oil is one of the vital sources of global energy, with its output, price, and supply chain stability affecting global economic development. As mentioned above, tankers are the main vehicles to transport crude oil from production sites to consumption sites. Hence, having knowledge about the scale, capacity, routes, and freight rates of tanker shipping is crucial in predicting supply-demand dynamics and price trends in the crude oil market, and aids companies in making capital structure decisions.

The main types of crude oil tankers are VLCC, Suezmax and Aframax. VLCC freight rates are often used as a direct indicator of the health of the crude oil tanker industry due to the cost-sharing benefits of long routes. The global trade routes for crude oil tankers primarily revolve around exporting countries to importing countries. VLCCs are primarily active on routes with long transportation distances and large volumes, such as the Middle East - East Asia routes. Suezmax crude oil tankers operate on scattered routes, including West Africa - Europe and the US Gulf - Europe. Aframax crude oil tankers are mainly used for short-haul routes, with a considerable proportion of deployment focused on routes aimed at Europe.

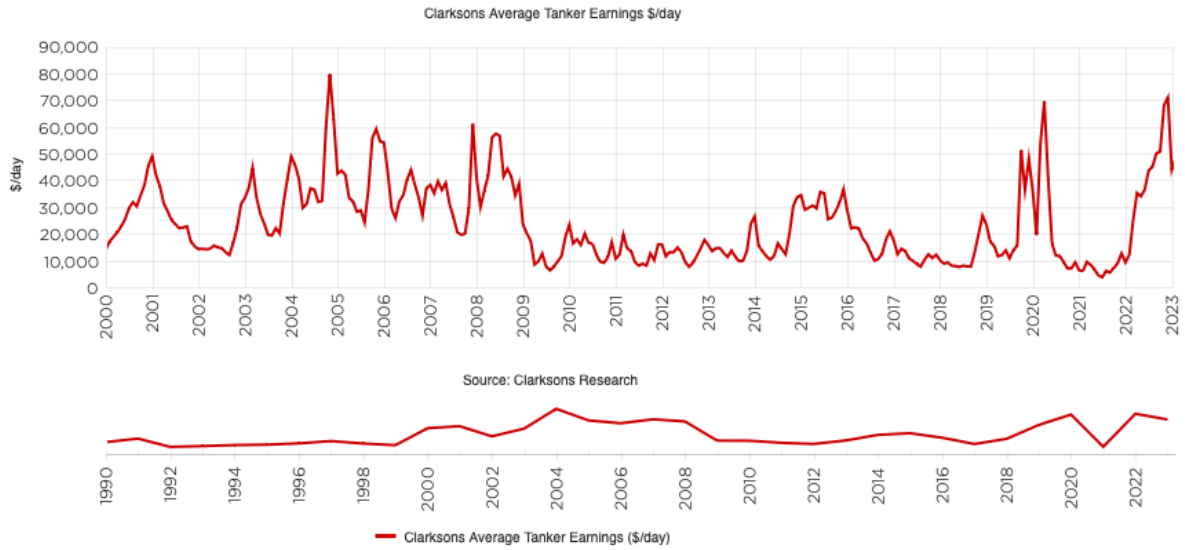
In 2022, according to Clarksons WFR data, there are 2,199 vessels in the tanker segment and the global crude oil tanker fleet has a total carrying capacity of 435 million deadweight tons. It increases by 1.62% compared to 2021. The VLCC ships have a carrying capacity of 262 million deadweight tons, accounting for 60% of the total transportation capacity of the fleet. The Suezmax crude oil tankers, with 622 ships and a carrying capacity of 97 million deadweight tons, accounted for 22% of the fleet's transportation capacity. The Aframax crude oil tankers, with 670 ships and a carrying capacity of 73.5 million deadweight tons, accounted for 17% of the fleet's transportation capacity. There were also 1% of Panamax crude oil tankers. More than half of the transportation capacity of VLCC crude oil tankers is deployed on the Middle East-East Asia route, which accounts for 25% of the global crude oil trade volume, with more than half of that trade volume being between the Middle East and China. (Appendix1,Res (2023b))

The oil tanker value chain consists of both upstream and downstream components that are key points in the oil industry. Upstream companies include ship design and construction

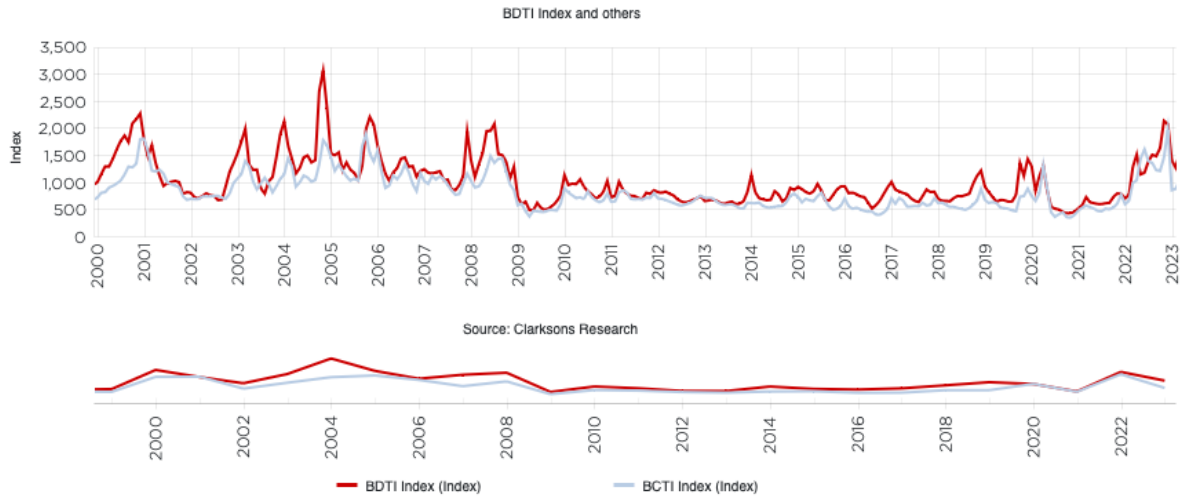
manufacturers, as well as oil commodity suppliers. Downstream companies, on the other hand, mainly consist of refining and chemical companies or traders. Changes in shipyard production cycles can amplify cyclical fluctuations in the tanker industry. Fuel costs are another expense for oil tanker companies, and the economic feasibility of using different types of fuel oil varies considerably under the constraints of Global Pact for the Environment. From the downstream perspective of the value chain, oil tankers serve the Global seaborne trade volume of crude oil and reffined oil prdocts, which is the main method of delivery for global oil trade. According to Clarksons SIN data, the global seaborne trade volume of crude oil in 2022 was 39.5 million barrels per day, representing a 5.6% increase compared to 2021. (Appendix2,Res (2023a))

The supply side of oil tankers is influenced by multiple factors, including existing capacity, deliverable capacity, scrapping capacity, capacity utilization, and sailing speed. On the other hand, the demand side of oil tankers is mainly influenced by the volume and distance of oil shipping trade.

Cyclicality is a significant characteristic of the shipping industry. Clarksons Research has been compiling and publishing a shipping index called the ClarkSea Index since 1990. This index tracks the earnings of four main shipping types: bulk carriers, tankers, container ships, and gas carriers, and is a composite index weighted by the number of ships in each segment of the global fleet. The index has recorded every major cycle in shipping history since its inception, witnessing the fluctuations in the shipping market under each boom and bust cycle. It has now become a barometer of international shipping market trends. The changes in the ClarkSea index for the tanker segment from 2000 to 2022 are clearly described in the chart below, revealing the obvious economic cyclicality of the shipping industry.



This is true for the oil tanker shipping industry as well. The red and grey lines in the following graph respectively represent the changes in the Baltic Exchange Dirty Tanker Index (BDTI) and the Baltic Exchange Clean Tanker Index (BCTI) between 2000 and 2022. From the graph, we can easily conclude that these indices exhibit regular fluctuations.



2.3 Ship Finance and Risks

A company can use its own funds, including retained earnings, as the principal for the next stage of production and investment. However, if the company's own capital is insufficient to meet its capital demand, relying solely on retained earnings as a financing method may not be feasible for a shipping company. The two most prevalent methods for shipping enterprises to get outside capital are funding via debt and funding with equity. Two main

forms for debt financing include bank loans and issuing bonds. The interest rate consists of the inter-bank lending rate (LIBOR) and a certain interest spread. Companies can employ different types of bank loans, such as credit loans, mortgage loans, and syndicated loans. Bond issuing is an effective means for companies to obtain funds from the public by borrowing in the bond market. If a company is not able to purchase a vessel immediately, the financial lease is a perfect method for it. During the lease term, the shipping company pays rent as agreed and can obtain ownership of the ship after the lease term ends. If the company is unable to pay the rentals on time, it only needs to return the right to use the ships instead of paying off the debts with other assets, thereby reducing the financing cost. Mezzanine loans are a hybrid financing method between equity financing and bank loans. Companies can raise significant funds through mezzanine loans, and the financing procedures are relatively simple. Equity financing is a way for shipping companies to obtain funding through the cross-integration of the shipping and capital markets. One effective way for companies to publicly raise funds is to issue stocks.

3 Literature Review

Owolabi et al. (2012) held that capital structure denotes the proportion of all types of capital in the total capital of a company. Capital structure is a vital aspect of corporate financial management, examining the capital structure of companies can help firms in making sound financing decisions. It also mitigates the potential risks and adverse effects caused by high financing costs or an imbalanced capital structure. Moreover, the research on the capital structure can furnish investors with valuable guidance, enabling them to evaluate a company's financial condition and investment potential more precisely. Moreover, the capital structure reflects a company's ability to obtain potential financial and economic benefits by arranging its capital structure in a reasonable manner, thereby realizing the interests of both shareholders and creditors. By utilizing different financing methods, such as debt, and equity, the company may strike a balance between cost and risk to construct its target capital structure. Furthermore, it is crucial to continuously evaluate the capital structure adapting to different stages of the market environment and corporate conditions.

