Sosyoekonomi

2024, Vol. 32(60), 159-179

RESEARCH ARTICLE

ISSN: 1305-5577
DOI: 10.17233/sosyoekonomi.2024.02.08
Date Submitted: 11.08.2023
Date Revised: 27.02.2024
Date Accepted: 15.03.2024

Validity of Capital Structure Theories in the Shipping Industry: An Application on U.S. Equity Markets

Berk YILDIZ *(https://orcid.org/0000-0002-3367-8753), Zonguldak Bülent Ecevit University, Türkiye; berkyildiz@beun.edu.tr*

Denizcilik Sektöründe Sermaye Yapısı Teorilerinin Geçerliliğinin Test Edilmesi: ABD Borsaları Üzerine Bir Uygulama

Abstract

This paper analyses the financial factors that affect the capital structure decisions of 29 shipping companies in the U.S. equity markets. The study focuses on the impact of International Maritime Organization (IMO) regulations and new initiatives. The results show that leverage has a negative impact on profitability and size, in contrast to tangibility. It is also confirmed that the decisions of shipping companies regarding capital structure align with the pecking order theory of capital structure.

Keywords : Capital Structure, Shipping Industry, Panel Data, Pecking Order Theory, U.S. Equity Markets.

JEL Classification Codes : G15, G32, C33.

Öz

Bu çalışmada, IMO'nun regülasyonlarının ve yeni girişimlerinin etkisine ve sermaye yapısı teorilerinin geçerliliğine odaklanarak, ABD'de listelenen 29 denizcilik şirketinin sermaye yapısı kararlarını etkileyen finansal faktörleri incelenmektir. Elde edilen sonuçlar, sabit varlık oranının aksine, karlılık ve işletme büyüklüğü faktörlerinin ABD borsalarında işlem gören denizcilik şirketlerinin sermaye yapıları üzerinde negatif bir etkiye sahip olduğunu göstermektedir. Ayrıca, denizcilik şirketlerinin sermaye yapısı kararlarının finansman hiyerarşisi teorisi ile uyumlu olduğu da teyit edilmiştir.

Anahtar Sözcükler : Sermaye Yapısı, Denizcilik Sektörü, Panel Veri, Finansman Hiyerarşisi Teorisi, ABD Borsaları.

1. Introduction

Despite its slowing growth rate, global trade surged to a record-breaking $7.7 trillion in the first quarter of 2022 (UNCTAD, 2022). Maritime transportation facilitates approximately 90% of these economic activities, enhancing efficiency, cost-affordability, and convenience. However, despite the ships' highly valuable assets equipped with cutting-edge technology, their construction costs surpassed 200 million dollars (ICS, 2022). Additionally, shipping companies are characterised by a significant need for capital investment, and their substantial reliance on loans makes them vulnerable to financial risks arising from volatility in earnings. Albertijn et al. (2011) consistently referred to the Clarksea freight rate index, which decreased from its highest point of 47,567 in 2007 to a low of 8,010 in April 2009, as proof of the shipping industry's fluctuations during the global financial crisis. Even though the market is volatile, merchant ship freight rates produce about $500 billion U.S. annually, providing great prospects for profitability (ICS, 2022).

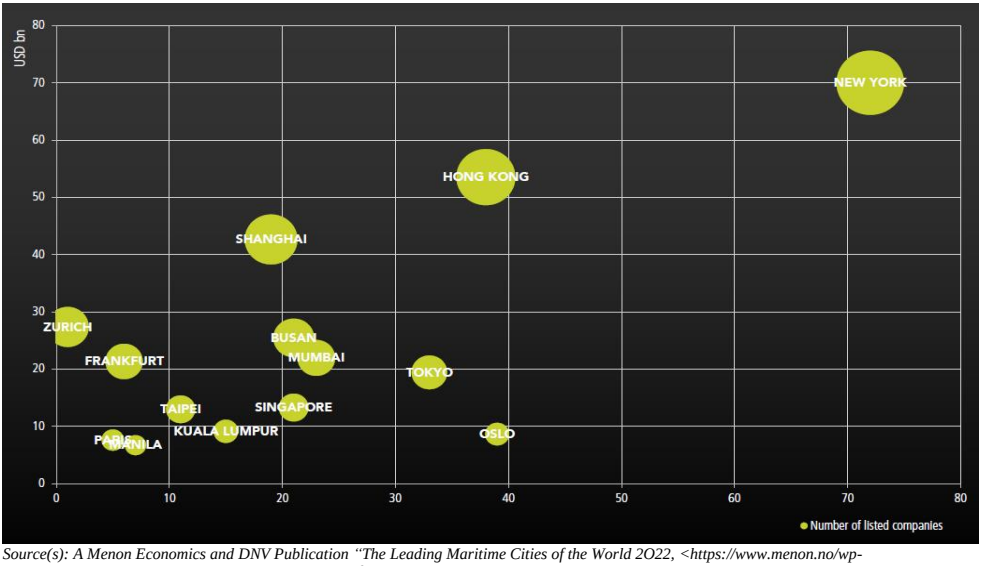
Nevertheless, from 2010 to 2023, the International Maritime Organization (IMO) enforced stricter environmental regulations, such as reducing sulphur oxide (SOx) emissions by 80% by 2023 and nitrogen oxide (NOx) emissions by 75% by 2020. These regulations lead to large shipping companies pursuing growth strategies through asset acquisitions, joint ventures, and mergers. For example, Mediterranean Shipping Company (MSC) acquired Hamburg Süd in 2021 to strengthen its position in the South American market. 2017, CMA CGM and Hapag-Lloyd formed Ocean Network Express (ONE) to create a more efficient network (Hapag-Llyod, 2021). Also, the demand for LNG-powered vessels surged during the mid-2010s, and the shipping industry has experienced a rise in LNG consumption since 2015. This led to LNG ship conversions and improved port infrastructure, with new LNG ship orders affecting the maritime industry from 2010 to 2023. Hence, the industry's energy strategies and capital structures had to adapt to the increasing demand for LNG-powered vessels, shifts in renewable energy sources, and the fall in oil prices.

On the other hand, large fluctuations in revenues, cash flows, and asset prices affect the conventional financial techniques of shipping companies, including capital structure and financing options. Market inefficiencies, such as taxes, distress costs, and asymmetric information, may affect the assessment of a company's financing choices. Drobetz et al. (2013) found that shipping companies' access to global capital markets raises new questions about how they make capital structure decisions. Indeed, the long-term success of many companies depends on their ability to access capital. Historically, banks have provided up to 75% of the industry's external financing, with bonds and public equity contributing only 5%. Shipping bonds offer more flexible maturities than shipping bank loans, which generally have variable interest rates and require financial collateral (Alexandridis et al., 2018). Therefore, the shipping industry is issuing increasing amounts of public debt due to several circumstances, including the transition of many shipping companies from family-owned to corporate entities. This transformation has improved their access to the debt capital markets. It has also led them to private equity investments, bond sales, and other forms of financing,

in addition to traditional bank loans, to diversify construction and renovation projects and to comply with IMO rules when oil prices are low.

