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MODELING DYNAMICS OF OIL TANKER FREIGHT RATES AND MARKET CAPITALIZATION OF OIL TANKER SHIPPING COMPANIES

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МОДЕЛЮВАННЯ ДИНАМІКИ НАФТОНАЛИВНИХ ФРАХТОВИХ СТАВОК ТА РИНКОВОЇ КАПІТАЛІЗАЦІЇ ТАНКЕРНИХ СУДНОПЛАВНИХ КОМПАНІЙ

Abstract. This study explores the oil tanker segment, a crucial component of the shipping industry, which accounts for 25% of international cargo transportation. Oil tankers, which transport liquid cargo such as crude oil and oil products, represent over 30% of the world's cargo-carrying fleet. By applying OLS regression techniques on a structural market dataset, the paper examines: (1) the impact of various economic indicators, including S&P 500 as a barometer of stock market performance, on oil tanker freight market indices, and (2) the influence of these economic parameters on the stock market capitalization of seven shipping companies engaged in oil transportation. The analysis covers the period from 1998 to 2023, utilizing the Baltic Clean Tanker Index (BCTI) and Baltic Dirty Tanker Index (BDTI) as proxies for tanker freight rates.

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The results show that the oil tanker freight market exhibits a positive dependence on inflation, consistent with existing theories, and a negative dependence on oil prices and global oil production. While this latter finding may seem counterintuitive, it suggests that more complex mechanisms are at play. Broader economic cycles and regional shifts in oil production likely influence tanker freight rates, while inflation appears to be driven not by oil prices, but by factors such as monetary policy, supply chain disruptions, and global demand.
Regarding the modeling of oil tanker companies' stock market capitalization, the study finds that different economic variables affect different maritime transport enterprises. Key trends indicate that the S&P 500 index affects companies with a longer history of public listing, LIBOR is significant for companies with larger fleets, and companies with smaller fleets appear more sensitive to freight levels. Inflation and oil prices, in contrast to freight rate models, have less influence on stock market capitalization. These findings offer valuable insights for shipping investors and market professionals, supporting more informed decision-making and improved operational management.

Keywords: transport, maritime transport, shipping, shipping companies, fleet, international cargo transportation, seaborne trade, tanker trade, freight rates, freight market, interest rates, inflation, oil price, S&P 500 index, stock market, market capitalization, structural market data, regression analysis.

Анотація. Стаття досліджує сегмент перевезення нафти та нафтопродуктів, важливу складову судноплавної галузі, яка складає 25% від обсягу міжнародних вантажних перевезень. Нафтові танкери, які перевозять рідкі вантажі, такі як сиру нафту та нафтопродукти, складають понад 30% світового вантажного флоту. За допомогою регресії МНК на структурованих ринкових даних, у статті проаналізовано: (1) вплив різних економічних показників, включаючи індекс S&P 500 як барометр фондового ринку, на нафтоналивні фрахтові індекси, і (2) вплив цих економічних параметрів на ринкову капіталізацію семи судноплавних компаній, що займаються транспортуванням нафти та нафтопродуктів. Аналіз охоплює період з 1998 по 2023 рік та використовує Балтійський індекс чистих танкерів (BCTI) та Балтійський індекс брудних танкерів (BDTI) як проксі для ставок фрахту танкерного сектору.
Результати показують, що танкерний фрахтовий ринок має позитивну залежність від інфляції, що відповідає існуючим теоріям, і негативну залежність від цін на нафту та світового виробництва нафти. Хоча останнє спостереження може здатися контрінтуїтивним, це свідчить про наявність складніших механізмів, що впливають. Ширші економічні цикли та регіональні зміщення у виробництві нафти, ймовірно, впливають на танкерні ставки фрахту, а інфляція зумовлена не цінами на нафту, а такими факторами, як грошово-кредитна політика, збої в ланцюгах постачання та світовий попит.
Щодо моделювання ринкової капіталізації танкерних судноплавних компаній, дослідження показує, що різні економічні змінні впливають на різні підприємства морського транспорту. Основні тенденції вказують на те, що індекс S&P 500 впливає на компанії з довшою історією публічного лістингу, ставка LIBOR є значущою для компаній з більшими флотами, а компанії з меншими флотами виявляються більш чутливими до рівня ставки фрахту. Інфляція та ціна на нафту, на відміну від моделей фрахтових ставок, мають менший вплив на ринкову капіталізацію підприємств морського транспорту. Ці висновки дають цінні відомості для інвесторів у судноплавну галузь та фахівців, дозволяючи приймати більш обґрунтовані рішення та поліпшити управління операціями.