Prior to 2000, academics in this discipline conducted research that provided a strong foundation for subsequent analysis. Taub (1975) conducted a quantitative analysis concerning the capital structure of American-listed enterprises. On a basis of Baxter and Cragg (1970) research, he clarified the association between a company's debt-equity ratio and its novel options for financing as being positive. He was also concerned that the risk premium needed for bond issuance might vary from firm to firm or year to year. Finally, he added the corporate tax rate variable and discovered that it has an adverse correlation with the debt-equity ratio. It turns out from Lee and Kwok (1988)'s study that agency costs and bankruptcy costs may possess an effect upon the capital structure of American multinational companies (MNCs) and American domestic companies (DCs), which lines up with agency theory. The agency cost of debt arises when the risk of a company's debt increases, and the manager entrusted by the shareholders may prioritize the interests of the shareholders over those of the creditors. In response, the creditors may demand higher requirements on their capital, which indirectly increases the cost of debt and affects the value of the enterprise. Profitability is the primary factor influencing the debt ratio of Japanese firms, as indicated in Allen and Mizuno (1989)'s regression analysis of elements

affecting the debt-to-value ratio of 125 Japanese companies. Industry influences may further have a profound effect on the capital structure. Depreciation deductions and expenditures associated with financial hardship are also essential factors in the capital structure of real estate, corresponding to research on the real estate sector by Gau and Wang (1990). In his analysis of 48 publicly traded corporations in Australia, Allen (1991) came to the conclusion that the company's financing occurred in a particular sequence of financing avenues, which lends credence to the pecking order theory. It asserts that businesses should finance their operations in a a specific sequence and emphasizes the importance of transaction costs. According to López-Gracia and Sogorb-Mira (2008), they first use internal funds, then resort to debt financing, and finally consider equity financing. Non-financial enterprise capital structure throughout the UK is explained by the Bennett and Donnelly (1993)'s research using cross-sectional data. Depending on him, capital structure is tied to firm size, profitability, and non-deductible tax shielding, and more volatile companies get to borrow more.

The MM Theory (Modigliani and Miller, 1958a) proposes in the case of corporate tax, interest expenses incurred by enterprises due to debt financing can be deducted before tax. Under this circumstance, companies only need to continuously expand debt financing, and new interest will be generated to offset taxes, meaning the tax shield effect will be more obvious. In this case, as the debt-asset ratio rises, so will the market value of the enterprises. From WACC's vantage point, Bradley et al. (1984) held the view that it will reduce as the leverage ratio increases taking advantage of the cheap cost of debt financing, and the ideal capital structure will show up when the business totally relies on debt financing. This provides evidence for the author's points. The research performed by Sharpe (1995) uses time series data and cross-sectional data from the Australian trading bank, spanning from 1967 to 1988. He concluded that instead of trade-off theory, which states that it is necessary for companies to strike a balance between the tax shield and cost associated with financial risks, as well as to consider corporate tax shield revenue, plus corporate financial distress cost that can help us theoretically determine the optimal capital cost, pecking order theory supports the choice model of transaction bank capital structure. The risk may have a beneficial influence on financial leverage, as seen in Robert and Lloyd Hunter (1995)'s analysis of the UK retail industry. They evaluated how rapidly retail enterprises adapt their capital structure in a recession and showed that the adjustment is relatively

speedy. Under the market economy conditions, Enqvist et al. (2014) asserts that national economic development exhibits cyclical fluctuations, and enterprises should adopt different financial management strategies at different stages. In light of Robert and Lloyd Hunter (1995)'s analysis, we have concerns that the shipping industry may be susceptible to the global economic cycles, which may limit the accessible sources of funding and customer demand for firms across different phases of the economic cycle and affect their capital structure. To identify the long-term drivers of corporate capital structure, Gatward and Sharpe (1996) developed a model implementing cross-sectional and time series data from 164 listed businesses in Australia spanning 1967 and 1985. His conclusion—which supports the pecking order theory—was that corporate leverage is favorably correlated with profitability and adversely correlated with opportunities to grow. The agency cost of debt, which is pertinent to the agency theory, focuses primarily on the connection between agency costs and corporate leverage. Owing to a discrepancy in information, shareholders typically exercise strict supervision and restriction on management to ensure their interests are not harmed. These efforts have a cost known as agency costs, which results in the consistency of the duration of the debt and the asset in Gatward and Sharpe (1996)'s study. One of the main topics of focus in Kim (1997)'s study of the capital structure of American restaurant companies is growth opportunities. He observed a significant inverse relationship between growth opportunities and three distinct types of leverage ratios, including overall, long-run and short-run debt level.

We learned that the majority of the empirical findings from the research conducted before the year 2000 suggest the business's size, profitability, non-debt tax shelters, and growth prospects are significant variables driving the capital structure for enterprises in many nations and industries. Agency theory and pecking order theory are two that can offer substantial theoretical backing for the factors that affect capital structure. Moreover, business issues and economic cycles take a significant effect when establishing the capital structure. Additionally, we find out that the debt-to-capital ratio, the debt-to-equity ratio, and the indicators throughout different time periods can all be applicable to evaluate the capital structure of firms, allowing us to compare capital structures easily.

On the basis of earlier research, empirical studies on the factors affecting capital structure evolved between 2001 and 2010. In line with the predictions of the Modigliani and Miller

(1958b) taxed theory, De Miguel and Pindado (2001)'s empirical research on Spanish enterprises identified an inverse link between non-debt tax shields and debt alongside a reciprocal relationship between the cost of the financial difficulty and debt. It is concluded by Degryse et al. (2012), there are two additional propositions in the MM theory with tax. Proposition 1 shows that debt financing will produce a tax shield effect, which will affect the value of the company. Since dividends cannot be deducted before tax, the dividend policy of the company will not have a bearing upon enterprise value(Modigliani and Miller, 1958a). Proposition 2 is to affirm the existence of the relationship described in Proposition 1. They noticed that firms are more probable to use cash flow than debt as their source of funding. According to the notion of the pecking order, since companies must consider the financial difficulties caused by interest costs when carrying on debt financing. Therefore, using internal financing, which does not incur issue costs or income tax, is typically the preferred financing method (Myers and Majluf, 1984). 390 British companies were the subject of a regression examination by Ozkan (2001) between 1984 and 1996. They found that the size of the business has a beneficial effect on long-term borrowing decisions, while growth prospects, liquidity, profitability, and non-debt tax shelters have an unfavorable effect. Extending research on elements affecting the capital framework, Hatzinikolaou et al. (2002) analyzed twenty years of data from 30 Dow Jones industrial enterprises and figured out that inflation uncertainty drastically decreased the firm's debt-to-equity ratio. By using a variety of Australian firm-specific data to empirically test the static trade-off and pecking order theory, Cassar and Holmes (2003) saw that profitability and growth dominate as capital structure elements, backing the theoretical model's assertion that such variables are noteworthy. However, the static trade-off theory does not consider those costs incurred by companies when they modify their capital structure. According to Antoniou et al. (2002), only when profits outweigh the costs, the company will change their capital structure.

By examining corporate bonds issued in the United Kingdom and Italy between 1992 and 1996, Panno (2003) demonstrated how size and profitability exhibit positive effects on the financial leverage of an enterprise together with its adverse effects of liquidity concerns and risk of bankruptcy. Regression analysis was implemented by Hall et al. (2004) to study those elements determining the capital structure of European small and midsize companies. They chose data collected from 4,000 businesses across 8 nations and noted

that asset size had an adverse correlation with short-run debt but an advantageous link to long-run ones. Additionally, they think that some country factors, such as signal cost degrees, disparities in information, and the agency between nations, may alter choices concerning capital structures. The practice of an effect of regional elements on capital structure, however, is furthered by Deemsomsak et al. (2004)'s research on the capital decisions taken by companies in the Asia-Pacific region. They find out that government agencies, financial regulations, and legal frameworks all have a bearing upon the capital structure of companies' selections.

Corporate financial structure correlates positively with growth rate, while profitability and non-debt tax shelter have a negative association with debt ratio, from Bhayani (2005)'s analysis of the capital structures of 504 Indian publicly traded firms. The evaluation of Greek manufacturing firms by Voulgaris et al. (2004) displays that business size and profitability exert a significant role in determining capital structure. Bigger corporations had higher levels of long-term and short-term obligations, whereas profitability was inversely connected with leverage, in keeping with Bevan and Danbolt (2004)'s fixed-effect panel model research of the drivers of capital structure of 1,054 UK enterprises between 1991 and 1997. Newly formed companies differ from established businesses in terms of funding methods and capital structures, as demonstrated by a study by Örtqvist et al. (2006) that filled a gap in the literature in this field for emerging businesses. The study took into account the distinction between short-run and long-run debt and ultimately found financial structure and entrepreneurial age are influential factors in start-ups' capital structure. The capital structure of UK enterprises was studied by Fattouh et al. (2008) employing a non-linear methodology as an extension of the research method, and they found that the estimated impacts of the explanatory factors varied across different percentiles of the distribution. Meanwhile, unlike the sample utilized by the majority of scholars, José Arcas and Bachiller (2008) studied the capital structure of private companies and privatized companies in the European Union and noticed that profitability had a negative association with debt ratios while tangibility showed a hardly significant relationship with capital structure. In agreement with Jairo (2008)'s analysis of 651 publicly traded firms in the UK, changes in leverage ratios are inversely connected with variations in non-debt tax shields, profitability, and cash, yet positively associated with shifts in firm size and taxes. Based on Titman and Wessels (1988)'s structural equation

modeling, making use of multiple indicators and multiple causes, Chang et al. (2009) uncovers that growth is the most vital consideration in selecting a capital structure, with the short-term debt ratio coming in second. After performing an empirical examination of 2007 data on 10905 Swedish businesses in multiple sectors, Yazdanfar and Odlund (2010) found that other than industry-specific factors, size, tangible assets, and profitability are significant factors that determine both short and long term liabilities.

We can assume academics have identified that firm size and debt ratio are positively correlated during this decade, while profitability, non-deductible tax shelter, and debt ratio have an inverse association. On top of that, numerous scholars have also examined new factors like inflation uncertainty, liquidity, as well as industry and country factors. In theory, in addition to agency and pecking order theory, it has been found that trade-off theory also provides a basis for capital structure decisions. Additionally, certain scholars are applying nonlinear methodologies to analyze models of capital structure determinants. Regarding sample selection, more businesses of various industries and stages are examined. These have substantially enhanced the research findings in the area of capital structure detrimental factors.