However, a thorough investigation of decisions regarding capital structures in the shipping industry requires a drill-down investigation of a particular market segment. This paper examined the capital structures of shipping companies publicly traded on the U.S. equity markets, namely the New York Stock Exchange (NYSE) and the National Association of Securities Dealers Automated Quotations (NASDAQ). These markets are the largest and most liquid financial markets globally, and many shipping companies from various countries list their shares there to increase liquidity and benefit from the transparency and regulatory standards of these markets, including oversight by the Securities and Exchange Commission (SEC). Additionally, New York is emerging as the world's leading equity market for maritime stocks in terms of the number of stocks listed and the market capitalisation of maritime finance and legal companies. London, Tokyo, Oslo, and Paris follow New York. Equity investors prioritise the health of a company's balance sheet when evaluating investment opportunities. A company's capital structure is critical to determining its investment grade. A company's sound use of debt and equity indicates a strong balance sheet, contributing to higher market valuation earnings growth and stakeholder returns.

Figure: 1
Market Value and Number of Listed Maritime Companies on Local Stock Exchange



Source(s): A Menon Economics and DNV Publication "The Leading Maritime Cities of the World 2O22, <https://www.menon.no/wp-content/uploads/Maritime-cities-2022_13-oppdatert.pdf>, 11.09.2022.

Furthermore, financial markets enable shipping companies to grow and generate value. Still, they also provide a channel to obtain the funds needed to support new investment

projects and sustain long-term growth opportunities. Syriopoulos (2010) highlighted the importance of fast and cost-effective. They expedited access to capital financing to maintain a flexible capital structure composition, enhance competitiveness, ensure uninterrupted operations, and promote sustainable growth, particularly in the shipping industry. There is a growing trend among shipping companies seeking funding from the global financial markets to support their ambitious investment plans. This is achieved through methods such as equity financing or debt issuance. Optimising the capital structure of shipping companies is not solely about cost minimisation. Rather, it involves achieving a delicate balance between risk, return, and long-term growth. It is crucial to comprehensively understand the industry's unique challenges and opportunities to make informed decisions that promote financial stability and sustainable growth.

This paper investigates the financial factors affecting capital structure decisions and the validity of capital theories for U.S.-listed shipping companies, focusing on IMO deregulations and new initiatives. The study adds to the existing literature by examining the dynamic aspects of capital structure decisions and testing the validity of capital structure theories in the shipping industry. The remaining sections of this study enhance what has already been written to find out the industry-specific factors that affect how shipping companies listed on U.S. equity markets choose their capital structure, with a focus on the deregulations and new initiatives put in place by the IMO, which are structured as follows: The next section offers a thorough examination of prior concepts and theories on organisations' decisions regarding their capital structure. The paper also introduces the leading indicators utilised to assess capital structure. These indicators are included as independent variables in the hypothesis specification. Section 3 provides a comprehensive overview of the study's methodology and model. It contains detailed information on the sample and data collection processes and gives specific definitions of the variables utilised in the hypothesis. Section 4 requires a detailed account of the statistical analysis and the resulting empirical findings. The concluding part of the paper discusses the research's findings and conclusions.

2. Theoretical Background and Proxies for the Determinants of the Capital Structure

2.1. The Theoretical Framework

Franco Modigliani and Merton Miller (MM), who developed the principle of capital structure irrelevance in 1958, contend that a company's overall value is unaffected by its capital structure. According to this principle, the weighted average cost of capital (WACC) remains constant regardless of a company's debt-to-equity ratio or capital structure under certain conditions. In 1963, MM revised their theory to include the tax shield effect, which states that debt affects a company's value. They suggested that a company's ability to generate cash from its assets can serve as a measure of its value. They argue that debt, an expense that can be deducted from taxes, affects the valuation of the company receiving the loan. Tax savings resulting from interest deductions can equal net income from the

company's assets, resulting in a gain in value for a leveraged company. While not a definitive explanation, this highlights the challenges of financing transactions.

In contrast, the trade-off theory significantly contributes to the theory by incorporating more important aspects, such as the cost of financial distress. This theory asserts that a company's optimal capital structure is achieved when the benefits and costs of debt are in equilibrium. Therefore, when a company's debt exceeds a certain threshold, the bankruptcy cost increases even though the company's value decreases (Baxter, 1967; Kraus & Litzenberger, 1973; Scott, 1976). In addition, from the agency perspective of Jensen and Meckling (1976), there are conflicts of interest between shareholders, managers, and major debt financing providers (creditors and bondholders), as each of these groups has its own interests and objectives. Hence, companies must assess the agency costs associated with debt, which stem from the issues of underinvestment (Myers, 1977) and asset substitution (Jensen & Meckling, 1976), about the agency costs linked with equity, which originate from the problem of free cash flow (Drobetz et al., 2013).

The pecking order theory, originally put forth by Donaldson in 1961 and revised by Myers and Majluf in 1984, contends that there is no perfect leverage ratio. This is because, unlike other theories, the pecking order model suggests that companies hold to a financing hierarchy and prioritise their sources of financing (from internal financing to equity) based on the cost of the funding, using equity as the last option when they require capital. In other words, companies typically rely primarily on internal funds. Thus, companies do not turn to the capital markets only when their retained earnings are depleted, and they mainly use debt instead of equity.

However, capital structure theories offer a framework for understanding operational situations. Still, thorough evaluations are necessary to consider industry-specific factors, and each sector's unique characteristics and financial requirements impact capital structure decisions. This paper investigates the financial factors affecting capital structure decisions and the validity of capital theories for U.S.-listed shipping companies, focusing on IMO deregulations and new initiatives. It aims to enhance understanding of operational situations in the shipping industry by analysing the dynamic components of capital structure decisions and assessing the validity of capital structure theories. The following section presents the key factors affecting capital structure decisions that have been identified through a literature review.

2.2. Proxies for the Determinants of the Capital Structure and Literature Review

Since Myers (1984) highlighted the enigma of capital structure determination by posing the question, "How do firms make capital structure decisions?" numerous studies also have been undertaken in the current amount of finance literature to ascertain the determinants influencing the capital structure of companies across various industries and countries (Maksimovic, 1988; Harris & Raviv, 1991; Huang & Song, 2006; Berk et al., 2010;

Hovakimian et al., 2012; Güner, 2016; Yildirim et al., 2018; Dang et al., 2019; Ramli et al., 2019; Sari & Sedana, 2020; Yıldırım & Çelik, 2020; Chen et al., 2021). However, the lack of research on the shipping industry is evident (Arvanitis et al., 2012; Drobetz et al., 2013; Merika et al., 2015; Paun & Topan, 2016; Kotcharin & Maneenop, 2017; Aarland & Fidjeland, 2018; Cantero-Sáiz et al., 2019; Lykseth, 2022; Majid & Gandakusuma, 2023). The findings of these studies show that profitability, tangibility, size, non-debt tax shield, growth potential, and volatility are important and widely accepted determinants.

2.2.1. Profitability

Profitability is crucial for a company's ability to generate revenue, cover operating costs, and allocate resources for growth, with return on assets (ROA) being significant in capital-intensive industries like shipping, which heavily rely on tangible assets. Despite several studies being undertaken since the seminal paper of Modigliani and Miller (1958), a consensus regarding the association between profitability and capital structure has yet to be reached. However, Kraus and Litzenberger (1973), with their trade-off theory of capital structure, argue that a company's ideal capital structure occurs when the advantages and disadvantages of debt are balanced. Although debt can lead to bankruptcy due to the tax deductibility of interest, the reduction of free cash flow, and agency conflicts between stockholders and bondholders, Fama and French (2002) found a positive relationship between leverage and profitability. In addition, Jensen and Meckling (1976), Easterbrook (1984), and Jensen (1986) discuss the disciplinary function of leverage and argue that profitable companies use high leverage to reduce agency conflicts. This proposal aligns with Ross' (1977) signalling hypothesis, which posits that managers may employ increased leverage to express a positive outlook for the company (Drobetz & Wanzenried, 2006).