Ключові слова: транспорт, морський транспорт, судноплавство, підприємства морського транспорту, флот, міжнародні вантажні перевезення, морська торгівля, торгівля нафтопродуктами, фрахтові ставки, фрахтовий ринок, процентні ставки, інфляція, ціна нафти, індекс S&P 500, фондовий ринок, ринкова капіталізація, структурні ринкові дані, регресійний аналіз.

JEL: C20, C55, F10, G12, G17, R40, R41, Q41

Introduction. The shipping industry is a critical component of the world economy and international economic relations, with over 80% of international trade transported by sea [1]. Within this industry, tanker vessels play a pivotal role. The tanker segment is complex and heterogeneous. Although shipping literature lacks a unified approach to vessel categorization, tankers are generally divided into two main groups: i) crude oil and oil products tankers, which fall under liquid bulk transport, and ii) chemical, gas, and other specialized tankers. For the purpose of this study, the focus will be on liquid bulk fleet transporting crude oil and diversified oil products, excluding the specialized cargo fleet.

At the start of 2024, oil tankers comprised more than 30% of the world's cargo fleet in terms of carrying capacity, while oil tanker trade accounted for approximately 25% of international cargo transportation, measured either in tonnes of cargo moved or tonne-miles [2].

Unlike the containership fleet, which has remained stable percentage wise over the past 15 years, or the dry bulk fleet, whose share has firmly grown since 2009 [3], the share of oil tanker fleets and trade has gradually declined over the same period [2], mainly due to the global decarbonization mega-trend. Nonetheless, the significance of tankers to the global economy cannot be understated.

Oil tankers serve different functions at various stages of the industrial process, acting as either primary (transporting raw materials to refineries) or secondary (transporting finished products) sea transport. Crude oil tankers move crude oil from extraction sites to refineries [4], while oil product tankers carry refined products such as fuel oil, diesel, gasoline, jet fuel, naphtha, and vegetable oils further to consumption centers [5]. Key crude oil trade routes include those from the Persian Gulf and West Africa to the Far East, North America, and Europe. Smaller product tankers are employed in regional trades (U.S. Gulf Coast, U.S. East Coast, Western Europe, and the Far East) and on long-haul voyages, such as from Europe to North America [6].

Freight rates are known as the main variable of interest for any participant in the shipping industry, be it a shipowner, a shipping company, a charterer, a shipper, an investor [7]. In the oil tanker sector, freight rates are tracked by two key indices: the Baltic Clean Tanker Index (BCTI) and the Baltic Dirty Tanker Index (BDTI), both produced by the London-based Baltic Exchange, a leading provider of freight market information.

The distinction between these indices lies in the types of cargo they cover and the trade routes they represent. Clean products which include lighter distillates of the crude oil refining process such as gasoline, naphtha, jet fuel, heating oil and kerosene, are shipped in vessels with coated, clean tanks [6]. In contrast, dirty products include unrefined crude oil, residual oil and lower distillates, which are transported in conventional tankers that may require steam-heating coils due to the cargo's high viscosity [4]. Specific trade routes used in the calculation of both the BCTI and BDTI are quoted in Worldscale (WS) points [8].

This study has two primary research objectives: 1) to identify the factors influencing the development of the BCTI and BDTI between 1998 and 2023, and 2) to model the relationship between the stock market capitalization of seven active oil tanker shipowning companies and various macroeconomic indicators and relevant freight rate barometers. The ultimate goal is to support the operational decision-making and provide market practitioners and shipping investors with actionable recommendations based on a thorough evaluation and comparison of the resulting models.

Literature review. Despite recent advancements in machine learning and deep learning techniques, the shipping industry remains conservative from a scientific standpoint, with traditional methods still dominating research [9]. Much of the extant literature on shipping focuses on tanker markets, particularly regarding the complexity and cyclicality of crude oil cycles, which are considered more difficult to decompose and analyze compared to other market segments [10].

Chen et al. used wavelet analysis to identify the durations of short-, medium-, and long-term cycles in Aframax tanker one-year charter freight rates [11]. In view of co-movements of freight rates reflecting specific segment [6], the findings of this paper offer valuable practical insights as well as predicting reference for stakeholders in the highly volatile oil tanker market.

Michail and Melas found that the BDTI is influenced by the volume of seaborne commodity trade, whereas the BCTI does not exhibit this behavior, largely due to the broader applications of clean tankers. Importantly, they revealed that oil price shocks negatively impact both the BDTI and BCTI, a finding that diverges from conventional economic theory. This behavior can be explained by the practice of using tankers as floating storage units during periods of low oil prices to reserve oil for future, potentially more profitable, sales [7].