Between 2011 and 2020, the theory of capital structure determinants has become more complete in all aspects of research. A hierarchical linear model used in Kayo and Kimura (2011)'s research to analyze time, firm, industry, and nation characteristics revealed that time and firm-level factors explained 78% of the leverage ratio. This conclusion is reinforced by Gungoraydinoglu and Öztekin (2011)'s research, which indicates that firm-level factors drive two-thirds of global changes in corporate capital structure. A small number of researchers have examined the factors influencing capital structure without tax, in the absence of tax, MM theory (Modigliani and Miller, 1958a) contains two propositions. The first proposition demonstrates that the debt-asset ratio of a company will not have an impact on the company's value. The second proposition shows that the increase in the cost of equity does not affect the weighted average cost of capital when the leverage ratio increases. However, this is merely an ideal scenario. For recognizing factors influencing the capital structure of Kuwaiti companies under a tax-exempt setting, Sbeti and Moosa (2012) used extreme bounds analysis. The pecking order theory is supported by the evidence, rather than the trade-off theory. Furthermore, they discovered how crucial profitability

and growth prospects are in a tax-exempt context. Pinková et al. (2012) investigated the effect of the business life cycle upon the corporate leverage. He found firms in the initialization, growth, and recession phases typically had higher debt levels, whereas, in the mature phase, companies would prefer equity capital, this is keeping with core tenet of the pecking order theory. Mokhova and Zinecker (2014) similarly argues that the influence of macroeconomic factors varies across countries and depends on corporate debt structure, generally capital structure can be influenced by changes in macroeconomic variables, including interest rates, inflation rates, fiscal policies, and economic cycles. Under market economy conditions, national economic development exhibits cyclical fluctuations, and enterprises should adopt different financial management strategies at different stages. Merika et al. (2015) believe a close relationship exists between the economic cycle and capital structure. During an economic boom, companies usually tend to use more external financing to expand their business operations and increase profitability. Conversely, during an economic recession, companies typically favor internal financing options to reduce financial risks and maintain a stable financial situation. Consequently, companies will adopt different capital structures during different economic cycle stages, depending on their specific circumstances and the prevailing market conditions. So, it is easy to have the thought that the global economic cycles can affect the shipping industry, limiting the financing methods and demand for companies in different economic cycle stages, thereby affecting their capital structure.

To test the significance of unobservable firm-specific effects, Matemilola et al. (2013) applied a novel method called the restricted least squares method. He discovered that first-specific capital structure models might be inaccurate because invisible variables like management skill and ability also affect capital structure. Öztekin (2015) noted that industry leverage is a significant consideration in making capital structure determinations. When a company is within a high-leverage-ratio industry, it will be influenced by its competitors a lot, in other words, companies may adjust their capital structure in response to industry competitors. Assuming businesses function normally and efficiently, Sarkar (2014) explored a neglected issue and discovered that product market flexibility can have a favorable effect on debt levels and leverage ratios. Myint et al. (2017) mention that to determine the optimal debt-to-equity ratio, firms must understand the interaction of three critical factors: the value of tax deductibility of debt, which increases with

leverage, the potential costs of financial distress, which also increase with leverage, and the value of investment opportunities available to the firm, which can decline with excessive leverage. In other words, capital structure decisions and objectives should also consider a company's competitive position and the availability of investment opportunities in order to provide suitable solutions for its financing demands. Kumar et al. (2017) pointed out that the capital structure involves the inclusion of all available financial resources and the determinants of a company's capital structure can be mainly categorized into three main aspects: macro, which means the influence of the macroeconomic environment to the capital structure of enterprises, industrial, pertains to a effect of distinct industry features on a company's capital structure, and micro, which refers to the characteristics and circumstances of a company, such as its size, operational risks, and profitability, which can potentially influence its choice of capital structure. In his analysis, Eldomiaty et al. (2014) finds that while inflation rates are adversely connected with debt financing, productivity, exports, and unemployment are positively correlated with debt ratios. These findings are depending upon quarterly data from non-financial companies traded on the DJIA and Nasdaq between 1992 and 2010. Krämer (2015) looked into the connection between capital structure and ownership structure. He applies the firm fixed effect estimating approach to evaluate corporate data from Europe. The analysis concludes that corporations with concentrated ownership are more sensitive to this tax rate and that a rise in corporate tax rates has a favorable effect on the debt-to-asset ratio.

It is worth noting that the view proposed by Li and Islam (2019) that the selection of industry-specific variables is difficult as the literature on industry factors and capital structure is limited. However, companies operating in disparate industries may encounter varying market competition and policy environments, and the business model of enterprises will change accordingly. As a result, each company will choose different financing methods and proportions that align with its specific circumstances. This is why the researchers still bear it in their mind. In the views of Anabila and Whang (2017), Matemilola et al. (2018), and Kurronen (2018), the capital structure can be influenced by cultural secrecy, management expertise, and natural resources. Between 2003 and 2016, Sakr et al. (2019) collected information on the financial statements of 62 Egyptian listed firms. They discovered that the debt ratio is positively connected with both profitability and size, which is consistent with the trade-off theory. Growth is positively connected with

the debt ratio whereas liquidity is negatively correlated, supporting by pecking order theory. A regression analysis of Polish TSL (Transport, Spedition, Logistics) companies by Jędrzejczak-Gas (2018) finds the level of debt can be only positively related to enterprise scale, but negatively related to liquidity and effective tax rate. The Gungoraydinoglu and Öztekin (2011)'s study examined 69 banks from the Gulf Cooperation Council countries between 2009 and 2018 via an autoregressive distributed lag approach. The regression analysis reveals that whereas profitability, liquidity, and risk are adversely correlated with leverage, the ratio of tangible assets and bank size are positively correlated. In the highly cyclical Norwegian farmed salmon industry, Sikveland and Zhang (2020)'s study discusses firm-level capital structure determinants and observes that profitability has an adverse effect on both short-term debt and total debt.

By 2020, more theories have been tested, and a large number of researchers have already shown that the majority proportion of debt ratios are explained by firm-specific factors like size, liquidity, profitability, tangible asset ratios, and growth. Apart from that, it has been discovered that capital structure and the cyclicality of companies, industries, and the global economy are interchangeable. Furthermore, some findings have been updated or validated by new research techniques.

In fact, the issues affecting the capital structure of the shipping industry have received very little attention in the literature. The tangible assets had a strong association with corporate leverage when compared to other industries, corresponding to an empirical analysis by Drobetz et al. (2013) of the data of 115 listed shipping companies between 1992 and 2010. Only thin proof was found to back up the market timing theory. They looked at the cyclicality of the shipping sector as well as firm-specific influencing factors and discovered that because of the unique supply and demand patterns of this industry, shipping companies' leverages run counter-cyclically. They also talked about the speed of adjustment in the shipping industry, arguing that while it is generally faster than other businesses in other industries, it tends to be slower when shipping firms diverge from their ideal capital structure during the recession. This paper limits the sample to tanker shipping companies based on the research of Drobetz et al. (2013). In order to further their exploration, industry factors are included in the regression analysis, such as the orderbook-to-fleet ratio, oil price, and BDTI. Moreover, we investigate the relationship

between debt levels with various maturities and the capital structure of shipping companies via different dependent variables. The study of Paun and Topan (2016) rejects the pecking hypothesis but confirms trade-off theory's validity. From the standpoint of shipping investments, Drobetz et al. (2019) examines the capital structures of shipping companies and discovers that ownership has a favorable effect on investment-freight rate sensitivity, which raises company value. Kotcharin and Maneenop (2020) found geopolitical risk has an adverse bearing on financial leverage, and this effect is more pronounced in cycles of high freight rates and rapid economic growth, according to an empirical analysis of panel data from 118 listed shipping companies in countries participating in the Belt and Road Initiative between 1987 and 2017. Regression analysis was implemented by Yang et al. (2022) to evaluate 60 Korean and 32 Greek shipping firms from the operators' and owners' perspectives, respectively and the empirical findings corroborate the pecking order theory.

In summary, prior research has identified certain factors that determine capital structure and their potential impact on capital structure through empirical studies. However, due to variations in research methodologies and sample selection among scholars, the findings are not consistent. Moreover, capital structures are not static, there are crucial factors such as macroeconomic, industry-specific, and company-specific factors that are equally significant but frequently neglected. These factors play a vital role in determining capital structure, but prior research has failed to adequately address them. On top of that, there is a gap in academic literature as few scholars have examined the capital structure of tanker shipping companies. This thesis aims to fill this gap by examining the capital structure of oil tanker shipping companies and representing the tanker industry, based on previous scholars' theoretical foundations regarding capital structure determinants. Empirical research will be conducted to identify the possible determinants of capital structure for oil tanker shipping companies.

4 Methodology

We will in this chapter describe and explain how our research has been carried out and the testing we have performed. This includes a detailed description of our model and why we decided on using the estimator we have used.

4.1 Research Models

To find the determinants of the capital structure we have created three research models:

Model 1: Total debt ratio

$$\begin{aligned} TDR_{it} = \alpha_i &+ \beta_1 \text{Size}_{it} + \beta_2 \text{AT}_{it} + \beta_3 \text{LQ}_{it} + \beta_4 \text{EFF}_{it} \\ &+ \beta_5 \text{PA}_{it} + \beta_6 \text{Z}_{it} + \beta_7 \text{Growth}_{it} + \beta_8 \text{NDTS}_{it} \\ &+ \beta_9 \text{BSOP}_{it} + \beta_{10} \text{BDTI}_{it} + \beta_{11} \text{OBF} + \epsilon_{it} \end{aligned} \tag{4.1}$$

Model 2: Long-term debt ratio

$$\begin{aligned} LTDR_{it} = \alpha_i &+ \beta_1 \text{Size}_{it} + \beta_2 \text{AT}_{it} + \beta_3 \text{LQ}_{it} + \beta_4 \text{EFF}_{it} \\ &+ \beta_5 \text{PA}_{it} + \beta_6 \text{Z}_{it} + \beta_7 \text{Growth}_{it} + \beta_8 \text{NDTS}_{it} \\ &+ \beta_9 \text{BSOP}_{it} + \beta_{10} \text{BDTI}_{it} + \beta_{11} \text{OBF} + \epsilon_{it} \end{aligned} \tag{4.2}$$

Model 3: Short-term debt ratio

$$\begin{aligned} STDR_{it} = \alpha_i &+ \beta_1 \text{Size}_{it} + \beta_2 \text{AT}_{it} + \beta_3 \text{LQ}_{it} + \beta_4 \text{EFF}_{it} \\ &+ \beta_5 \text{PA}_{it} + \beta_6 \text{Z}_{it} + \beta_7 \text{Growth}_{it} + \beta_8 \text{NDTS}_{it} \\ &+ \beta_9 \text{BSOP}_{it} + \beta_{10} \text{BDTI}_{it} + \beta_{11} \text{OBF} + \epsilon_{it} \end{aligned} \tag{4.3}$$

Table 4.1: Independent Variables and Abbreviations

Abbreviation	Independent Variables	Abbreviation	Independent Variables
Size	Size	Growth	Growth
AT	Asset Tangibility	LQ	Liquidity
EFF	Efficiency	PA	Profitability
Z	Z-score	NDTS	Non Deductible Tax shield
BSOP	Brent Spot Oil Price	BDTI	Baltic Dirty Tanker Index
OBF	Order Book as A Percent of Fleet		

We have the following hypotheses for our models:

H0= The independent variables have no significant influence on the capital structure

H1= The independent variables exert a significant influence on the capital structure

4.2 Regressions Estimators

When performing a regression estimation on panel data there are three standard methodologies: Pooled Ordinary Least Square (OLS), Random Effects (RE), and Fixed Effects (FE).