Contrary to previous theories, Myers and Majluf (1984) emphasise the pecking order theory of capital structure, which challenges the notion of an optimal leverage ratio and instead posits a hierarchical structure for determining financing options based on the level of information asymmetry. According to this theory, a company will initially use internal funds, debt, and equity if it needs financial resources. In addition, Titman and Wessels (1988) contend that profitability is a major factor in the capital structure because it indicates the amount of retainable earnings. Consequently, Fama and French (2002) propose that, within a basic pecking order model, with the investment level remaining constant, leverage would have a negative relationship with profitability. This assumption is supported by numerous empirical studies (Titman & Wessels, 1988; Rajan & Zingales, 1995; Frank & Goyal, 2009; Drobetz et al., 2013; Nenu et al., 2018; Moradi & Paulet, 2019; Chen et al. 2021).

Furthermore, Merika et al. (2015) studied 117 global shipping companies to understand how economic cycles (expansion, peak, and trough) affect capital structure and ownership concentration. They found that profitability negatively impacts leverage in all stages, except for peak, supporting the pecking order theory and suggesting that profitability negatively impacts the company's leverage. In their study, Kotcharin and Maneenop (2017)

also examined the determinants of capital structure decisions and the impact of family company structure on decision-making in Thai sea and coastal freight water transport companies. The hypotheses were investigated using the panel data methodology on a sample panel of 77 non-listed companies. The findings show a direct correlation between tangibility, operating leverage, and size and capital structure, but profitability exhibits an inverse relationship. Family-owned shipping companies observe a comparable conclusion to all the data, except for a reversal in the sign of operating leverage. The study's empirical findings provide a blend of explanations supporting and refuting the trade-off and pecking order theories.

The literature review reveals that there is no consensus on the existence and direction of the relationship between leverage and profitability. Different capital structure theories have different effects on various industries. Therefore, this study investigates the relationship between leverage and profitability in the shipping industry and employs ROA, the ratio of net income to total assets, to represent profitability in the analysis.

2.2.2. Tangibility

Property, plant, and equipment (PP&E), or fixed assets, also known as tangible assets, are essential to a company's operations and have a measurable value. As a result, creditors and lenders consider tangible assets to be a guarantee against default risk because they can be used as collateral. This study uses the net tangible assets ratio to total assets to measure tangibility. Moreover, organisations with high tangible assets like ships can use these assets as collateral for loans, enhancing their borrowing capacity and enabling lower costs for cash generation. Fixed assets are essential for operational efficiency, resulting in cost savings and improved efficiency compared to chartered vessels. The trade-off theory of capital structure suggests that a higher ratio of fixed assets to total assets can mitigate the costs of financial distress and prevent excessive losses in the event of insolvency. Many empirical studies also support this hypothesis (Baker & Wurgler, 2002; Huang & Song, 2006; Frank & Goyal, 2009; Drobetz et al., 2013; Paun & Topan, 2016; Moradi & Paulet, 2019; Chen et al., 2021). Thus, the trade-off theory expects a positive relationship between tangibility and leverage. However, the expected relationship between leverage and tangibility in pecking order theory is intricate and dependent on various factors. Although high tangibility may facilitate debt access, companies still balance this with adherence to the pecking order preference for internal financing and consider growth opportunities, profitability, and market conditions. Majid and Gandakusuma (2023) investigated the influence of macroeconomic factors on capital structure decisions in the Indonesian maritime industry. They analysed data from 23 publicly traded companies and found that tangible assets positively affect financial leverage. The study also revealed a significant inverse relationship between profitability and company leverage, supporting the pecking order theory and suggesting highly profitable companies prioritise low leverage and prefer internal finance over external sources.

On the other hand, this study explores the relationship between leverage and tangibility in the shipping industry, utilising the net value of property, plants, and equipment to demonstrate tangibility in the total asset value.

2.2.3. Size

The size of a company, mainly shipping companies, is a crucial factor in its operations. The total value of a company's assets is often used as a benchmark, and larger companies can leverage economies of scale to secure better deals with suppliers, optimise transportation routes, and spread fixed costs over a larger volume of goods. This strengthens the influence of freight forwarders, potentially resulting in lower prices and terms. Syriopoulos et al. (2018) examined the capital structures of 50 shipping companies, focusing on loan capital, the primary form of external financing in the industry. They used dynamic panel data from 2006 to 2016 and tested various ratios and indicators to assess the importance of capital structure decisions on financial resources. The results showed that factors such as asset structure, firm size, growth opportunities, profitability, and debt-related risk significantly influence the optimal selection of capital structure. The relationship between company size and leverage is also ambiguous from the different perspectives of capital structure theories. According to Titman and Wessels (1988), large companies are typically more diversified and less likely to declare bankruptcy because they have easy access to capital markets. They also borrow at favourable interest rates to obtain a higher credit rating for their debt issues (Ferri and Jones, 1979; Ozkan, 2001). Moreover, the trade-off theory predicts a positive sign in the relationship between leverage and size, and numerous empirical studies have found a positive correlation between leverage and size (Booth et al., 2001; Rajan & Zingales, 1995; Huang & Song, 2006; Ibhagui & Olokoyo, 2018; Moradi & Paulet, 2019; Dinlersoz et al. 2019), and this suggests that the trade-off theory predicts a positive sign in the relationship between leverage and company size, with many empirical studies supporting this conclusion.

Alternatively, the pecking order theory suggests that a company's size can indicate information asymmetry between insiders and capital markets (Drobetz et al., 2013), as larger firms tend to have more equity than debt and less leverage, implying an inverse relationship between company size and leverage. Consequently, given the findings of previous studies, the relationship between size and leverage is examined by taking the natural logarithm of the total assets of the companies under study. In econometric analysis, one of the main reasons for taking the natural logarithm of a series is to express the change in the series proportionally, allowing for a better understanding of how the series has changed over time. Thus, the total asset growth logarithm reflects the relative changes in the company's asset growth. This enables more precise comparisons of company growth rates and provides an appropriate measure for evaluating elasticity.

2.2.4. Non-Debt Tax Shields

Understanding industry volatility helps companies make informed decisions about investments, financing, and risk mitigation. The shipping industry is influenced by factors like crude oil prices, the global economy, freight rates, natural disasters, and regulations, which can create ambiguities about revenues and financial performance. Therefore, shipping companies and investors prioritise market volatility and risk management strategies. Cantero-Sáiz et al. (2019) investigated the financial crisis's impact on Spanish shipping companies' capital structure using trade-off and pecking order theories. The study's analysis of 1,805 observations from 2001 to 2015 revealed that liquidity, profitability, non-debt tax shields, and tangible assets all impacted leverage. Empirical studies confirm the inverse relationship between leverage and non-debt tax shields (NDTS). According to DeAngelo and Masulis (1980), non-debt tax shields are tax deductions for depreciation and investment tax credits, as well as substitutes for the tax benefits of debt financing. Therefore, a company with a larger non-debt tax shield is expected to use less debt. Similarly, Kim et al. (2006) and Rajagopal (2010) find that leverage negatively correlates with the non-debt tax shield. On the other hand, in contrast to the De Angelo and Masulis (1980) study, Bradley et al. (1984) find that debt is positively correlated with the non-debt tax shield represented by depreciation and investment tax credits. However, Minton and Wruck (2001) suggest that non-debt tax shields may have a positive relationship with debt conservatism due to their association with companies that invest more. Hence, despite the controversial findings, the ratio of depreciation and amortisation to total assets, a proxy for non-debt tax shields, is used to test the relationship between tax deductibility and the leverage of shipping companies.