Earlier attempts to determine the dynamic relationship between the oil market and tanker freight rates have produced divergent findings. Sun et al. found that tanker freight rates and oil prices exhibited distinct multiscale properties, with correlations shifting in opposite directions depending on the sub-periods analyzed [12]. In contrast, Shi et al. concluded that crude oil prices and tanker freight rates co-moved, with non-supply oil shocks and tanker-specific shocks driving the dynamic correlation during peak periods, while oil supply and non-supply shocks were significant during troughs [13].

Khan, Khurshid and Koseoglu investigated the presence of speculative bubbles in the BDI, BDTI, and BCTI during the covid-19 pandemic. They confirmed the existence of bubbles in these indices, with the BDTI bubble driven by sharp oil price fluctuations and the subsequent demand for floating storage, which led to tonnage shortages. The BCTI bubble, on the other hand, was influenced by logistical disruptions, oil price increases, and the need for oil products. Interestingly, both tanker indices appeared to be less explosive than the BDI [14].

Fei et al. examined the BDTI and how it is affected by the critical events and shocks, by applying the innovative tool for shipping research tool — the rescaled range analysis. The financial crisis and global market competition had a negative effect on the index, while events like the crude oil agreement and enhancement of environmental regulations positively impacted it [15].

Given the increased focus on decarbonization initiatives in shipping, Meng et al. found that the carbon finance market dominated the relationship with shipping market, and there was a dependence and information linkage from carbon to shipping in the long run, with stronger linkages during crises. Although the tanker segment was less influenced by carbon finance than the dry bulk sector, certain geopolitical events intensified the relationship [16].

To date, limited research has integrated stock market indicators into shipping studies. Grammenos and Arkoulis pioneered this area, finding that oil prices and laid-up tonnage had a negative impact on shipping stocks, while exchange rates showed a positive influence. Industrial production and inflation, however, showed no significant relationship [17]. Subsequently, Michail and Melas established a bi-directional and lagged connection between S&P 500 and the BDTI, identifying a negative correlation for present values and a positive one for the present S&P 500 and the BDTI one day later [18].

More recent research has further expanded this domain. Maersk's market capitalization was identified as a significant variable in modeling containership charter rates [19]. Additionally, the stock market performance of a diverse range of shipping companies across various segments was found to align with broader COVID-19-related market trends, where optimistic developments boosted stock returns while pessimistic events led to declines [20].

Notably, strong positive impact of ore prices and oil prices on stock returns of specifically dry bulk shipping companies has also been observed [21]. Furthermore, the market capitalization of dry bulk shipping companies has been examined in depth [22], and the present study draws on this work for a comparative analysis between the dry bulk and oil tanker segments.

Research methodology. This paper aims to contribute to the existing literature by comparing the development of the BCTI and BDTI, as well as by modeling the relationship between the performance of tanker shipping stocks and various influencing variables. To achieve this, stepwise regression analyses are conducted using the Ordinary Least Squares (OLS) technique to determine the best-fitting regression equations. The optimal equation is defined as the one that minimizes the sum of the squared errors between observed values and predicted (theoretical) values. For this purpose, IBM SPSS Statistics software is employed. Additionally, the Pearson's correlation coefficients between certain individual variables are calculated using Microsoft Excel's Data Analysis tool.

Two opposing hypotheses are formulated: the null hypothesis, which posits an insignificant relationship between the response variable and each explanatory variable, and the alternative hypothesis. The analysis is conducted with a 95% confidence level. Hypotheses are tested against the p-value, Student's t-distribution, and standard error. The coefficient of determination (R-squared) is then evaluated to verify the goodness of fit of each model — i.e., the extent to which the regression equation explains the variation in the dependent variable. The F-statistic and its significance are also examined to evaluate the overall adequacy of the model. The Durbin-Watson statistic is used as a diagnostic test to detect autocorrelation.

As Stopford notes, forecasting is less about predicting the future and more about analyzing the present using the right data [4]. Accordingly, this study uses annual time-series data from 1998 to 2023, sourced from various databases, including Clarksons SIN [2], the Federal Reserve Bank of St. Louis [23], Global Rates [24], Macrotrends [25], and Companies Market Cap [26].

For the analysis of stock market capitalization, seven pure-play oil tanker owners are selected. Five of these companies are ranked among the top 50 tanker owners by Clarksons SIN [2]: Scorpio Tankers, TORM, International Seaways, Euronav, and Teekay. Since historical data on stock market performance for these companies is available for only 8 to 17 years, two additional tanker companies are included in the analysis: Frontline, which is also part of the Clarksons' top 50 being a subsidiary of the Fredriksen Group, and Nordic American Tankers, which has been publicly listed since 1997 and operates 20 crude oil tankers.