4.2.1 Pooled OLS

Pooled OLS is a method for estimating a linear regression model with cross-sectional data, where data is collected from multiple units at a single point in time (Stock and Watson, 2015). It involves estimating the coefficients using ordinary least squares and can be expressed mathematically as:

$$y_{it} = \beta_0 + x_{it}\beta + \epsilon_{it} \tag{4.4}$$

where:

y_{it} : dependent variable for unit i at time t

β_0 : Intercept

x_{it} : vector of independent variables for unit i at time t

β : vector of coefficients to be estimated

ϵ_{it} : error term, representing the random error or unobserved factors for unit i at time t

Pooled OLS assumes no systematic differences among units, and estimates the coefficients based on the pooled data. However, it may have limitations in accounting for unobserved heterogeneity among units.

4.2.2 Random Effects

The random effects estimator is a statistical method used in panel data analysis to estimate time-invariant and time-changing variables while considering unobserved heterogeneity. It assumes that the individual-specific effects adhere to a normal distribution with mean zero constant variance (Wooldridge, 2016).

The random effects estimator can be expressed mathematically using the following formula:

$$y_{it} = \beta x_{it} + u_{it} + \epsilon_{it} \tag{4.5}$$

where:

y_{it} : dependent variable for unit i at time t

x_{it} : vector of independent variables for unit i at time t

β : vector of coefficients to be estimated

u_{it} : is the individual-specific random effect or error term for unit i at time t,

u_{it} : which is presumptively normal with a mean of zero and a constant variance

ϵ_{it} : is the error term, representing the random error or unobserved factors for unit i at time t

This estimator involves estimating variances of the individual-specific effects using a first-stage regression and then estimating the coefficients of the independent variables using pooled regression models (Wooldridge, 2016).

4.2.3 Fixed Effects

Fixed effects estimation is a statistical method used in econometrics to address unobserved heterogeneity in panel data. It involves including unit-specific or entity-specific dummy variables in the regression model to capture time-invariant factors unique to each unit (Wooldridge, 2016). The fixed effects estimator can be expressed mathematically as:

$$y_{it} = \beta x_{it} + \alpha_i + \epsilon_{it} \tag{4.6}$$

where:

y_{it} : dependent variable for unit i at time t

x_{it} : vector of independent variables for unit i at time t

β : vector of coefficients to be estimated

α_i : is the unit-specific fixed effect or dummy variable for unit i

ϵ_{it} : is the error term, representing the random error or unobserved factors for unit i at time t

The fixed effects estimator involves estimating the model separately for each unit or entity and then pooling the estimates across units. This method allows for controlling unobserved heterogeneity and estimating the time-varying effects of the independent variables (Wooldridge, 2016).

4.3 Testing

We do several tests to learn more about our data and to decide on the best regressions estimator. We will test for normality and multicollinearity of variables. We will also test for cross-sectional dependence, serial correlation, and heteroskedasticity. We also look

into whether we should perform fixed or random effects if we can't employ OLS.

4.3.1 Shapiro-Wilk Test

The Shapiro–Wilk test is a statistical test used to check if a data-set follows a normal distribution. The test tests for skewness and kurtosis. The test is regarded to be a powerful test of normality (Tomšik, 2019).

H0= Our values are normally distributed

H1= Our values are not normally distributed

Table 4.2: Shapiro–Wilk Test

Model	Statistic	P-value
TDR	0.9894	0.0000
LTDR	0.9912	1e-04
STDR	0.869	0.0000

From the results of the test, we fail to keep our null hypothesis. This means that we can conclude that we do not have normally distributed values for any of our models.

4.3.2 VIF Test

A Variance Inflation factor (VIF) tests for multicollinearity. The test calculates the degree to which the variance of an estimated regression coefficient is increased due to the presence of correlation among the independent variables (**?**). A high degree of multicollinearity between two independent variables can lead to issues when interpreting the individual coefficients.

Table 4.3: VIF Test Model1: TDR

Variable	Statistic	Variable	Statistic
Orderbook as A Percent of Fleet	1.481713	Brent Spot Price	1.316687
BDTI	1.688106	Size	1.771763
Asset Tangibility	1.832779	Liquidity	2.467307
Efficiency	2.523730	Growth	1.083476
Profitability	2.554769	Z-Score	2.718082
Non-debt Tax Shield	1.790884		

In the given results, the VIF values for all the predictor variables are below 10, which suggests a low degree of multicollinearity between the variables (Snee, 1983). This suggests

the coefficients are probably accurate and interpretive. We find the same results for the other two models, see Appendix A3 for results for the result from all three models.

4.3.3 Pesaren Cross-Sectional Dependence Test

The Pesaren cross-sectional dependence test was developed to detect cross-sectional dependence in panel data. It is designed to examine whether the observations in a panel dataset are independent or exhibit some form of dependence.

H0= We do not have cross-sectional dependence in our data

H1= We do have cross-sectional dependence in our data

Table 4.4: Pesaran CD Test for Cross-Sectional Dependence

Model	Z-value	P-value
TDR	4.0716	4.67e-05
LTDR	2.4397	0.0147
STDR	0.7167	0.4736

We reject our null hypothesis at the 5% significant level for all our models, and conclude that we have cross sectional dependence.

4.3.4 Breusch-Godfrey Test for Serial Correlation

We use the Breusch-Godfrey test to test for serial correlation in our data. The problem happens when there is a correlation between the errors in different time periods for the same factor. This can lead to biased estimators.

H0= There is no serial correlation in our data

H1= There is a serial correlation in our data

Table 4.5: Breusch-Godfrey Test for Serial Correlation

Model	LM Test	DF	P-Value
TDR	556.64	3	$<$ 2.2e-16
LTDR	530.94	3	$<$ 2.2e-16
STDR	412.49	3	$<$ 2.2e-16

The p values for the test is close to zero, this indicates that we reject the null hypothesis. We can conclude that we have a certain degree of serial correlation.

4.3.5 Brusch Pagan Test

Brusch Pagan's test is used to test for heteroskedasticity. If there is evidence of heteroskedasticity in a regression model it means that there is unequal variance of the errors.

H0= Homoskedasticity exists

H1= Heteroscedasticity exists

Table 4.6: Brusch Pagan Longrun Multiplier Test

Model	BP-Value	DF	P-value
TDR	164.74	11	$<$ 2.2e-16
LTDR	124.97	11	$<$ 2.2e-16
STDR	56.351	11	4.38e-08

We reject the null hypothesis for all models under a 5% significant level. We now can conclude that hetroscedasticity exists in the models.

4.4 Summary and Determination of Regression Model

We have tested for normality, multicollinearity, cross-sectional dependence, serial correlation, and heteroscedasticity. For the test, we can see that we are in breach of some of the assumptions of normality, cross-sectional dependence, serial correlation, and heteroskedasticity. Due to this we have exluded pooled OLS as a estimator. That leaves fixed effects and random effects. We will conduct a Wu-Hausman test, to test which of the estimators will best estimate data.

4.4.1 Wu-Hausman Test

To choose between fixed and random effects in the model, we performed the Wu-Hausman test.

H0= Both estimates are consistent, but random estimates are efficient

H1= Fixed estimates are consistent, random estimation is not

Table 4.7: Wu-Hausman Test

Model	Chisq	DF	P-value
TDR	644.68	11	$<$ 2.2e-16
LTDR	30.594	11	0.001277
STDR	29.867	11	0.001663

As we can see from the results of Chisq value in the test we reject the null hypothesis for all three models. Fixed effect estimation will because of this be the preferred estimator for our data (Wooldridge, 2016).

We will use a fixed effect model with firm fixed effects and cluster standard errors, this is in line with (Drobetz et al., 2013)

5 Data

We have timeline panel data. The data has been collected from Refinitiv Eikon and Clarksons Intelligence database. We have collected quarterly financial data from publicly traded firms that either own or operate oil tankers. We excluded firms where the main revenue stream did not come from oil tankers. We did this to try to capture the effects of only the oil tanker shipping trade. This meant then we had to eliminate the MISC group and Mitsui O.S.K Lines as an example. We also excluded firms whose main fleet was chemical tankers as chemical tankers can take other chemicals except oil. Odfjell SE was as an example excluded from this study. We also excluded firms that currently do not own or operate oil tankers but have been in the past, such as Hunter Tankers.

We gathered quarterly financial data for the period 01.01.2000 to 01.01.2022. This has been done to try to catch any cyclical effects of the industry. Gathering public data before 2000 has not been possible, due to few publicly traded oil tanker firms. We gathered data for a total of 14 different oil tanker firms all publicly traded. We run our data in R Studio.

5.1 Dependent Variables

To find the determiners of oil shipping enterprise's capital structure we have decided to create a model containing three regressions. The dependent variables are presented in Table 5.1. We have done this look at what effects the debt ratio, but also to see if there is any differences on what effects the long term debt ratio and short term debt ratio.

Table 5.1: Determinant Variables

Determinants	Definition
Total debt ratio	The ratio of total book value debt to total book value assets
Long-term debt ratio	The ratio of book value long-run debt to total book value assets
Short-term debt ratio	The ratio of total short-run debt to total book value assets

All interest-bearing obligations represent total debt. Long-term debt contains all non-

current debt obligations for firms with obligations longer than a year. Short-term debt contains all current interest-bearing debt obligations and debt obligations shorter than one year. We used the total book value of assets to calculate the debt value. We did this because book value would not be influenced by volatility in the equity market and other macro effects as much. This is in line with Alam and Akhter (2020).

5.2 Independent Variables

5.2.1 Size

Size is a commonly used determinant variable in regression models that examine the determinants of capital structure. According to the pecking order theory, larger firms may have greater internal financing capacity due to higher profits and cash flows and thus may rely less on external debt financing. Empirical studies have found mixed evidence regarding the association between enterprise size and capital structure. Booth et al. (2001) have found an inverse connection, supporting the pecking order theory, while Rajan and Zingales (1995) have found no significant relationship. Trade-off theory suggests enterprises choose capital structures to balance the profits and costs when employing debt. According to this theory, larger firms may have a lower cost of debt financing due to their greater bargaining power, economies of scale, and risk diversification. Empirical studies from Frank and Goyal (2009)generally support the trade-off theory, finding size has a positive link to leverage.

We believe that firm size is a relevant factor for tank firms, due to the capital-intense nature of the industry. Buying vessels is a capital intense investment, and already having a large fleet that could be put up as collateral could lead to favorable debt financing terms.

We have used the natural logarithm of the book value of total assets to measure the size of a firm in accordance with Alam and Akhter (2020). We have employed the book value because it represents the historical cost of the companies' assets. The size will then not be affected by general market conditions as market capitalization could do.