2.2.5. Growth Opportunities

The agency model suggests a negative relationship between growth opportunities and leverage, while the pecking order theory suggests a positive relationship due to the disciplinary effect of leverage on managerial opportunism. Berger and Patti (2006) found that high leverage ratios reduce external equity agency costs and increase company value by forcing managers to maximise shareholder wealth. In addition, Jensen and Meckling (1976) noted that leverage nonlinearly impacts total agency costs. Low leverage increases incentives and reduces total agency costs by lowering external equity costs.

Conversely, the pecking order hypothesis posits that companies with more potential for growth are likely to exhibit higher levels of debt. Based on asymmetric information, this theory suggests that managers use a hierarchical approach to finance, initially using retained profits but prioritising debt over equity when seeking more funding (Kayo & Kimura 2011). The impact of growth on leverage has contradictory theoretical predictions. Aarland and Fidjeland (2018) analysed the factors influencing capital structure decisions, the relationship between capital structure and firm performance, and the speed of change for 115 shipping companies from 1996 to 2016. The findings revealed that financial leverage is countercyclical, and tangibility, profitability, and asset risk are shipping companies' most critical firm-specific factors. Lykseth (2022) also studied the capital structure decisions of

publicly traded bulk, LNG, and container companies listed on the New York Stock Exchange between 2000 and 2021. He developed seven propositions and predictions from the pecking order, trade-off, and market conditions models through qualitative and statistical analysis. The pecking order model reflects the capital structure choices of shipping companies in three segments, while the trade-off theory predicts a target mix of short- and long-term debt. Container companies issued equity when their leverage ratio was above the target ratio. Studies have shown a significant inverse relationship between growth and leverage (Kim et al., 2006; Eriotis et al., 2007; De Jong et al., 2008; Paun & Topan, 2016; Yeo, 2016; Moradi & Paulet, 2019), while others show a positive correlation (Fama & French, 2002; Hall et al., 2004; Chen & Zhao, 2006; Yang et al., 2022). In this paper, the proxy for growth opportunities is the ratio of the company's total market value (debt plus equity market value) to the net book value of equity (total assets minus total liabilities).

2.2.6. Volatility

The cyclical nature and sensitivity to changes in the shipping industry's global economy impact its capital structure. Economic growth increases demand for shipping containers, resulting in higher freight rates. Conversely, economic recessions cause a decrease in demand, leading to an oversupply of vessels and a decline in rates. Geopolitical crises, trade conflicts, and economic constraints can disrupt global product and service flows, causing instability in certain regions. Shipbuilding industry volatility can result from mismatches between supply and demand, often due to lengthy construction processes. Fixed costs, such as crew wages, fuel, maintenance, and insurance, also impact shipping companies. During periods of low cargo volumes, fixed costs increase, leading to lower revenues and increased volatility. The potential decline in a company's market value due to earnings fluctuations is recognised as volatility or business risk and is used as a proxy for financial distress. It is also expected to be negatively correlated with leverage. Albertijn et al. (2011) found that the highest risk for a shipping firm is the volatility of earnings or freight rates. In this context, companies may be forced to issue debt or equity because stockholders and lenders are unwilling to invest in a company with high default and bankruptcy risks and volatile earnings. This study's standard deviation of earnings before interest and taxes was scaled by total assets to measure volatility.

3. Methodology and Variables

3.1. Data and the Panel Regression Model

Table 1 presents variables from a literature review of 29 shipping companies listed on the U.S. equity markets (NYSE and Nasdaq), obtained from their websites and Yahoo Finance terminals, covering an annual data set from 2010 to 2021. When conducting panel data analysis, it is recommended to have a greater time dimension if the number of cross-sections is limited. Therefore, to obtain precise results, the study was specifically designed to use data from 2010-2021, including IMO deregulations, as shipping companies listed on

equity markets were limited in availability. This approach allows for analysing a substantial number of cross-sections, ensuring continuity.

Table: 1
Definitions of Variables

Variables	Symbol	Definitions
Dependent variable		
Leverage	LEV	Total liabilities to total assets
Explanatory variables		
Profitability	ROA	The ratio of return on assets
Tangibility	FXAS	The ratio of property, plants, and equipment (net) to total assets
Size	SIZE	Natural logarithms of total assets
Non-Debt Tax Shield	NDTS	Depreciation and amortisation divided by total assets
Growth	MBV	The ratio of market to book value (market capitalisation to net book value)
Volatility	VOL	Standard deviation of EBIT to total assets

Panel data analysis is often used to estimate linear regression equations (1).

$$y_{it} = \alpha + \beta x_{it} + \varepsilon_{it} \ (\varepsilon_{it} = \mu_i + \lambda_t + \nu_{it}) \quad (1)$$

The variable μ_i represents an individual effect, while λ_t represents an unobservable time effect. The term ν_{it} represents the residual stochastic disturbance. Equation (2) is formulated to estimate the capital structure model.

$$LEV_{it} = \alpha + \beta_1 ROA_{it} + \beta_2 FXAS_{it} + \beta_3 SIZE_{it} + \beta_4 NDTS_{it} + \beta_5 MBV_{it} + \beta_6 VOL_{it} + \varepsilon_{it} \quad (2)$$

Where LEV_{it} is the ratio of total liabilities to total assets for company *i* at time *t* (Frank & Goyal, 2009; Arvanitis et al., 2012; Yang et al., 2022); ROA_{it} is the ratio of return on assets (Paun & Topan, 2016); $FXAS_{it}$ is the ratio of net property, plants, and equipment to total assets (Frank & Goyal, 2009; Drobetz et al., 2013; Merika et al., 2015; Yang et al., 2022). $SIZE_{it}$ is the natural logarithms of total assets (Rajagopal, 2010; Drobetz et al., 2013; Yeo, 2016; Moradi & Paulet, 2019; Chen et al., 2021); $NDTS_{it}$ is the ratio of depreciation to total assets (Rajagopal, 2010; Paun & Topan, 2016; Moradi & Paulet, 2019); MBV_{it} is the ratio of market value to book value of equity (Booth et al. 2001; Frank & Goyal 2009; Harris & Roark 2019); VOL_{it} is the standard deviation of EBIT to total assets (Frank & Goyal 2009; Drobetz et al. 2013).

Table 2 displays the descriptive statistics for all variables, including the number of company-year observations (Obs.), mean, standard deviation (SD), median, minimum (Min), and maximum (Max) values. Table 3 displays correlation coefficients indicating a clear negative correlation between all variables and leverage, in contrast to the non-debt tax shield.