The dataset of structural market data used in this study includes the following variables, with acronyms utilized when constructing regression models in the software, provided in italics in brackets: Baltic Clean Tanker Index (*BCTI*), Baltic Dirty Tanker Index (*BDTI*), global price of Brent crude oil (*P_BRENT*), 1-year LIBOR interest rate (*LIBOR*), global inflation (consumer prices) (*INFLATION*), S&P 500 index (*SP500*), global oil production (*OIL_PROD*), world seaborne total oil trade (*SEAB_OIL_TRADE*), average earnings for all tankers (*EARNINGS*), market capitalization of selected tanker companies — Scorpio Tankers (*SCORPIO_MARCAP*), TORM (*TORM_MARCAP*), International Seaways (*INSW_MARCAP*), Euronav (*EURONAV_MARCAP*), Teekay (*TEEKAY_MARCAP*), Frontline (*FRONTLINE_MARCAP*), Nordic American Tankers (*NAT_MARCAP*).

Structural market data analysis. *A. Oil tanker freight indices modeling.* To address the first research objective, a stepwise regression was conducted for the following models:

$$\mathrm{BDTI} = \beta 0 + \beta 1 * \mathrm{P\_BRENT} + \beta 2 * \mathrm{LIBOR} + \beta 3 * \mathrm{INFLATION} + \beta 4 * \mathrm{SP500} + \beta 5 * \mathrm{OIL\_PROD} + \beta 6 * \mathrm{SEAB\_OIL\_TRADE} \quad (1)$$

$$\mathrm{BCTI} = \beta 0 + \beta 1 * \mathrm{P\_BRENT} + \beta 2 * \mathrm{LIBOR} + \beta 3 * \mathrm{INFLATION} + \beta 4 * \mathrm{SP500} + \beta 5 * \mathrm{OIL\_PROD} + \beta 6 * \mathrm{SEAB\_OIL\_TRADE} \quad (2)$$

For the BDTI, the regression analysis suggests that only inflation and Brent oil prices proved significant. For the BCTI, inflation also showed significance, along with global oil production, while other independent variables were not statistically significant. Tab. 1 presents the statistical outcomes of the regression analysis. Insignificant variables were excluded, and the remaining statistically significant variables are displayed alongside their corresponding freight indices.

TABLE 1 **. SUMMARY OF REGRESSION ANALYSIS OF TANKER FREIGHT INDICES ON VARIOUS ECONOMIC INDICATORS**

Depen. variab.	R-sq.	DW	Fisher			Significant independent variables	Std. coef.	Student t-statistic		
			Coef.	Prob.	Crit.			Coef.	Prob.	Crit.
BDTI	0.389	1.205	7.314	0.003	3.420	INFLATION	0.638	3.687	0.001	2.069
						P_BRENT	-0.379	-2.192	0.039	
						_cons	817.318[a]	5.381	0.000	
BCTI	0.466	0.951	10.035	0.001	3.420	INFLATION	0.571	3.739	0.001	2.069
						OIL_PROD	-0.333	-2.183	0.040	
						_cons	1391.621[a]	3.261	0.003	

[a]Unstandardized coefficients are used for constants.

Source: compiled by the authors on regression analysis performed in IBM SPSS Statistics.

From an econometrics perspective, the regression models for both the BDTI and BCTI display some common characteristics. The regression model explains 38.9% of the variation in the BDTI, with inflation positively affecting the index and oil prices having a negative impact. The F-statistic of 7.314 exceeds the critical threshold of 3.420 at the 5% significance level, and the Durbin-Watson statistic (1.205) suggests weak positive autocorrelation, slightly deviating from the inconclusive range (1.220–1.550). Similarly, for the BCTI, inflation had a positive influence, while global oil production exhibited a negative relationship with the index. In this case, 46.6% of the variation in BCTI can be explained by these variables. The F-statistic (10.035) comfortably exceeds the critical value (3.420), and the Durbin-Watson statistic (0.951) also suggests positive autocorrelation.

B. Modeling of stock market capitalization of seven oil tanker shipping companies. To address the second research objective, the market capitalization of seven oil tanker shipping companies was analyzed. Each company was examined independently, and a stepwise regression was conducted for each using the following general model:

$$\mathrm{MARCAP} = \beta 0 + \beta 1 * \mathrm{EARNINGS} + \beta 2 * \mathrm{P\_BRENT} + \beta 3 * \mathrm{LIBOR} + \beta 4 * \mathrm{INFLATION} + \beta 5 * \mathrm{SP500} \quad (3)$$

TABLE 2 **. SUMMARY OF REGRESSION ANALYSIS OF OIL TANKER SHIPPING COMPANIES' MARKET CAPITALIZATION ON VARIOUS ECONOMIC INDICATORS**

