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Evaluating the efficacy of shipping pools : an empirical analysis of tanker and dry bulk segments

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EVALUATING THE EFFICACY OF SHIPPING POOLS

AN EMPIRICAL ANALYSIS OF TANKER AND DRY BULK SEGMENTS

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A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of Master of Science in Maritime Affairs

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Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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Abstract

Title of Dissertation: **Evaluating the Efficacy of Shipping Pools: An Empirical Analysis of Tanker and Dry Bulk Segments**

Degree: **Master of Science**

Shipping pools are a common form of horizontal collaboration, primarily in the bulk shipping sector, covering both wet and dry markets. They allow ship owners to enhance vessel performance and adapt more dynamically to market changes by participating in a collective pool. However, limited research exists that comprehensively examines shipping pools, quantifies their benefits using extensive voyage data, or investigates the causal relationships between their benefits and adoption. A deeper understanding of shipping pools is essential for ship owners to make informed participation decisions based on their characteristics.

This study has identified four key performance metrics, the ballast-voyage ratio, laid-up ratio, utilization ratio, and freight-surplus ratio, to assess and compare the performance of the pool and non-pool vessels. Handysize vessels for dry bulk and Aframax vessels for tankers were chosen as the subjects of this research. In the tanker category, statistically significant differences were found in the performance between pool and non-pool vessels across all metrics, except for the laid-up ratio. On the other hand, in the dry bulk category, no statistically significant variances were identified in the performance between pool and non-pool vessels across the evaluated metrics.

Aframax tanker vessels exhibited superior performance within shipping pools as opposed to non-pool vessels. Consequently, shipping firms of various sizes—from small to large—might opt to allocate a majority or a portion of their fleet to a tanker pool, contingent on their specific characteristics and strategic considerations. In contrast, when it comes to Handysize vessels in the dry bulk category, no statistically significant performance disparities were observed between the pool and non-pool vessels, indicating a lack of additional benefits for vessels participating in dry bulk shipping pools. While retaining relevance, dry bulk shipping pools may see hesitation from knowledgeable ship owners in participation, unless innovative strategies or components are introduced by the pool operators.

KEYWORDS: Shipping Pool, Horizontal Cooperation, Tanker, Dry bulk,

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List of Abbreviations

BIMCO	The Baltic and International Maritime Council
BSHI	Baltic Exchange Handysize Index
CoA	Contract of Affreightment
CoA	Contract of Affreightment
DWT	Deadweight Tonnag
EEOI	Energy Efficiency Operational Index
EPU	Economic Policy Uncertainty
GPR	Geopolitical Risk
LSP	Logistic Service Provider
M	Million
MT	Metric Ton
SPSS	Statistical Package for the Social Sciences
TC	Time Charter
USD	United States Dollars
VLCC	Very Large Crude Carriers
VRP	Vehicle Routing Problem
WS	Worldscale

Chapter 1: Introduction

1.1 Background of the Study

The shipping industry is characterized by high levels of volatility owing to its susceptibility to various shocks and its sensitivity to both long and short business cycles. The implementation of effective strategies is critical for shipping companies to optimize profits during periods of prosperity and ensure their survival during periods of adversity. Shipping pools are a type of horizontal collaboration between homogenous shipping companies as a strategic decision to enhance benefits. Shipping companies in the bulk shipping segment, which is a perfectly competitive market, often form shipping pools to minimize shocks during various market cycles.

While the business cycle is a common driver of volatility in the shipping market, this phenomenon is not exclusive to shipping. Howrey (1968) suggested that typical business cycles span three to five years, contrasting with the traditionally perceived seven-year duration of shipping cycles. However, Chistè and Van Vuuren's more recent research (2014) indicates that shipping cycles may actually align more closely with a four-year period. Despite these estimations, predicting shipping cycles remains exceptionally challenging due to their susceptibility to various forms of volatility, shocks, and geopolitical events, as outlined by Scarsi (2007).

The complexity of forecasting is further compounded by the fact that economic factors influencing shipping cycles can vary over different periods, as noted by Chistè and Van Vuuren (2014). This variability adds another layer of unpredictability. Moreover, Scarsi (2007) highlights that shipowners often resort to intuition or irrational decision-making, a behavior termed as "zero memory" by Zannetos (1966). This tendency complicates the analysis and understanding of shipping market trends and cycle predictions.

Due to the potential detrimental effects that the volatility mentioned above may inflict on a shipping company, its ability to comprehend the market and respond appropriately may determine its success or mere survival (Scarsi, 2007). In order to address market challenges, shipping companies may implement tactics that guarantee production factors that are economical and yield enhanced advantages (Cariou & Wolf, 2011). Cooperation is a highly prevalent market-facing strategy within the transportation industry. As stated by UNCTAD (2022, p. 138), the prevailing form of collaboration within the shipping industry is liner alliances. On the contrary, for bulk shipping segment, shipping pools have been recognized as the most prevalent form of collaboration (Clarksons, 2015, p. 33; Jarvenpaa, 2016).