Table: 2
Descriptive Statistics

Variables	Obs.	Mean	Std. Deviation	Median	Min.	Max.
LEV	348	0,714	1,214	0,548	0,014	14,124
ROA	348	−1,547	138,030	-0,085	-370,780	2458,630
FXAS	348	0,725	0,237	0,812	0,000	0,978
SIZE	348	7,176	1,991	7,190	1,065	14,973
NDTS	348	0,105	0,403	0,043	0,000	5,552
MVBV	348	149,063	2377,504	0,476	−52,830	44263,34
VOL	348	30,854	256,869	1,344	0,000	2769,285

Table: 3
Correlation Matrix

	LEV	ROA	FXAS	SIZE	NDTS	MBV	VOL
LEV	1 -----						
ROA	-0,27 *(0,000)*	1 -----					
FXAS	-0,34 *(0,000)*	-0,07 *(0,219)*	1 -----				
SIZE	-0,39 *(0,000)*	-0,03 *(0,542)*	-0,25 *(0,000)*	1 -----			
NDTS	0,85 *(0,000)*	-0,25 *(0,000)*	-0,27 *(0,000)*	-0,36 *(0,000)*	1 -----		
MBV	-0,01 *(0,925)*	0,00 *(0,983)*	0,02 *(0,690)*	0,01 *(0,893)*	-0,01 *(0,832)*	1 -----	
VOL	-0,02 *(0,685)*	-0,02 *(0,694)*	0,04 *(0,495)*	-0,04 *(0,408)*	-0,01 *(0,000)*	-0,01 (0,890)	1 -----

Numbers in italics below the coefficients indicate p-values.

Financial econometric research should employ panel data methodology to consider cross-sectional simultaneously and time-series components, avoid cross-sectional dependence, maintain stationarity, and avoid challenges like heteroscedasticity, multicollinearity, or autocorrelation, with multicollinearity being the initial assessment step.

Ragnar Frisch introduced the term multicollinearity to describe the linear relationship between explanatory variables in a regression model. This can lead to estimation errors in research using time and cross-sectional series. When analysing panel data, it is crucial to note that the coefficients of variables may be biased if they have minimal impact on the regressor and exhibit a high degree of correlation. To reduce bias, independent variables strongly associated with the variance inflation factor (VIF) should be eliminated. Although multicollinearity is often not a major concern in panel data analysis, conducting correlation matrix or variance inflation factor (VIF) tests is recommended to ensure the absence of problematic multicollinearity. This paper uses the VIF approach to identify potential factors leading to multicollinearity.

Panel regression models require each variable's time series to exhibit stationarity. An autoregressive model is represented by Equation (3), and a time series is stationary if the absolute value of the parameter ρ is less than one or non-stationary if it equals 1.

$$y_t = \rho y_{t-1} + \nu_t \tag{3}$$

Panel data often shows cross-sectional dependence, making unit root tests more reliable for model selection and estimation. As Nelson and Plosser (1982) hypothesised, a sizable portion of time series data exhibits non-stationarity and follows a random walk pattern. Incorporating this type of data into a model can lead to misleading results. Therefore, it's crucial to determine if variables have a unit root to determine their stationarity in the data set. Additionally, the analysis of cross-sectional dependency significantly impacts the choice of test for unit root tests. Tugcu (2018) proposed a framework that includes two generations of testing for performing panel unit root tests.

Table: 4
Pesaran (2004) CD Test

	Average correlation coefficients & Pesaran (2004) CD test			
Variables	**CD-test**	**p-value**	**corr.**	**abs (corr.)**
LEV	1.52	0.130*	0.022	0.394
ROA	2.45	0.014	0.035	0.303
FXAS	1.36	0.173*	0.020	0.320
SIZE	1.59	0.112*	0.023	0.485
NDTS	1.94	0.053*	0.028	0.316
MBV	5.59	0.000	0.080	0.340
VOL	6.20	0.000	0.089	0.359

** Under the null hypothesis of cross-section independence CD ~ N (0,1) ˜at 5% level.*

Baltagi (2009) suggests that second-generation unit root tests should be applied when there is evidence or a strong suspicion of cross-sectional dependence (CSD) in panel data analysis. The Pesaran (2004) CD Test results in Table 4 show that ROA, MBV, and VOL have cross-sectional dependence. Thus, Pesaran's second-generation unit root tests (2003) are performed to test the stationary of these series and series that have their unit root transformed into stationary through first differencing.

However, when there is no cross-sectional dependence in a time series, the Augmented Dickey-Fuller (ADF) Test, Phillips-Perron (PP) Test, Im-Pesaran-Shin (IPS) Test, and Levin Lin Chu (LLC) Test could be applied. If cross-sectional dependency is present, the units can be categorised into homogeneous and heterogeneous groups, and the choice of the first unit root test depends on them. The Delta test can identify the homogeneity of a time series without cross-sectional interdependence, even when cross-sectional dependency is ignored. Therefore, the Delta test proposed by Pesaran and Yamagata (2008) was conducted, and the results are shown in Table 5.

Table: 5
Delta Test

	Homogeneity Test			
Variables	**Delta**	**p-value**	**adj. Delta**	**p-value**
LEV	3,960	0,000*	4,573	0,000*
FXAS	2,419	0,008*	2,793	0,003*
SIZE	2,831	0,002*	3,269	0,001*
NDTS	2,336	0,010*	2,698	0,003*

** Series are heterogeneous.*

Table 5 presents the test results and confirms the series' heterogeneity. On the other hand, IPS is generally preferred if there is significant heterogeneity in autoregressive

parameters. However, if heterogeneity is less pronounced, LLC is more suitable. Thus, various unit root tests (LLC, IPS, ADF, and PP) are utilised to verify stationarity in non-cross-sectional dependent series like LEV, FXAS, SIZE, and NDTS, and the variables that exhibit unit roots except for NDTS are transformed into first differences to provide the stationary. Table 6 displays the results of the unit root tests.

Table: 6
The Results of the Unit Root Tests

	Im, Pesaran, and Shin (IPS) constant		**Im, Pesaran, and Shin (IPS) constant & trend**	
Variables	**statistics**	**p-value**	**statistics**	**p-value**
LEV	-9.1096	0.0000*	-4.9216	0,0000***
FXAS	-9.9996	0.0000*	-5.7254	0.0000***
SIZE	-6.7925	0.0000*	-3.5044	0.0002***
NDTS	-2.67453	0.0000*	-1.9289	0.0269****
	Levin, Lin & Chu (LLC) constant		**Levin, Lin & Chu (LLC) constant & trend**	
Variables	**statistics**	**p-value**	**statistics**	**p-value**
LEV	-14,3229	0,0000*	-14,6465	0,0000***
FXAS	-17.4570	0.0000*	-16.7171	0.0000***
SIZE	-10.6597	0.0000*	-10.4396	0.0000***
NDTS	-5.50330	0.0000*	-8.26096	0.0000***
	Augmented Dickey-Fuller (ADF) constant		**Augmented Dickey-Fuller (ADF) constant & trend**	
Variables	**statistics**	**p-value**	**statistics**	**p-value**
LEV	182,509	0,0000*	130,131	0,0000***
FXAS	199.054	0.0000*	149.766	0.0000***
SIZE	144.402	0.0000*	118.888	0.0000***
NDTS	87.6164	0.0072*	80.8115	0.0255****
	Phillips-Perron (PP) constant		**Phillips-Perron (PP) constant & trend**	
Variables	**statistics**	**p-value**	**statistics**	**p-value**
LEV	204,872	0,0000*	206,908	0,0000***
FXAS	237.780	0,0000*	209.889	0,0000***
SIZE	148.516	0.0000*	136.885	0.0000***
NDTS	97.3106	0.0009*	88.4920	0.0061***

** Statistical significance at 1% level.*
*** Statistical significance at 5% level.*
**** Statistical significance at 1% level included time trend.*
***** Statistical significance at 5% level included time trend.*

After confirming that all series are stationary, the Hausman test determines whether a fixed or random effect is appropriate for a panel model. If the Hausman test accepts the null hypothesis that the random effect is valid, then the random effect is more appropriate for the model; if the null hypothesis is rejected, then the fixed effect is more appropriate. The results show that the null hypothesis is rejected (p-value = 0.000), indicating the fixed effect is more appropriate.