Dependent variable	R-sq.	DW	Fisher			Significant independent variables	Std. coef.	Student t-statistic		
			Coef.	Prob.	Crit.			Coef.	Prob.	Crit.
SCORPIO	0.480	1.573	11.176	0.006	4.750	LIBOR	0.694	3.343	0.006	2.179
						_cons	0.507[a]	1.552	0.147	
TORM	0.778	1.546	20.986	0.000	3.880	LIBOR	0.649	4.345	0.001	2.179
						SP500	0.386	2.587	0.024	
						_cons	-0.483[a]	-1.901	0.082	
INSW	0.917	2.213	27.603	0.002	5.790	INFLATION	0.599	3.590	0.016	2.571
						LIBOR	0.458	2.742	0.041	
						_cons	-0.129[a]	-0.774	0.474	
EURONAV	0.886	1.858	46.554	0.000	3.880	SP500	0.580	5.403	0.000	2.179
						EARNINGS	0.538	5.010	0.000	
						_cons	-0.700[a]	-2.703	0.019	
TEEKAY	0.576	1.692	9.510	0.002	3.740	EARNINGS	0.535	3.058	0.009	2.145
						SP500	0.488	2.791	0.014	
						_cons	-0.228[a]	-1.179	0.258	
FRONTLINE	0.672	2.021	23.566	0.000	3.420	EARNINGS	0.772	6.448	0.000	2.069
						SP500	0.339	2.830	0.009	
						_cons	-0.895[a]	-2.152	0.042	
NORDIC AMERICAN TANKERS	0.399	1.091	7.959	0.002	3.400	P_BRENT	0.544	3.437	0.002	2.064
						EARNINGS	0.339	2.140	0.043	
						_cons	-0.089[a]	-0.472	0.641	

[a]Unstandardized coefficients are used for constants.

Source: compiled by the authors on regression analysis performed in IBM SPSS Statistics.

Tab. 2 presents the statistical outcomes of the regression analysis, where insignificant variables were excluded, and statistically significant relationships between variables and market capitalization are highlighted.

For Scorpio Tankers, LIBOR was the only variable found to be statistically significant. The model is statistically valid, as evidenced by the F-statistic, t-statistic, and Durbin-Watson statistic values, and 48% of the variation in Scorpio's market capitalization can be attributed to changes in LIBOR.

To further investigate the relationship between Scorpio's market capitalization and LIBOR, the model was reconstructed using linear, quadratic, and cubic regression equations to determine which provided the best fit.

***TABLE 3.* MODELS SUMMARY OF SCORPIO TANKERS MARKET CAPITALIZATION ON LIBOR**

Equation	Model Summary					Parameter Estimates (Stand.)			
	R-squared	F	df1	df2	Sig.	Constant	β1	β2	β3
Linear	0.482	11.176	1	12	0.006	0.507	0.509		
Quadratic	0.491	5.295	2	11	0.025	0.691	0.277	0.043	
Cubic	0.596	4.925	3	10	0.024	2.043	-2.414	1.265	-0.143

Source: compiled by the authors on regression analysis performed in IBM SPSS Statistics.

The results indicate that the cubic equation provides the highest R-squared value, suggesting it is the most appropriate model for explaining the relationship:

$$\mathrm{SCORPIO\_MARCAP} = 2.043 - 2.141 * \mathrm{LIBOR} + 1.265 * \mathrm{LIBOR}^2 - 0.143 * \mathrm{LIBOR}^3 \quad (4)$$

This cubic equation explains 59.6% of the variation in Scorpio's market capitalization between 2010 and 2023 due to changes in LIBOR, with a 97.6% level of confidence. The F-statistic (4.925) exceeds the critical value (4.750) at the 5% significance level, with an actual significance level of 0.024.

Fig. 1 illustrates the comparison of linear, quadratic, and cubic models for Scorpio Tankers.

In summary, the relationship between Scorpio Tankers' stock market capitalization and LIBOR is best captured by a cubic function. Initially, as LIBOR increases from relatively low levels, Scorpio's market capitalization decreases. However, beyond a certain threshold (USD 1.024 billion), further increases in LIBOR lead to a rise in Scorpio's market capitalization, peaking around USD 5.1 billion. Practically, Scorpio's market capitalization has fluctuated between USD 0.15 billion and USD 3.31 billion over the observed period, having not reached USD 5 billion.

For TORM stock market capitalization, statistical significance was confirmed for both LIBOR and the S&P 500 index, with both variables exhibiting a positive impact on the dependent variable and explaining 77.8% of the variation in TORM's market capitalization over the examined period. The F-statistic (20.986) comfortably exceeds the critical threshold of 3.880 at a 5% significance level, with the actual significance level of F effectively being zero. The Durbin-Watson statistic (1.546) suggests that no autocorrelation is present. Both t-statistics exceed the critical value (2.179), with corresponding p-values below the specified level of significance.