5.2.2 Asset Tangibility

Assets that have physical forms are generally known as tangible assets. Fixed assets, inventories, and other physical assets that serve as collateral are the main types of tangible assets. The percentage of the firm's complete fixed assets to its overall assets represents the way the tangible asset ratio is commonly referred to.

The issuer of debt can use tangible assets as collateral. Firms with more tangible assets could because of this be able to secure cheaper and more debt financing. A firm with a higher asset tangibility will post lower risk for debt issuer. Pecking order theory and trade-off theory support this.

However,Serghiescu and Văidean (2014) have established a negative correlation between the tangible asset ratio and capital structure. Special enterprises such as high-tech companies, which may have a small proportion of tangible assets relative to their total assets, can still maintain high levels of debt because of the high value of intangible assets. Despite the inadequacy of tangible assets, such high income generated by intangible assets may allow these companies to manage their debts more effectively.

To measure this element, we have used Net property, plant, and equipment divided by total assets, which is similar to Drobetz et al. (2013).

5.2.3 Liquidity

Liquidity has been considered an important determinant of enterprises' capital structure in previous empirical research. The capacity to satisfy short-run obligations is measured by liquidity.

Specifically, if a firm has high levels of liquidity, it may be more able to service its debt and therefore may be more likely to use debt financing. On the other hand, if a firm has low levels of liquidity, it may be more difficult for the firm to service its debt, and the firm may be more likely to rely on equity financing.

Furthermore, liquidity can also impact a firm's borrowing costs. If a firm has high levels of liquidity, it may be perceived as less risky by lenders, and may therefore be able to secure lower interest rates on its debt. Conversely, if a firm has low levels of liquidity,

it may be perceived as more risky and may be required to pay higher interest rates to compensate lenders for the additional risk.

Ghasemi et al. (2016) prove that the result, a positive effect of quick ratio upon capital structure, has a similarity to the preceding research and indicates that banks put liquidity as the top priority to debt financing. Likewise, Sibilkov (2009) and Sharma and Paul (2015) have also arrived at the same conclusion, denoting that a few scholars believe in a positive relationship.

To calculate this variable we have divided current interest-bearing liabilities on current assets this is in line with Shambor (2017).

5.2.4 Efficiency

The indicator efficiency has not been widely used in capital structure analysis previously, but from the pecking order theory, efficient enterprises may employ fewer financing needs and therefore may be less likely to use debt financing. However, there is limited empirical evidence to support this theory in relation to efficiency as an element.

Depending on the trade-off theory, efficient firms may be more likely to use debt financing due to their ability to meet debt obligations and lower bankruptcy costs.

We have included efficiency because we believe this is a good measurement of the ability of the shipowner to generate revenue from the fleet. A high degree of efficiency indicates that the owner is able to keep the vessel under contract and at a good rate and avoid discounts and collect its cash.

To measure efficiency we used the asset turnover rate. We divided total net sales by total assets.

5.2.5 Profitability

A couple of indicators can reflect the profitability of a company, such as operating profit margin, cash coverage ratio, return on total assets (ROA), and return on equity (ROE). However, scholars have not yet reached a consensus about the bearing of profitability on capital structure. In accordance with the pecking order theory, corporations would rather use retained earnings for internal funding before resorting to external financing

choices like bonds and loans. External financing typically incurs higher costs compared to internal financing. Thus, enterprises with strong profitability can retain more profit to finance their development, which has a critical impact on the capital structure.

However, equity capital financing is a viable option for enterprises with robust profitability as it raises funds for scaling up while minimizing the comprehensive capital cost of companies. As Khan (2012) stated, the financial leverage and the profitability indicator ROA has a strong negative association. In contrast, companies with poor profitability may struggle to raise funds through retained earnings or equity capital and may resort to debt financing, which increases the debt ratio and financial risk of the enterprise, being in line with the empirical result of Bokpin and Arko (2009). In summary, the correlation between profitability and capital structure has been proven to exist in certain industries, but the direction of its impact is still uncertain.

We believe profitability is an important factor for shipping firms as this says something about where you are during the cycle. A high profitability will indicate a top of the cycle and low profitability would indicate a lower in the cycle.

As a proxy for profitability, we used return on total assets: earnings before interest and tax (EBIT) divided by total assets.

5.2.6 Z-Score

Altman's Z-score was developed by Edward Altman in 1986. The Z-Score measures financial distress in firms. If a firm has below 1.8 i Z-Scores it indicates that the firm is in financial distress, if the score is over 3, it indicates that no financial distress. If the firm finds itself in between there is moderate distress (Corporate Finance Institute, 2023). The Z-score is calculated by the following equations (Corporate Finance Institute, 2023):

$$Z - Score = 1.2A + 1.4B + 3.3C + 0.6D + 1.0E \tag{5.1}$$

where:

A : Working Capital over Total Assets ratio

B : Retained Earnings over Total Assets ratio

C : Earnings Before Interest and Tax over Total Assets ratio

D : Market Value of Equity over Total Liabilities ratio

E : Total Sales over Total Assets ratio

We believe the Z-score is a good measurement of bankruptcy risk. By estimating the Z-score we can see if this effects the capital decisions for oil tanker firms.

5.2.7 Growth

The growth of a company is typically represented by the growth rate of its total assets. Myers (1977)'s analytical framework divides corporate assets into current business and growth opportunities. High-growth companies require substantial funds to support expansion, but their internal capital is often limited, necessitating external financing. Companies with ample growth opportunities are better suited to raise funds through equity finance to avoid missing out on positive net present value projects. In other words, growth and debt ratio are negatively correlated. Ahmadimousaabad et al. (2013)'s empirical analysis proves the same relationship. Conversely, the empirical research conducted by Tongkong (2012) reaches the opposite result. Companies without many investment opportunities should use more debt to mitigate costs associated with agency problems, leading to a positive correlation between growth and debt asset ratio. Drobetz et al. (2013) did not identify the relation between growth and capital structure decisions. We believe it is important to include growth because a significant relation can prove the preferred financing method for shipping firms.

We have calculated the growth by taking total assets in year 0 plus total assets in year 1 and dividing it by total assets in year 0. We now measure the change in assets. This is in line with Drobetz et al. (2019).

5.2.8 Non-Debt Tax Shield

To calculate the non-deductible tax shield ratio we have used depreciation and depletion divided by total assets. This is in accordance with Alam and Akhter (2020).

The non-debt tax shelter can affect the capital structure due to tax benefits. In similarities with the tax shield, the nondebt tax shield can increase ROE. By including it in our independent variables we can investigate whether or not oil tanker firms change their capital structure in order to reap the effects of this element and vice versa. However, new research done by Shaik et al. (2022) shows nondeductible tax shield hardly affects the capital structure.

The use of the variable can be somewhat controversial due to the tax regime in the shipping industry. However, looking at the financial data for the firms included in our study we concluded that the tax expenditures were big enough to make this variable relevant for the study.

5.2.9 Oil price

High oil prices are an indication of economic growth (Drobetz et al., 2013). We have because of this used the oil price as a macroeconomic factor. Bunkers are also the highest operating cost for a shipping firm. So higher oil prices will lead to higher operating costs. A very low oil price will lead to lower operating costs but will also affect the demand for oil tankers. During the covid pandemic oil prices fell drastically. This resulted in oil tankers being used for floating storage, creating a great demand for tankers Marine Insight (2023).

We used the Brent Crude Spot Price as a measurement of the oil price. The price is a quarterly average price calculated by Clarksons.

5.2.10 Baltic Dirty Tanker Index

A change in freight rates for the transportation of crude oil can be reflected by the Baltic Exchange Dirty Tanker Index. The indicator exhibits the supply-demand balance of the tanker market, which is closely related to the global oil trade and energy demand, it can also show the relative strength of different stages of the cycle, such as startup, growth,

maturity, and decline, as well as help forecast the beginning and end of industry cycles. Fei et al. (2020) mention that BDTI (Baltic Exchange Dirty Tanker Index) is a vital indicator to reflect the current environment and trend of the system of crude oil marine shipping.

We have used average quarterly data.

5.2.11 Order Book as a Percent of Fleet

The order book as a percent of the fleet shows the ratio of ordered vessels compared to the current fleet. An order book is all oil tankers ordered and under construction. The order book as a percent of the total fleet says something about where we are in the cycle and what the shipowner believes will happen. A larger percentage will indicate that shipowners expect the demand for tankers to increase and that the rates will increase. A lower percentage will indicate that the market is slowing down and that the rates will move closer to breaking even.

A high percentage will also indicate that the industry is growing, a positive relationship between order book and debt ratio could indicate that shipowners prefer financing ships with debt.

We have used the quarterly average order book as a percentage of the fleet.

5.3 Handling Outliers and Descriptive Statistics

Descriptive statistics are useful in investigating a panel data set because they offer a brief overview of the data's key properties and features. This includes measures of central tendency, such as mean and median, as well as measures of dispersion, such as standard deviation. Descriptive statistics can also reveal any outliers, patterns, or trends in the data, which can help to identify potential problems or opportunities for further analysis.

Table 5.2: Descriptive Statistic with Outliers

Variable	Median	Mean	Min	Max	SD
Total Debt Ratio	0.4840	0.4713	0.0000	0.9869	0.160359
Long-term Debt Ratio	0.4306	0.4120	0.0000	0.9332	0.1437078
Short-term Debt Ratio	0.0458	0.0558	0.0000	0.2867	0.04717069
Order Book-to-fleet	0.1819	0.2106	0.0749	0.4810	0.1084795
Oil price	61.54	64.24	19.35	121.50	28.76486
BDTI	847.8	996.3	429.7	2719.4	414.328
Size	14.52	14.36	11.31	16.39	1.107151
Asset Tangibility	0.8335	0.8138	0.2069	0.9936	0.09631923
Liquidity	1.4399	3.4115	0.0000	278.7955	18.1508
Efficiency	0.2322	0.2516	0.0195	0.6557	0.1103439
Growth	0.0000	0.0380	-1.0000	2.9481	0.2448419
Profitability	0.0312	0.0440	-0.3540	0.2889	0.08266944
Z Score	0.7032	1.0030	-1.2101	29.4005	2.120648
Non Debt Tax Shield	0.0410	0.0440	0.0000	0.1863	0.02103109

From Table 5.2 we can see that we have some extreme max and minimum values. Especially for growth, liquidity, and z-score. This is highly likely due to data reporting errors or extraordinary events. Outliers can create a false reality a lead to low interoperability. We deal with the outliers we have winsorized the data at the upper and lower percentile. This is in accordance with Drobetz et al. (2013).