4. Empirical Results

The diagnostic tests of the fixed effects model revealed two problems: heteroscedasticity and serial correlation. The modified Wald test statistic showed chi2 (29) = 2.8 e + 05, with a probability value of 0.0000, and the Wooldridge test statistic showed F (1,28) = 13.53, with a probability value of 0.0010. The model was re-evaluated using the Feasible Generalized Least Squares (FGLS) estimator to address these issues. The FGLS estimator can handle heteroskedasticity and autocorrelation, making it potentially more efficient for large N and small T panels than other estimators like Beck and Katz's (1995) PCSEs (Wooldridge, 2002: 178).

The results of the panel regressions for the model are presented in Table 7. According to the pecking order theory, it is a well-established practice for companies to prioritise financing their activities through retained earnings, loans, and capital issuance (Myers, 1984; Myers & Majluf, 1984). Prudent companies are cautious about using retained earnings for investment, confirming a negative relationship between profitability and leverage. The model shows a positive and statistically significant relationship between fixed assets and total assets and the leverage ratio, which aligns with the pecking order theory and trade-off theories of capital structure. The results also show a negative correlation between size and leverage, with larger companies mitigating knowledge asymmetry between insiders and capital markets. This suggests that larger companies provide more information to outside investors, reducing adverse selection costs through equity issuance. The pecking order theory suggests that U.S.-listed shipping companies prefer internal funds over external funds and debt financing over equity financing, supporting the pecking order hypothesis. Overall, the results lend credence to the pecking order hypothesis.

Table: 7
Results of Panel Regression

Dependent Variable: LEV				
	[Coefficient]	**[Std.Error]**	**[t Statistics]**	**[p-value]**
ROA	-0,000766	7,58E-05	-10,10317	0,0000*
FXAS	0,215245	0,059422	3,622320	0,0003*
SIZE	-0,119817	0,025860	-4,633290	0,0000*
NDTS	0,020571	0,086946	0,236592	0,8131
MBV	8,65E-07	4,23E-06	0,204586	0,8380
VOL	-1,57E-05	4,18E-05	-0,374373	0,7084
Observations	319	319	319	319
Adj. R^2				0,2791
Durbin-Watson stat.				2,0651

The model was applied with a fixed effect according to the Hausman Test.
** Statistical significance at 1% level.*

5. Concluding Remarks

This paper investigates the financial factors influencing capital structure decisions for 29 shipping companies listed on U.S. equity markets, focusing on the impact of IMO deregulations and stricter environmental regulations such as reducing sulphur oxide (SOx) emissions by 80% by 2023 and nitrogen oxide (NOx) emissions by 75% by 2020. These regulations have led to LNG ship conversions and improved port infrastructure, affecting the shipping industry from 2010 to 2023. Therefore, the industry's energy strategies and capital structures have had to adapt to the growing demand for LNG-powered vessels and changes in renewable energy sources. However, notwithstanding the surge in loans granted to the shipping industry since the 2008 financial crisis, the impacts of the pandemic and the following global price hikes have compelled companies to pursue additional resources. Consequently, shipping companies seek capital from established financial markets, such as the NYSE, to improve their financial stability and take advantage of organisations' transparency and regulatory standards, such as the SEC. Considering these developments, I discussed the potential impacts of the pandemic, inflation, and environmental regulations on

shipping companies' capital structure decisions, the factors influencing these decisions, and the validity of capital structure theories in the shipping industry.

The panel data analysis in Table 7 indicates that profitability has a statistically significant and negative impact on leverage. This finding provides empirical support for the validity of the pecking order hypothesis in the context of shipping companies listed on the U.S. equity markets. This theory suggests that companies with higher profitability tend to have lower leverage. They prioritise using retained earnings and minimise their reliance on external financing. However, these companies typically favour debt over equity if external funding is necessary. This finding is not unexpected. Because shipping companies are often affected by fluctuations in the global economy, they make their operations cyclical, and retained earnings, which are a form of internal financing, offer a stable and dependable source of funds not subject to external market conditions. Hence, this negative result is in line with the findings of previous research by Huang and Song (2006), Frank and Goyal (2009), Lemmon and Zender (2010), Syriopoulos and Tsatsaronis (2012), Drobetz et al. (2013), Paun and Topan (2016), Syriopoulos et al. (2018), Aarland and Fidjeland (2018), Cantero-Sáiz et al. (2019), Yang et al. (2022) and Majid and Gandakusuma (2023).

In addition, size, another key determinant in the decision to adopt a capital structure, not only in shipping but in all industries, also negatively impacts leverage. The acquisition of ships and similar assets, particularly in the shipping industry, significantly impacts the increase in total assets or revenues, a prominent measure of size. This is often referred to as fleet augmentation, representing an increase in the company's size. Therefore, when a shipping company is substantial, it can benefit from economies of scale by securing more favourable agreements with suppliers, optimising transportation routes, and distributing fixed costs across larger cargo. On the other hand, the trade-off theory of capital structure suggests that the relationship between size and leverage is ambiguous. It indicates that debt is an optimal capital structure that balances tax benefits with financial distress costs and risks. However, achieving this balance depends on larger companies' access to capital markets and potential cost benefits from economies of scale. Previous studies have found a positive correlation between leverage and size in the capital structure of shipping companies (Drobetz et al., 2013; Merika et al., 2015; Kotcharin & Maneenop, 2017; Aarland & Fidjeland, 2018; Lykset, 2022). However, this study confirms the validity of the pecking order theory, which is consistent with a limited number of studies (Arvenitis et al., 2012; Yang et al., 2022).

Contrary to size and profitability, the study found a negative correlation between tangibility and leverage in shipping companies, indicating a preference for internal funds over external funds due to industry cyclicality and earnings volatility. This suggests that tangible collateral reduces access to loans and costs, confirming the pecking order theory, where retained earnings are preferred over external funds.

In conclusion, the capital structure of shipping companies is a complex interplay of financial theories and industry-specific dynamics. According to the pecking order theory,

shipping companies exhibit a negative relationship between profitability and size with leverage due to considerations of information asymmetry and signalling effects. Larger and more profitable companies prefer residual earnings and are cautious about external debt, which aligns with the theory's predictions. Finally, tangibility seems to be an essential factor, and it positively correlates with leverage. Because, particularly for the shipping industry, it serves as valuable collateral, enabling the acquisition of external debt financing and aligning with the pecking order theory's inclination for debt rather than equity when external funds are needed. The signs of the other variables, namely non-debt tax shield, market-to-book value (a measure of growth potential), and volatility, are consistent with capital structure theories. However, these variables are not statistically significant.