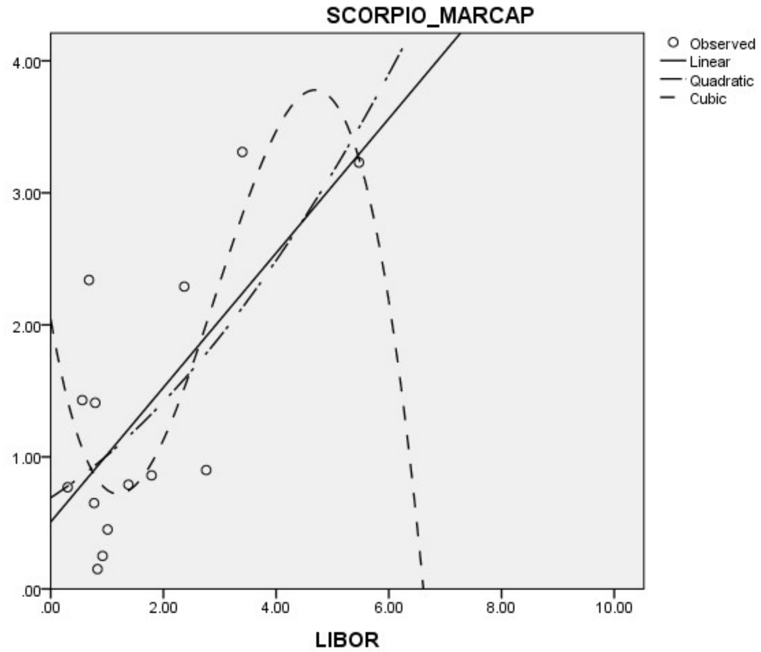

Fig. 1. Graphs of linear, quadratic, and cubic equations for the relationship between Scorpio Tankers' market capitalization and LIBOR

Source: compiled by the authors on regression analysis performed in IBM SPSS Statistics.

For International Seaways stock market capitalization, the regression analysis produced a similarly robust model, even more reliable for forecasting purposes. The high coefficient of determination (0.917) indicates that 91.7% of the variation in INSW's market capitalization can be attributed to changes in two macroeconomic indicators: inflation and LIBOR, both of which have a positive effect. However, it is important to note that the data for International Seaways' stock market performance covers only eight years (2016–2023), as the company only began trading on the stock exchange recently [27]. Despite this limitation, the model demonstrates a strong goodness of fit. The F-statistic (27.603) is nearly five times higher than the critical value (5.790), and both t-tests surpass the critical threshold (3.590 and 2.742 vs 2.571). The Durbin-Watson statistic (2.213) further indicates no autocorrelation in the sample.

An equally strong result was observed in the model for Euronav stock market capitalization, where both the S&P 500 index and freight rates proved statistically significant as independent variables, with a positive direction of impact. These variables explain 88.6% of the variation in Euronav's market capitalization, as indicated by the coefficient of determination (0.886). In addition to its high forecasting accuracy, the model exhibits strong adequacy, supported by the elevated F-statistic (46.554) with an effectively zero significance level, t-statistics more than twice the critical value for both variables (5.403 and 5.010 vs 2.179), and a Durbin-Watson score (1.858) within the range that suggests no autocorrelation.

While the coefficient of determination for Teekay stock market capitalization is lower than for Euronav (0.576), the models share similarities in terms of goodness of fit and significant factors. Both freight earnings and the S&P 500 index were found to positively influence Teekay's market capitalization, with respective t-statistics (3.058 and 2.791) surpassing the threshold (2.145), and p-values below the specified significance level. The F-statistic (9.510) exceeds the critical value (3.740) substantially, with the actual significance level well below 5%. The Durbin-Watson statistic (1.692) suggests no evidence of autocorrelation.

The regression model for Frontline produced similar results to those for Euronav and Teekay. However, Frontline has been publicly traded for a much longer period, starting in 1998. Changes in freight rates and the S&P 500 index, both of which positively influence market capitalization, account for 67.2% of the variation in Frontline's market capitalization. Both t-statistics (6.448 and 2.830) surpass the critical value (2.069), with insignificant p-values. The F-statistic (23.566) far exceeds the critical value (3.420), and the significance level is effectively zero. The Durbin-Watson statistic (2.021) indicates no autocorrelation in the sample.

Finally, Nordic American Tankers is the maritime transport enterprise with the smallest fleet among those selected for this study, though its stocks have been publicly traded since 1997. The regression analysis suggests that 39.9% of the variation in Nordic American Tankers' market capitalization can be explained by changes in two explanatory variables: the price of oil and freight rates. The respective t-statistics (3.437 and 2.140) exceed the critical value of 2.064, with p-values below 5%. The F-statistic (7.959) supports the model's adequacy, as it surpasses the critical value (3.400). However, the Durbin-Watson statistic (1.091) falls within the uncertainty region, indicating potential autocorrelation that cannot be entirely ruled out.