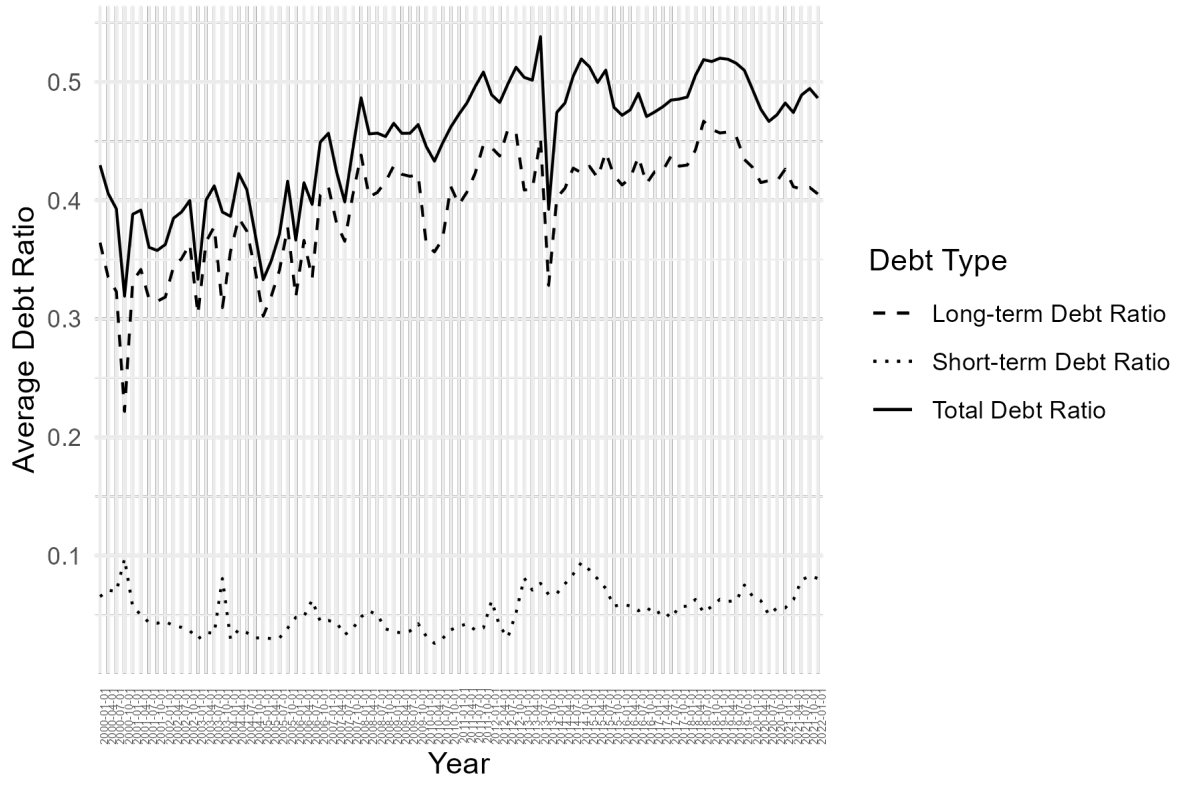
Table 5.3: Descriptive Statistic Winsorized

Variable	Median	Mean	Min	Max	SD
Total Debt Ratio	0.4840	0.4708	0.0000	0.8872	0.1587219
Long-term Debt Ratio	0.4306	0.4113	0.0000	0.7655	0.1417791
Short-term Debt Ratio	0.0458	0.0556	0.0000	0.2318	0.04634898
Order Book-to-fleet	0.1819	0.2106	0.0749	0.4810	0.1084795
Oil price	61.54	64.24	19.35	121.50	28.76486
BDTI	847.8	996.3	429.7	2719.4	414.328
Size	6.308	6.238	5.019	7.074	0.4794078
Asset Tangibility	0.8335	0.8160	0.5899	0.9735	0.08643617
Liquidity	1.4399	2.3374	0.1406	23.8158	3.389921
Efficiency	0.2322	0.2512	0.0413	0.5817	0.1082
Growth	0.0000	0.0323	-0.1970	1.0508	0.1558783
Profitability	0.0312	0.0444	-0.2099	0.2455	0.07940216
Z Score	0.7032	0.9210	-0.5038	9.4304	1.163646
Non Debt Tax Shield	0.0410	0.0436	0.0000	0.0936	0.01903997

Table 5.3 displays the descriptive statistic after the winsorization. As displayed the values max and minimum values are now not as extreme. The median total debt ratio is found to be 0.4840, the median long-term debt ratio is 0.4306 and the short-term debt ratio is 0.0458. Moving on, the table also presents the order book ratio information with a median of 0.1819 and a maximum of 0.4810. The liquidity measure has a median of 1.4399,

indicating that firms have a moderate level of liquidity. Both the Baltic Dirty Index and the oil price has a high level of volatility with a standard error of approximately 414 and 28.8. Compared to the study by Drobetz et al. (2013) both the asset tangibility and total debt ratios median are higher. This can indicate that the oil tanker shipping industry can be more capital intense than the shipping industry in general.

Figure 5.1: Development in debt ratios



In Figure 5.1 we can see not surprisingly that firms prefer to use long-term debt financing instead of short-term debt financing. The average total debt ratio has increased from around 40% to around 50%. From the figure, we can also see that there are some dips, finding the reasons for these dips and the increasing trend is what we hope to accomplish with our analysis.

6 Analysis

6.1 Result Analysis

Table 6.1: Summary of Fixed Effect Estimation

Debt Ratio	Total Debt Ration	Long-term Debt Ration	Short-term Debt Ratio
Industrial Variables			
Orderbook-to-Fleet	-2.017e-02	7.900e-02	-1.129e-01
	4.068e-02	*3.592e-02*	*1.529e-02*
	(0.620132)	(0.028147)*	(3.84e-13)***
Oil Price	2.154e-04	2.368e-05	1.010e-04
	1.518e-04	*1.340e-04*	*5.704e-05*
	(0.156239)	(0.859766)	(0.07708).
BDTI	8.203e-06	6.710e-06	5.406e-06
	1.341e-05	*1.184e-05*	*5.039e-06*
	(0.540859)	(0.571023)	(0.28368)
Micro Variables			
Size	5.893e-02	6.715e-02	1.307e-02
	6.937e-03	*6.125e-03*	*2.607e-03*
	(< 2e-16)***	(< 2e-16)***	(6.54e-07)***
Asset Tangibility	-1.795e-02	2.409e-02	-3.449e-02
	7.644e-02	*6.750e-02*	*2.873e-02*
	(0.814414)	(0.721245)	(0.23031)
Liquidity	-6.587e-03	-1.135e-03	-2.978e-03
	2.411e-03	*2.129e-03*	*9.061e-04*
	(0.006426)**	(0.594215)	(0.00106)**
Efficiency	2.204e-01	3.033e-01	1.812e-03
	5.575e-02	*4.922e-02*	*0.93109*
	(8.38e-05)***	(1.14e-09)***	(0.93109)
Growth	-2.239e-02	-2.581e-02	1.855e-02
	2.371e-02	*2.094e-02*	*8.913e-03*
	(0.345390)	(0.218027)	(0.03773)*
Profitability	-1.942e-01	-1.976e-01	-1.578e-02
	7.344e-02	*6.485e-02*	*2.760e-02*
	(0.008361)**	(0.002391)**	(0.56761)
Z-Score	-2.183e-02	-2.463e-02	1.521e-03
	4.965e-03	*4.384e-03*	*1.866e-03*
	(1.25e-050)***	(2.66e-08)***	(0.41509)
Nondebt Tax Shield	-8.532e-01	-5.302e-01	-2.317e-01
	2.770e-01	*2.446e-01*	*1.041e-01*
	(0.002141)**	(0.030494)*	(0.02629)*
R-Squared	0.6397	0.6483	0.4009
F-statistic	57.32	59.49	21.60

One way firm fixed estimation. Firm fixed effect with clustered standard errors.
Normal text: Displays the estimate.
Numbers in italic: Displays the standard error.
Numbers in () : Displays the p-value.
*****:** Statistical significant at 0.1% level.
****:** Statistical significant at 1% level.
***:** Statistical significant at 5% level.
.: Statistical significant at 10% level.
+/-: +: a positive relationship with leverages. -: an inverse relationship with leverages.

In the first model, we establish a firm fixed effect model to investigate the connection involving the overall debt ratio and other independent factors(Table 4.1). We conducted a fixed-effects panel regression on the model (4.1), and the results are shown in Table (6.1). There are no significant effects from the industrial variables on the total debt ratio. The micro variables growth and asset tangibility are not either significant.

The p-value of size suggests that the regression coefficient of size is highly significant and unlikely to be caused by random error. Therefore, firm size does play a positive, considerable influence upon the total debt level. Specifically, Size is defined in this study to be the logarithm of the company's total assets, so its regression coefficient can be interpreted as the effect of unit asset size. When asset size increase by 1%, the total debt ratio will increase by 5.893e-02%. The p-value of Liquidity indicates the overall debt ratio is profoundly affected negatively by liquidity. Explicitly, the total debt ratio of the Liquidity ratio will decrease by 6.587e-03 units for every additional unit, holding all other independent variables constant. This suggests that a higher liquidity ratio corresponds to a smaller impact on the total debt ratio. The efficiency ratio in similarities with the size is correlated positively with the total debt ratio. The variable is statistically significant at the 0.1 % level. As with liquidity, profitability, Z-score and nondebt tax shield also have an inverse effect on the overall debt ration. Higher profitability is also correlated with a lower overall debt ratio, for every added unit to the profitability ratio, the total debt ratio decreases by 1.942e-01. We also recognized firms with tax shield in the form of depreciation and low financial risk has lower total debt ratios.

R-squared is a commonly used indicator of goodness of fit, which shows the explanatory power of a model to the change of the dependent variable, with values ranging from 0 to 1. We always expected a large R-square value since it represents good fitness. However, in fixed effect models, we cannot only use R-squared to measure the model's goodness of fit. Fixed effect models are built on differences between individuals rather than all individuals, which can lead to low R-squared values. In this case, we add F-statistics to fix this problem. F-test is another indicator to help us measure fitness. We use R for data processing and modeling, it is easy for us to compare the p-value with the significance level to determine the significance of the F-statistic. When the p-value is smaller than the significance level, we can reject the null hypothesis, which means the model has

good fitness. In the first model, the R-square is 0.6397, which shows that the model explains 63.97% of the dependent variable variation, and the model has a reasonable fit. The F-value is 57.32, and the p-value is extremely small. These results suggest that the regression model is statistically significant. In other words, it is important to note that the first model accounts for a majority portion of the total debt ratio variability.