Future research could investigate the variations in these relationships among different shipping industry sub-sectors, such as dry bulk, tankers, and container ships. Additionally, exploring the effects of digitalisation and geopolitical changes on capital structure choices could provide valuable insights.

References

Aarland, A. & A. Fidjeland (2018), "Capital Structure Decisions, Speed of Adjustment and Firm Performance of Listed Shipping Companies: New Empirical Evidence", *Masters' Thesis*, NTNU Trondheim Business School.

Albertijn, S. et al. (2011), "Financing Shipping Companies and Shipping Operations: A Risk-Management Perspective", *The Journal of Applied Corporate Finance*, 23(4), 70-82.

Alexandridis, G. et al. (2018), "A Survey of Shipping Finance Research: Setting the Future Research Agenda", *Transportation Research Part E: Logistics and Transportation Review*, 115, 164-212.

Arvenitis, S.H. et al. (2012), "Dynamic Approach of Capital Structure of European Shipping Companies", *International Journal of Economic Sciences and Applied Research*, 5(3), 33-63.

Baker, M. & J. Wurgler (2002), "Market Timing and Capital Structure", *The Journal of Finance*, 57(1), 1-32.

Baltagi, B.H. (2009), *Econometric Analysis of Panel Data*, Chichester, England: John Wiley & Sons.

Baxter, N.D. (1967), "Leverage, Risk of Ruin and the Cost of Capital", *The Journal of Finance*, 22(3), 395-403.

Berger, A.N. & E.B. di Patti, (2006), "Capital Structure and Firm Performance: A New Approach to Testing Agency Theory and An Application to the Banking Industry", *Journal of Banking & Finance*, 30(4), 1065-1102.

Berk, J.B. et al. (2010), "Human Capital, Bankruptcy, and Capital Structure", *The Journal of Finance*, 65(3), 891-926.

Booth, L. et al. (2001), "Capital Structures in Developing Countries", *The Journal of Finance*, 56(1), 87-130.

Bradley, M. et al. (1984), "On the Existence of an Optimal Capital Structure: Theory and Evidence", *The Journal of Finance*, 39(3), 857-878.

Cantero-Sáiz, M. et al. (2019), "Financial Crisis and Determinants of the Capital Structure of Spanish Maritime Transport Firms", *Journal of Maritime Research*, XVI(II), 78-86.

Chen, L. & X.S.W. Zhao (2006), "On the Relation between the Market-to-Book Ratio, Growth Opportunity, and Leverage Ratio", *Finance Research Letters*, 3(4), 253-266.

Chen, Y. et al. (2021), "Determinants of Leverage in Emerging Markets: Empirical Evidence", *International Journal of Economics and Financial Issues*, 11(2), 40-46.

Dang, H.N. et al. (2019), "Study the Impact of Growth, Firm Size, Capital Structure, and Profitability on Enterprise Value: Evidence of Enterprises in Vietnam", *The Journal of Corporate Accounting & Finance*, 30(1), 144-160.

De Jong, A. et al. (2008), "Capital Structure around the World: The Roles of Firm- and Country-Specific Determinants", *Journal of Banking & Finance*, 32(9), 1954-1969.

DeAngelo, H. & R.W. Masulis (1980), "Optimal Capital Structure under Corporate and Personal Taxation", *Journal of Financial Economics*, 8(1), 3-29.

Dinlersoz, E. et al. (2019), "Leverage over the Life Cycle, Firm Growth and Aggregate Fluctuations", *Working Paper*, 25226, National Bureau of Economic Research, Cambridge.

Drobetz, W. & G. Wanzenried (2006), "What Determines the Speed of Adjustment to the Target Capital Structure?", *Applied Financial Economics*, 16(13), 941-958.

Drobetz, W. et al. (2013), "Capital Structure Decisions of Globally - Listed Shipping Companies", *Transportation Research Part E*, 52, 49-76.

Easterbrook, F.H. (1984), "Two Agency-Cost Explanations of Dividends", *The American Economic Review*, 74(4), 650-659.

Eriotis, N. et al. (2007), "How Firm Characteristics Affect Capital Structure: An Empirical Study", *Managerial Finance*, 33(5), 321-331.

Fama, E.F. & K.R. French (2002), "Testing Trade-Off and Pecking Order Predictions about Dividends and Debt", *The Review of Financial Studies*, 15(1), 1-33.

Ferri, M.G. & W.H. Jones (1979), "Determinants of Financial Structure: A New Methodological Approach", *The Journal of Finance*, 34(3), 631-644.

Frank, M.Z. & V.K. Goyal (2009), "Capital Structure Decisions: Which Factors Are Reliably Important?", *Financial Management*, 38(1), 1-37.

Güner, A. (2016), "The Determinants of Capital Structure Decisions: New Evidence from Turkish Companies", *Procedia Economics and Finance*, 38, 84-89.

Hall, G.C. et al. (2004), "Determinants of the Capital Structures of European SMEs", *Journal of Business Finance & Accounting*, 31(5-6), 711-728.

Hapag-Lloyd (2021), *Annual Report*, <https://www.hapaglloyd.com/content/dam/website/downloads/ir/HLAG_Annual_Report_FY2021.pdf>, 05.01.2024.

Harris, C. & S. Roark (2019), "Cash Flow Risk and Capital Structure Decisions", *Finance Research Letters*, 29, 393-397.

Harris, M. & A. Raviv (1991), "The Theory of Capital Structure", *The Journal of Finance*, 46(1), 297-355.

Hovakimian, A. et al. (2012), "Are Corporate Default Probabilities Consistent with the Static Trade-Off Theory?", *The Review of Financial Studies*, 25(2), 315-340.

Huang, G. & F.M. Song (2006), "The Determinants of Capital Structure: Evidence from China", *China Economic Review*, 17(1), 14-36.

Ibhagui, O.W. & F.O. Olokoyo (2018), "Leverage and Firm Performance: New Evidence on the Role of Firm Size", *North American Journal of Economics and Finance*, 45, 57-82.

Im, K.S. et al. (2003), "Testing for Unit Roots in Heterogeneous Panels", *Journal of Econometrics*, 115(1), 53-74.

International Chamber of Shipping (2022), <https://www.ics-shipping.org/shipping-fact/shipping-and-world-trade-global-supply-and-demand-for-seafarers/>, 29.11.2022.

Jensen, M.C. & R.W.H. Meckling (1976), "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure", *Journal of Financial Economics*, 3(4), 305-360.

Jensen, M.C. (1986), "Agency Cost of Free Cash Flow, Corporate Finance, and Takeovers", *American Economic Review*, 76(2), 323-329.

Kayo, E.K. & H. Kimura (2011), "Hierarchical Determinants of Capital Structure", *Journal of Banking & Finances*, 35(2), 358-371.

Kim, H. et al. (2006), "Dynamics of Capital Structure: The Case of Korean Listed Manufacturing Companies", *Asian Economic Journal*, 20(3), 275-302.

Kotcharin, S. & S. Maneenop (2017), "Understanding the Capital Structure of Thai Companies in the Shipping Sector", *Working Paper*, 2001-6, Thammasat Business School, Thammasat University, Bangkok, Thailand.