Findings and recommendations. *A. Oil tanker freight indices.* As opposed to recent research on dry bulk shipping, which identified LIBOR as the only variable impacting the Baltic Dry Index (BDI) [22], the modeling exercise in this study finds that LIBOR, S&P 500 index and volume of seaborne oil trade do not play a significant role in the oil tanker segment, while inflation does, positively affecting both the BDTI and BCTI. This result aligns with current economic theory, as shipping is a demand-derived industry highly dependent on the world economy. As Stopford notes, business cycles lay the foundation for freight cycles, and inflation typically influences various aspects of the economy, including the shipping sector [4].

What may seem counterintuitive at first is the negative impact of Brent oil prices on the BDTI and the similarly negative effect of global oil production on the BCTI. Both variables also exhibit a negative correlation with inflation (-0.26 for oil price and -0.52 for oil production). However, given the high positive Pearson's correlation coefficient between oil prices and global oil production (0.73), these observations may be explained by the same underlying logic, as apparently oil price fluctuations directly influence global oil production levels.

While oil prices and inflation are typically expected to move in tandem, the inverse relationship observed in this study is rather unusual. Prior to this, it has been documented in limited shipping research [7]. This observation can be attributed to several factors that are specific to the period under examination. For example, an increase in freight rates may lead to higher transportation costs for end consumers, prompting market participants to seek ways to mitigate these costs, which in turn could put downward pressure on commodity (oil) prices.

Conversely, if the oil price increases, it can incentivize the exploration and production of alternative sources like shale oil which becomes economically viable at certain price levels [28]. Since shale oil is primarily produced in the United States, the increased domestic production could reduce the need for long-haul oil transportation from overseas markets, such as from the Middle East to the U.S. The excessive supply in turn decreases demand for maritime transport services and puts downward pressure on freight rates for crude and refined oil transportation.

This dynamic helps explain why inflation could still positively impact oil tanker freight indices, even when oil prices show a negative relationship with freight rates. Inflation's broader economic effects, such as increased operational costs, supply chain disruptions, and growth in demand for shipping services, can contribute towards rising oil tanker freight rates, regardless of oil price trends.

The evidence suggests that, during the period under examination, inflation was likely driven by factors other than oil prices, such as monetary policy expansion, supply chain constraints, and increased global demand for goods and services. Recent research also confirms that uncertainty shocks in shipping costs have a considerable influence on inflation indicators, with their pass-through effect proving stronger than that of global or domestic shocks [29]. Supply chain disruptions, like the ones seen during the covid-19 pandemic, can raise freight demand as supply chains seek alternative routes or modes, while monetary policy expansion leads to increased liquidity in the economy, boosting trade activity and shipping demand.

Given the complex relationship between oil prices, inflation, and tanker freight indicators, oil tanker operators may benefit from diversifying their vessel portfolios and fleet operations to strike a reasonable balance between exposure to long-haul routes and shorter-haul routes. This could offer resilience against future market fluctuations. For policymakers, this paper underlines the complex interplay between oil prices, inflation, and tanker freight rates. Managing inflationary pressures, particularly in the maritime transport industry, requires a broader understanding of the impact of economic conditions beyond oil prices alone.

B. Oil tanker shipping companies marcap. Contrary to recent analysis of the dry bulk shipping segment, which produced the most credible models for companies with the highest market capitalizations [22], no such correlation exists between market capitalization and model robustness in the liquid bulk segment. The most robust model was constructed for International Seaways (INSW), the only U.S.-based company in the analysis. The market capitalization of INSW is explained by both inflation and LIBOR, making it the only company in the study where inflation plays a significant role.

LIBOR emerges as an explanatory variable in three models: INSW, Scorpio, and TORM. Notably, these three companies have the largest fleet sizes according to Clarksons SIN [2] and have only recently begun trading on the stock exchange, with listings from 8 to 16 years ago. Frontline, though also possessing a large fleet, is excluded from this grouping as its fleet is listed under the Fredriksen Group. Interestingly, Euronav, which went public in 2009, is unaffected by LIBOR, distinguishing it from the other major players.

Scorpio is solely influenced by LIBOR, while INSW is driven by both inflation and LIBOR. TORM, on the other hand, is impacted by both LIBOR and the S&P 500 index. Although the S&P 500 is mainly composed of IT, financial, and healthcare companies rather than maritime transport enterprises, oil tanker companies often depend on oil majors and the energy sector, which constitutes 3.3% of the S&P 500 [30]. This suggests that oil tanker companies may follow broader market trends, in line with the performance of large global firms.