In the second model, we keep the independent variables in Table 4.1 unchanged and use the fixed effect model to explore the association between the long-run debt ratio and these independent variables. We performed a fixed-effects panel regression on the model (4.2), and the results are shown in Table (6.1). The results from Model 2 somewhat differ from model 1.

In model 2 long term debt ratio we have a statistical significant relationship with the order book to fleet ratio. The regression coefficient is significant at the 5 % level. This indicates that we with somewhat certainty can state that with one added unit to the order book ratio the long term debt ratio in oil tanker firms will increase with 0.079. The other two industrial variables are not significant at any sensible levels.

The estimate of size is significant and the influence is positive as with model 1. However, we can see that there is a greater effect in model 2. The long-run leverage will increase by 0.067 % when we add one unit to the size of an oil tanker firm. Oil tanker firms with positive growth tend to have a lower debt ratio than firms where their assets are decreasing in value. Efficiency has a positive and substantial effect on long-run leverage. The coefficient is 3.033e-01, we can say the long-run debt level will increase by 3.033e-01 units for every additional unit of efficiency (one unit of asset income is generated from one dollar of income) if other explanatory variables remain constant. Both the Z-score and nondebt tax shield has a negative significant effect as they had in model 1. There is an inverse relationship between the non-debt benefits and the long-term debt ration. The long-term debt ratio decreases by 5.302e-01 units if there is a one-unit increase in the value of the non-deductible tax shield. However, we see that the effect of the nondeductible tax shield is greater in the long-run debt model.

Model 2 has an R-square value of 0.6483, indicating that the model explains 64.83% of the dependent variable changes and has a certain degree of goodness of fit. The F-value for the model is 59.49, and the p-value is very small so we suggest that the regression

model is statistically significant. To sum up, Model 2 is statistically significant, and is able to explain large part of the change in long-run debt rations.

For the third model, we still keep the independent variables in Table 4.1 unchanged and use the fixed effect model to explore the connection between the short-run debt ration and these independent variables. We conducted a fixed-effects panel regression on the model (4.3), and the results are shown in Table (6.1). The results from Model 3 suggest that the Orderbook-to-fleet and oil price have significant influences on the short-term leverage ration. The p-value of the BDTI Index indicates that the oil tanker industry's business cycle has no significant impact on the short-run debt levels in the firms. The p-value of the efficiency, profitability, and Z score demonstrate there is no association among these variables with the short-run debt level. On the other hand, the p-value of size implies that the probability to achieve such an extreme t-value is very small, so the size coefficient is very significant. Therefore, the short-run debt ration correlates favorably with the enterprise's size. Specifically, if the asset scale is increased by 1%, the short-term debt ratio will increase by 1.307e-02%. The p-value of liquidity indicates that the regression coefficient of liquidity is very significant and unlikely to be caused by random error. Hence, it is obvious that liquidity has a negative relationship with the short-term debt ratio. If the liquidity ratio adds one unit, the short-run leverage will decrease by 2.978e-03 units. It indicates that if the liquidity is higher, the short-run debt ratio will be lower. Growth's p-value suggests the regression coefficient is significant. If other explanatory variables are constant, the short-run debt ration will increase by 1.855e-02 when the growth increases by one unit. The nondeductible tax shield has a coefficient of -2.317e-01, depending on the results, the nondeductible tax shelter has an unfavorable effect upon the short-term debt ration. We may infer that a company's current debt ratio will be lower the larger its non-debt tax shield is.

In short, the results of model 3 suggest that the orderbook-to -fleet ratio and oil price may affect the leverage of oil tanker firms but the business cycle in the tanker industry does not influence the short-term borrowing ratio. The size of the firm, liquidity, growth, as well as the non-debt tax allowance play key roles in deciding the short-term leverage. On the other hand, tangibility, efficiency and profitability and z-score hardly have link to short-run leverage. The model has certain goodness of fit since it explains 40.09% of the

dependent variable changes. Moreover, the F-value is 21.6, and the p-value is extremely small. Consequently, model 3 has statistical significance and a generally reasonable fit.

6.2 Robustness Check

When conducting fixed effect panel regression, it is crucial to guarantee the robustness of models. In this thesis, we check the robustness of the model by using a proxy variable introduced by Neumayer and Plümper (2017) via modifying the dependent variable while keeping a series of independent variables in Table 4.1 constant. We employ three different dependent variables in our analysis.

From the industrial variables, we find that the order book-to-fleet ratio is an important indicator and in the short term, we should consider the effect of oil prices as well.

Our fixed effect panel regression also reveals that the results of the first two models are largely consistent. We observe that size, efficiency, profitability, z-score, and non-debt tax shield significantly affect oil tankers companies' overall and long-run leverage ratios, and the direction of impact is consistent across these variables, the results of size and non-deductible tax shelter are also evident in the third model.

Nevertheless, in the third model, liquidity also exhibits an effect on short-term leverage, which is similar to our first model. According to the p-value of liquidity, we can say it is negatively related to the short-run debt ration. If an additional unit of liquidity ratio is added, the short-run leverage will decrease by 2.978e-03 units keeping other independent variables unchanged. That is to say, the higher the liquidity ratio of the company, the lower the influence on the short-run debt ratio. These results identify that the influence of Size and Non-deductible tax shelter on capital structure is robust because these elements are more likely to be influenced by firms' predetermined investment projects and development plans. But since different debt ratios reflect varying financial risks, inconsistent results may arise. For instance, a company's total and long-run leverage is commonly influenced by its operating capacity and earning ability but the short-term financial position is not. Thus, when analyzing capital structure, it is necessary to consider the impact of the same factors on different types of debt ratios.

7 Discussion

The two firm-specific elements, size and non-deductible tax shelter, can affect the overall capital structure of a oil tanker company regardless of in the short term or the long term, which can be considered determiners of the capital structure for oil tanker enterprises. Moreover, within these three models, we show that whereas nondeductible tax shield presents adversely connection with debt ratios of oil tanker enterprises, the company's size is favorably correlated with them.

The size of a oil tanker company exerts a positive impact on all three of its debt ratios, which is in line with Drobetz et al. (2013)'s research study and several other researches. The oil tanker industry is capital-intensive, which requires significant funds for the purchase, operation, and maintenance of crude tankers. Under the pecking order theory, companies may consider debt financing as a viable choice to supplement internal financing, leading to an increase in short-run, long-run, and total leverages. Furthermore, large oil tanker companies often have greater operational risks. To mitigate these risks, firms may increase their risk management and insurance expenses. However, larger companies can often employ the relatively low-risk bond market for financing since they are able to disclose information completely and timely to the market, which causes an increase in the debt amount.

The inverse relation between non debt tax benefits and debt levels are consistent with most other empirical studies. Since the debt ratios decrease when the non-deductible tax shelter increases it means that firms take advantage of it and will not opt for dept financing to get the benefits, which backs the trade-off theory. We see that the effect on of the shield is higher on the long term debt. This is consistent with our findings from the descriptive statistics where we could see that oil tanker firms have a higher degree of long-run liabilities than short ones. The effect from the shield will then be higher from reducing long-run debt than short-run debt.

The liquidity of a oil tanker company's assets negatively affects all three of its debt ratios apart from long term leverage. The direction of effect consists with the findings of most scholars and give evidence to the considerations of risk cost in the trade-off theory. In the real world, strong liquidity for oil tanker companies indicates better ability when

facing emergencies and market fluctuations and makes it easier to sell some assets for capital turnover to pay off debts when market demand drops. In contrast, companies with low liquidity assume more significant debt pressure as most assets are difficult to sell quickly. Furthermore, in the equity market, liquid companies typically enjoy higher credit ratings and stronger reputations, in this case, they attract more investors and offer greater financing opportunities, thus reducing debt ratios.

The efficiency and profitability of oil tanker companies positively and negatively affects their debt ratios, relatively, under a degree of uncertainty. Efficiency reflects the earning ability of a company to operate its assets in a certain peroid and it signifies a positive collaboration with the entire and long-term loan ratio. This may be because long-term liabilities are usually used to support the company's overall activities. Short liabilities changes few part of the leverage. As a result, efficiency has little bearing overall on the ratios of short-term obligations. Concerning the profitability, the finding is consistent with Drobetz et al. (2013) when the study did not include macro variables. The agency theory can explain this phenomenon, as tanker companies with strong profitability possess excellent management teams who can control risks while increasing revenue, which means that they can better protect the interests of shareholders. It is helpful for companies to reduce agency costs, thus lowering debt risk and debt ratio. On the contrary, oil tanker shipping companies with low profitability may be more prone to agency problems, where managers prioritize short-term profits over long-term interests. These high-risk behaviors, including excessive debt and leverage, may escalate the financial risk of the company. In addition, based on the pecking order theory, profitable companies can give priority to using their own funds and profits instead of debt to finance their investments and expand their business scale, which reduces the company's debt requirements and debt ratio.

From the results we could see that growth has a negative relationship with short term debt. This is a indication that oil tanker enterprises have a preference to employ retained earnings or capital increases rather than short term debt for funding, which is adhere to the pecking order theory. However we see that our results contradict with the agency theory. As the theory states that growth comes with higher agency costs and firms should use debt financing to decrease the costs.

Z-score evaluates the risk of bankruptcy of a company. Oil tanker companies typically

possess large amounts of goods and assets, they make them as mortgaged property to acquire loans. In addition, due to the highly standardized and large-scale oil shipping business, many financial institutions in the market are willing to provide funds, so the probability of bankruptcy is low. Long-term contracts and stable cash flows also help reduce bankruptcy risk. Our results show that the lower the bankruptcy risk the lower the debt ratio in the firms. This is not surprising as added higher levels of debt ratios is often related to higher bankruptcy costs.

We had a hypothesis that an increase in orderbook-to-fleet ratio could lead to a reduction in the debt ratios since the orderbook-to-fleet ratio can function as a thermometer for the industry. However, our results only indicates strong relationship between the the short term debt ratio and the orderbook-to-fleet ratio. The reason for this could be that firms finance some of the early stage new build costs with short term debt. We were not able to demonstrate that the orderbook-to-fleet ratio had any effect on the overall debt ratio.

We worked with the hypothesis that the Baltic Dirty Tanker Index supposed could effect the decision making in regards to the capital structure of oil tanker enterprises. Since the BDTI reflects a cyclical characteristic of the oil tanker shipping industry. We belived that firms have the tendency to modify their capital structure in response to different cycles. However, our empirical results do not support this hypothesis. It implies that factors such as differences in corporate governance models and industry competition may result in the capital structure of companies not significantly changing in different industry cycles. One of the reasons for the not significant values could be that the dirty and clean index does not correlate the same way as they previously did (Greg Miller, 2020). This could be the reasons our results differ from what was previously proven by Drobetz et al. (2013).