Kraus, A. & R.H. Litzenberger (1973), "A State-Preference Model of Optimal Financial Leverage", *The Journal of Finance*, 28(4), 911-922.

Lemmon, M.L. & J.F. Zender (2010), "Debt Capacity and Tests of Capital Structure Theories", *The Journal of Financial and Quantitative Analysis*, 45(5), 1161-1187.

Levin, A. et al. (2002), "Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties", *Journal of Econometrics*, 108(1), 1-24.

Lykseth, B.S. (2022), "Capital Structure Choices in the Shipping Industry An Analysis of Bulk, LNG, Container Shipping Firms", *Masters' Thesis*, Copenhagen Business School.

Majid, N.H.S. & I. Gandakusuma (2023), "How Maritime Connectivity and Crude Oil Price Determine Capital Structure of Maritime Industry in Indonesia", *Proceedings of the 7th Global Conference on Business, Management, and Entrepreneurship (GCBME 2022)*, <https://www.atlantis-press.com/proceedings/gcbme-22/125991972>, 16.12.2023.

Maksimovic, V. (1988), "Capital Structure in Repeated Oligopolies", *The Rand Journal of Economics*, 19(3), 389-407.

Menon Economics and DNV Publication (2022), *The Leading Maritime Cities of the World*, <https://www.menon.no/wp-content/uploads/Maritime-cities-2022_13-oppdatert.pdf>, 11.09.2022.

Merika, A. et al. (2015), "The Relationship between Business Cycles and Capital Structure Choice: The Case of the International Shipping Industry", *The Journal of Economic Asymmetries*, 12, 92-99.

Minton, B.A. & K.H. Wruck (2001), "Financial Conservatism: Evidence on Capital Structure from Low Leverage Firms", *Working Paper*, 2001-6, Fisher College of Business, Columbus, Ohio.

Modigliani, F. & M.H. Miller (1958), "The Cost of Capital, Corporation Finance and The Theory of Investment", *The American Economic Review*, 48(3), 261-297.

Modigliani, F. & M.H. Miller (1963), "Corporate Income Taxes and the Cost of Capital: A Correction", *The American Economic Review*, 53(3), 433-443.

Moradi, A. & E. Paulet (2019), "The Firm-Specific Determinants of Capital Structure - An Empirical Analysis of Firms Before and During the Euro Crisis", *Research in International Business and Finance*, 47, 150-161.

Myers, S.C. & N.S. Majluf (1984), "Corporate Financing and Investment Decisions When Firms Have Information that Investors Do Not Have", *Journal of Financial Economics*, 13(2), 187-221.

Myers, S.C. (1977), "Determinants of Corporate Borrowing", *Journal of Financial Economics*, 5(2), 147-175.

Myers, S.C. (1984), "Capital Structure Puzzle", *The Journal of Finance*, 39(3), 575-592.

Myers, S.C. (2001), "Capital Structure", *The Journal of Economic Perspectives*, 15(2), 81-102.

Nelson, C.R. & C.R. Plosser (1982), "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications", *Journal of Monetary Economics*, 10(2), 139-162.

Nenu, E.A. et al. (2018), "The Impact of Capital Structure on Risk and Firm Performance: Empirical Evidence for the Bucharest Stock Exchange Listed Companies", *International Journal of Financial Studies*, 6(2), 1-29.

Ozkan, A. (2001), "Determinants of Capital Structure and Adjustment to Long Run Target: Evidence from UK Company Panel Data", *Journal of Business Finance & Accounting*, 28(1-2), 175-198.

Paun, C. & M.V. Topan (2016), "Capital Structure in the Global Shipping Industry", *Panoeconomicus*, 63(3), 359-384.

Pesaran, M. & T. Yamagata (2008), "Testing Slope Homogeneity in Large Panels", *Journal of Econometrics*, 142(1), 50-93.

Pesaran, M.H. (2004), "General Diagnostic Tests for Cross Section Dependence in Panels", *IZA Discussion Paper*, 1240, The Institute for the Study of Labor Discussion Paper Series.

Rajagopal, S. (2010), "The Portability of Capital Structure Theory: Do Traditional Models Fit in An Emerging Economy?", *Journal of Finance and Accountancy*, 5, 1-17.

Rajan, R.G. & L. Zingales (1995), "What Do We Know about Capital Structure? Some Evidence from International Data", *The Journal of Finance*, 50(5), 1421-1460.

Ramli, N.A. et al. (2019), "Determinants of Capital Structure and Firm Financial Performance-A PLS-SEM Approach: Evidence from Malaysia and Indonesia", *The Quarterly Review of Economics and Finance*, 71, 148-160.

Ross, S.A. (1977), "The Determination of Financial Structure: The Incentive Signaling Approach", *The Bell Journal of Economics*, 8(1), 23-40.

Sari, I.A.G.D.M. & I.B.P. Sedana (2020), "Profitability and Liquidity on Firm Value and Capital Structure as Intervening Variable", *International Research Journal of Management, IT and Social Sciences*, 7(1), 116-127.

Scott, J.H. Jr. (1976), "A Theory of Optimal Capital Structure", *The Bell Journal of Economics*, 7(1), 33-54.

Syriopoulos, T. & M. Tsatsaronis (2012), "Corporate Governance Mechanisms and Financial Performance: CEO Duality in Shipping Firms", *Eurasian Business Review*, 2(1), 1-30.

Syriopoulos, T. (2010), "Shipping Finance and International Capital Markets", in: C. Grammenos (ed.), *The Handbook of Maritime Economics and Business* (1-37), Lloyd's List London: British Library Cataloguing in Publication Data.

Syriopoulos, T. et al. (2018), "Capital Structure Determinants According to Risk Periods in Shipping Companies", *International Conference on Business & Economics of the Hellenic Open University*, <http://hdl.handle.net/11610/21042>, 17.12.2023.

Titman, S. & R. Wessels (1988), "The Determinants of Capital Structure Choice", *The Journal of Finance*, 43(1), 1-19.

Tugcu, C.T. (2018), "Panel Data Analysis in the Energy-Growth Nexus (EGN)", in: A.N. Menegaki (ed.), *The Economics and Econometrics of the Energy-Growth Nexus* (255-271), New York: Elsevier.

UNCTAD (2021), *Review of Maritime Transport 2021*, <https://unctad.org/system/files/official-document/rmt2021_en_0.pdf>, 29.12.2022.

UNCTAD (2022) *United Nations Conference on Trade and Development*, <https://unctad.org/news/global-trade-hits-record-77-trillion-first-quarter-2022>, 29.12.2022.

Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*, London: The MIT Press.

Yang, H. et al. (2022), "A Comparative Study of the Determinants of Capital Structure in Shipping Companies: The Case of Korea and Greece", *Maritime Policy & Management*, 49(4), 528-539.

Yeo, H. (2016), "Solvency and Liquidity in Shipping Companies", *The Asian Journal of Shipping and Logistics*, 32(4), 235-241.

Yıldırım, D. & A.K. Çelik (2020), "Testing the Pecking Order Theory of Capital Structure: Evidence from Turkey Using Panel Quantile Regression Approach", *Borsa Istanbul Review*, 21(4), 317-331.

Yildirim, R. et al. (2018), "Determinants of Capital Structure: Evidence from Shari'ah Compliant and Non-Compliant Firms", *Pacific-Basin Finance Journal*, 51, 198-219.