Similarly to dry bulk shipping companies, where the S&P 500 index was significant for three out of five firms [22], the current analysis finds that stock market capitalization of four of the seven oil tanker companies are influenced by the S&P 500. In addition to TORM, three other companies — Euronav, Teekay, and Frontline — also exhibit a significant influence from the S&P 500 index. This could indicate that the longer a company is publicly listed, the more likely its market capitalization is to be influenced by broader market trends such as those reflected in the S&P 500.

For Euronav, Teekay, and Frontline, the impact of freight rates is also significant, with some variations. Euronav is more heavily influenced by the S&P 500 than freight rates, while for Teekay and Frontline, freight rates play a more substantial role. Nordic American Tankers' market capitalization is also influenced by freight indicators, which supports the assumption that smaller companies, in terms of fleet size, are more sensitive to freight rate fluctuations, with Frontline being an exception to this rule.

Nordic American Tankers is the only company in the analysis whose market capitalization is influenced by oil prices. This could be attributed to its smaller fleet size, as NAT operates the smallest fleet among the companies considered, and associated lack of diversification and fewer contracts with charterers.

One important general observation is that no clear commonalities or differences in influencing factors emerge based on the country of origin of the shipping companies. The firms in the analysis are based across Europe and North America — Scorpio, TORM, Euronav, Frontline, and Nordic American Tankers are headquartered in Europe, while International Seaways and Teekay are based in the United States and Canada, respectively. The fact that all companies are publicly listed in the U.S. emphasizes the international nature of the shipping industry, suggesting that marcap dynamics are less influenced by geographical origin and more by global market factors.

Shipping investors should be aware that for oil tanker companies, different factors such as LIBOR, the S&P 500, and oil prices influence their stock market capitalization. Depending on a company’s fleet size, its market capitalization could be more sensitive to freight rates or broader market trends, such as inflation. For instance, larger, well-established companies may respond more to global economic trends, while smaller companies are likely to be more reactive to sector-specific dynamics, such as oil prices or freight rates.

Companies could consider hedging against the potential negative effects of LIBOR changes and freight rate fluctuations by diversifying their revenue streams and adjusting their exposure to different types of routes and clients. This can mitigate stock market capitalization volatility and ensure more stable growth.

Conclusion. The modeling exercise based on structural market data analysis yields the following conclusions. In the oil tanker shipping segment, the indices used as proxies for freight rates (BDTI and BCTI) can be effectively modeled using similar variables, namely inflation and oil prices, with the latter being directly correlated with global oil production. While the positive relationship between inflation and freight rates aligns with prevailing economic theory, the negative impact of oil prices and global oil production on freight indices necessitates more nuanced explanations. On the one hand, rising freight rates may increase transportation costs, prompting market players to keep end-user prices stable to maintain competitiveness. On the other hand, an increase in oil prices, beyond a certain threshold, makes the exploitation of alternative oil sources such as shale oil economically viable. This, following the basic demand-supply framework, can lead to an oversupply, exerting downward pressure on transportation service costs and freight rates. Importantly, this phenomenon can occur even if inflation trends in the opposite direction of oil prices, as multiple factors beyond oil prices may drive or decline inflation.

These findings highlight the complex interplay between various economic forces and their impact on the tanker market. While oil prices remain a critical factor, inflation, broader economic cycles, and shifts in domestic production (e.g., U.S. shale oil) also significantly shape tanker freight rates. Diversifying fleet and operations portfolios may, therefore, be crucial for oil tanker shipping companies to mitigate these effects. Future research may focus on refining tanker freight rate models to minimize the risk of autocorrelation.

Regarding the modeling of oil tanker companies' stock market capitalization, five explanatory variables were analyzed, all of which showed significance at least once. Inflation impacted only INSW's market capitalization, the sole U.S.-based owner in the sample. The S&P 500 index affected four companies with a longer history of public listing. LIBOR was significant for the three companies operating larger fleets (INSW, Scorpio, and TORM), while companies with smaller fleets (Euronav, Teekay) appeared more sensitive to freight levels. The price of oil was found to significantly affect the market capitalization of Nordic American Tankers only.

This analysis reveals that the relationship between stock market capitalization and shipping industry is inconsistent across major companies, with no clear pattern based on country of origin. However, the direction of impact of macroeconomic factors remained consistent. Thus, while different macroeconomic indicators may influence individual companies, each shipping company is still significantly influenced by at least one economic variable. Consequently, shipping investors should, therefore, consider broader economic trends when evaluating potential investments in the sector.

Future research could extend this modeling exercise to additional companies, as well as incorporate a broader range of variables to potentially enhance the robustness of the models. By expanding the scope of analysis and refining the models, it may be possible to better capture the complex dynamics of the oil tanker shipping sector and improve the predictive power of the findings. In addition, this approach could be applied to other shipping segments for further exploration.

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