As an important factor affecting the supply and demand of the oil shipping market, we assume that oil price will affect the capital structure of the enterprise. It is a well known fact that bunkers is the biggest operating expense for shipping firms. The positive relation between short term debt and the oil price indicates that firms fund bunkers via short term debt. However we see no any significant effect upon the long-run liabilities, this leads us to a difference from Drobetz et al. (2013)'s study that found a significant negative relationship between the total debt ratio and the oil price.

8 Conclusion

8.1 Implications of the Results

This paper employs pertinent capital structure theories and considers the current state of the global oil tanker industry, as well as the unique characteristics of shipping companies' capital structures. To conduct an empirical research looking for determiners of capital structure in the oil tanker shipping sector, this research utilizes financial and relevant shipping industry data from 14 listed tanker companies spanning from 2000 to 2021.

Our research provides no evidence that our industrial elements affect total debt ratios. Conversely, we can see that it has some effects on the order book-to-fleet ratio and oil price in the short term. We suggest that the capital structure of oil tanker shipping companies is primarily influenced by two factors: Size and Non-deductible Tax Shield. Our results are consistent with previous research findings, indicating that the size of a tanker company has a positive impact on its debt ratios. The capital-intensive nature of the industry and the increased operating risks faced by larger companies make debt financing an excellent choice for them. Besides, these risks may cause greater expenses for risk management and insurance, making debt financing an attractive option. Nondeductible tax shields help companies reduce taxes because costs such as capital expenditures and depreciation can be deducted. In reality, firms would take advantage of this feature. Tax policy is a key point, different tax policies can affect an oil tanker company's ability to obtain non-debt financing in any period.

Furthermore, we discover that added liquidity reduces debt ratios within the oil tanker industry which is confirmed in total and short-run models. This could be because higher liquidity enables companies to better respond to unexpected events and market fluctuations, while also providing them with easier access to the equity market, resulting in a decrease in the debt ratio. We also see the efficiency of oil tanker companies positively affects their overall and long-run debt ratios. This indicates that efficient firms have lower long-run debt rations. In contrast, profitability and z-score adversely associate with them.

Especially, our findings prove that while growth, affects the short-term debt proportion of tanker enterprises, its effects on the total and long-run debt ratio are not statistically

noteworthy. There is no evidence exhibiting the association between debt rations and asset tangibility. We assume that the proportion of tangible assets in a tanker company can affect its debt structure. High asset tangibility should enable companies to obtain lower-cost debt by using these assets as mortgages, reducing the interest rate cost of short-term liabilities. Contrary to that, companies that have a high proportion of intangible assets may find it difficult to secure funds. This would cause higher interest-rate costs for them to obtain funding, thereby increasing the risk of liabilities. The tangible asset ratio, however, had little effect on all the debt ratios in our analysis. This may be mainly because they are not the major affecting aspects related to the operating plans and strategies.

8.2 Research Limitations

During our study of capital structure determinants for oil tanker shipping companies, we faced several limitations. Firstly, limited literature on this topic made it difficult to compare our results with previous studies, and we had to rely on research conducted on capital structure determinants for general enterprises. This has a certain impact on the depth of our research on the capital structure for oil tanker shipping companies. We also face the problem of sample error and endogeneity. Industry constraints make it hard for the data collecting and we only got a small sample. We would maybe have included firms with chemical tankers as they also can transport petroleum products. We face an issue with a lot of NA values in the earlier years due to few public traded oil tanker stocks. This may have affected the representatives and reliability of our findings. Furthermore, we only included public listed companies in our sample, which could have led to a biased understanding of the industry. Finally, our research methods may have omitted some explanatory variables and did not account for nonlinear factors, which may our understanding of the determiners of capital structure for oil tanker shipping firms. The use of a combined product and crude tanker rate index could have been favorable instead of using the Baltic Dirty Tanker Index. It could also have been advantageous to also have looked at market leverages as this would further increased the robustness of our model.

8.3 Future Research

Future research on the determinative elements of capital structure for oil tanker shipping enterprises can be explored in many ways. Researchers can expand the depth and breadth of literature research to obtain more concerning data and results. They can also conduct in-depth research on oil tanker shipping companies under specific conditions, such as interviewing practitioners. Enlarging the sample size, extending the research time span, and increasing the industry coverage can improve the representativeness and universality of the research results. Additionally, researchers can adopt more precise research methodologies, take the influence of nonlinear factors and into consideration, and introduce more explanatory variables to gradually improve the research framework and methods. Adding the study on the endogeneity is another good point. It is wise if researchers combine quantitative and qualitative research methods since it will help them obtain more comprehensive and accurate research results. By exploring these aspects, researchers can better understand the determiners of the capital structure for oil shipping enterprises, and provide more scientific and effective guidance for relevant policies and practices.

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Appendix

A1 Industry Chain Data - Fleet

Table A1.1: Suezmax

	Fleet > Crude Tankers > Suezmax 125-199,999 dwt	Fleet > Crude Tankers > Suezmax 125-199,999 dwt
Date	No	DWT million
2005	282	42.64
2006	303	46.10
2007	322	49.09
2008	332	50.86
2009	333	51.14
2010	366	56.39
2011	384	59.45
2012	421	65.36
2013	445	69.28
2014	464	72.31
2015	463	72.21
2016	473	73.76
2017	497	77.53
2018	540	84.32
2019	545	85.29
2020	564	88.28
2021	592	92.54
2022	602	94.21
2023	636	99.57

Source: Clarksons Research Services Limited 2023

Table A1.2: Total Crude Tankers

	Fleet > Crude Tankers	Fleet > Crude Tankers
Date	No	DWT million
2005	1,407	236.44
2006	1,483	250.77
2007	1,545	261.18
2008	1,593	271.54
2009	1,595	275.48
2010	1,660	292.27
2011	1,687	300.60
2012	1,774	320.74
2013	1,834	335.90
2014	1,843	340.46
2015	1,824	341.78
2016	1,842	348.08
2017	1,932	368.33
2018	2,012	386.66
2019	2,009	388.96
2020	2,116	414.41
2021	2,179	428.16
2022	2,199	435.09
2023	2,279	453.12

Note: As at Start of Period Specified
Source: Clarksons Research Services Limited 2023

Table A1.3: UL/VLCC

	Fleet > Crude Tankers > UL/VLCC 200,000+ dwt	Fleet > Crude Tankers > UL/VLCC 200,000+ dwt
Date	DWT million	No
2005	130.93	449
2006	137.86	471
2007	142.18	485
2008	147.67	501
2009	150.95	507
2010	160.76	536
2011	164.69	544
2012	176.88	581
2013	187.43	613
2014	190.42	621
2015	194.49	633
2016	199.93	650
2017	214.35	697
2018	225.40	733
2019	227.73	739
2020	247.36	802
2021	256.19	831
2022	261.88	849
2023	273.41	887

Source: Clarksons Research Services Limited 2023

Table A1.4: Aframax

	Fleet > Crude Tankers > Aframax 85-124,999 dwt	Fleet > Crude Tankers > Aframax 85-124,999 dwt
Date	No	DWT million
2005	502	51.05
2006	537	55.10
2007	556	57.48
2008	592	61.54
2009	599	62.73
2010	626	66.05
2011	647	68.68
2012	669	71.35
2013	672	71.97
2014	659	70.87
2015	636	68.66
2016	633	68.37
2017	650	70.31
2018	652	70.86
2019	643	70.21
2020	668	73.04
2021	672	73.56
2022	670	73.57
2023	681	74.90

Source: Clarksons Research Services Limited 2023

Table A1.5: Panamax

	Fleet > Crude Tankers > Panamax Crude 55-84,999 dwt	Fleet > Crude Tankers > Panamax Crude 55-84,999 dwt
Date	DWT million	No
2005	11.81	174
2006	11.71	172
2007	12.42	182
2008	11.47	168
2009	10.67	156
2010	9.06	132
2011	7.78	112
2012	7.15	103
2013	7.22	104
2014	6.88	99
2015	6.42	92
2016	6.02	86
2017	6.15	88
2018	6.08	87
2019	5.74	82
2020	5.73	82
2021	5.87	84
2022	5.44	78
2023	5.23	75

Source: Clarksons Research Services Limited 2023

A2 Industry Chain Data - Trade

Table A2.1: World Seaborne Crude Oil Trade

Date	Million Tonnes	mbpd	% Yr/Yr (tonnes)	% Yr/Yr (mbpd)
2005	1,995.4	40.1	1.6	1.9
2006	1,998.1	40.1	0.1	0.1
2007	2,017.7	40.5	1.0	1.0
2008	2,023.7	40.5	0.3	0.0
2009	1,898.0	38.1	-6.2	-6.0
2010	1,916.7	38.5	1.0	1.0
2011	1,955.4	39.3	2.0	2.0
2012	1,961.0	39.3	0.3	0.0
2013	1,899.8	38.2	-3.1	-2.9
2014	1,850.8	37.2	-2.6	-2.6
2015	1,919.6	38.5	3.7	3.7
2016	1,984.9	39.8	3.4	3.1
2017	2,036.7	40.9	2.6	2.9
2018	2,060.7	41.4	1.2	1.2
2019	2,017.0	40.5	-2.1	-2.1
2020	1,852.4	37.1	-8.2	-8.4
2021	1,853.8	37.2	0.1	0.4
2022	1,957.3	39.3	5.6	5.6
2023	2,020.2	40.6	3.2	3.2

Note:
Source: Clarksons Research Services Limited 2023

A3 VIF Testing

Table A3.1: VIF Test Model1: TDR

Variable	Statistic	Variable	Statistic
Order Book as a percent of the fleet	1.481713	Brent Spot Price	1.316687
BDTI	1.688106	Size	1.771763
Asset Tangebility	1.832779	Liquidity	2.467307
Efficiency	2.523730	Growth	1.083476
Profitability	2.554769	Z-Score	2.718082
Non debt tax shield	1.790884		

Table A3.2: VIF Test Model2: LTDR

Variable	Statistic	Variable	Statistic
Order Book as a percent of the fleet	1.481713	Brent Spot Price	1.316687
BDTI	1.688106	Size	1.771763
Asset Tangebility	1.832779	Liquidity	2.467307
Efficiency	2.523730	Growth	1.083476
Profitability	2.554769	Z-Score	2.718082
Non debt tax shield	1.790884		

Table A3.3: VIF Test Model3: STDR

Variable	Statistic	Variable	Statistic
Order Book as a percent of the fleet	1.481713	Brent Spot Price	1.316687
BDTI	1.688106	Size	1.771763
Asset Tangebility	1.832779	Liquidity	2.467307
Efficiency	2.523730	Growth	1.083476
Profitability	2.554769	Z-Score	2.718082
Non debt tax shield	1.790884		