Bulk shipping segment encompasses three major bulk cargo classifications: liquid bulks, major bulks, and minor bulks (Stopford, 2009, p. 422). Historically, both the wet and dry bulk markets have been regarded as highly competitive, with limited influence of individual shipowners (Papachristidis and Papachristidis, 2015, p. 269). Therefore, the most viable strategy for shipowners is to increase efficiency via adoption. The shipowner's selection of an appropriate response strategy to market challenges is of the utmost importance.

1.2 Problem Statement and Significance of the Study

Tramp or bulk shipping, as identified by Stopford (2009, p. 99), is regarded as one of the most speculative markets within the realm of various business sectors. Shipping pools have emerged as a popular strategy in the bulk shipping industry, with the goal of encouraging cooperation and maximizing benefits. There are a significant number of tanker pools, whereas the presence of dry bulk pools is comparatively limited. Furthermore, each shipowner's characteristics differ in terms of purpose, nature, size, origin, and expertise, among other things. From the perspective of a ship owner, it is critical to have a thorough understanding of the specific factors that serve as key determinants of benefits. This knowledge is critical in making strategic decisions that allow the ship owner to assess the appropriateness of a given course of action.

Building on the nuanced understanding of shipping industry dynamics, the exploration of horizontal cooperation within the industry remains relatively nascent, as illuminated by Schmoltzi & Marcus Wallenburg (2011). Although there has been some research on liner alliances, there has been little research on shipping pools (Wen et al., 2018). Moreover, the author is aware of no research that uses vessel voyage data to empirically pinpoint the measurable factors for pooling benefits and analyzing the relationships in a holistic manner. In order to make strategic decisions for commercial operations, it is critical for a shipowner to understand the actual parameters of benefits and how they are impacted when they enter a shipping pool. This study examines the relationship between vessel key performance parameters and shipping pool participation using empirical data.

1.3 Aims and Objectives of the Study

The following are the aims and objectives of the research:

- To delineate the distinctive characteristics of shipping pools within the bulk (tanker and dry bulk) shipping market comprehensively.
- To identify the variables essential for evaluating the commercial and operational advantages of vessels operating within a pool arrangement.
- To conduct an empirical investigation to ascertain whether vessels within a shipping pool exhibit distinguishable differences compared to those operating independently.
- To explore the possible relationships between commercial and operational benefits, focusing specifically on assessing whether vessels in shipping pools manifest enhanced efficiency relative to independently operated vessels.

1.4 Research Questions

In accordance with the research's aims and objectives, the study attempted to answer the following questions:

- Which measurable indicators are effective in evaluating the commercial and operational benefits of participation in shipping pools?
- Is there a difference in commercial and operational efficiency between ships operated by shipping pools and those operated independently?
- How does participation in a shipping pool influence the commercial and operational performance parameters of a ship?

1.5 Scope of the study

This study aims to comprehensively understand the concept and benefits of shipping pools by deeply exploring their fundamental characteristics and identifying the specific types of cooperation they entail. Initially, the study intends to employ qualitative analysis to uncover the quantitative aspects influencing the commercial and operational effectiveness of vessels participating in shipping pools. Subsequently, the focus will narrow down to quantitatively measuring and analyzing selected performance indicators, utilizing accessible secondary data.

For dry bulk and tanker vessels, specific sizes have been selected: Handysize (30k - 40k DWT) and Aframax (85k - 120k DWT), respectively. These sizes were chosen due to the abundance of information available regarding pool operators and their closer proximity to perfect competition market structures. Given the high substitution levels among various ship types within the shipping market (Stopford, 2009, p. 153), studying a specific category within broader segments like dry bulks and tankers can provide a representative understanding of these segments as a whole.

1.6 Summary of the Findings

Four key performance metrics were selected to evaluate both pool and non-pool vessels: the ballast-voyage ratio, laid-up ratio, utilization ratio, and freight-surplus ratio. This selection was grounded in a qualitative analysis of the existing literature, ensuring a comprehensive assessment of vessel performance.

In the dry bulk sector, the analysis unveils no statistically significant distinctions between vessels operating in pools and those operating independently across the examined variables. However, in the tanker segment, clear disparities are apparent, with pool vessels exhibiting statistically significant variations in the ballast-voyage ratio, utilization ratio, and fixture-surplus ratio. Interestingly, such differences were not observed in the laid-up ratio.

Expanding on the above findings, a focused investigation into the tanker sector uncovers distinct relationships. The pool vessel group, serving as the independent variable, demonstrates a negative correlation with several dependent variables, namely the ballast-voyage ratio, laid-up ratio, and utilization ratio. Conversely, a positive correlation is evident with the freight-surplus ratio. Notably, all these relationships, with the exception of the laid-up ratio, are statistically significant.

Focusing on the dry bulk sector, a different pattern emerges. Negative correlations are noted in the ballast-laden ratio, while the laid-up and fixture-surplus ratios show positive correlations in relation to pool participation. It's noteworthy that, unlike in the tanker sector, these correlations did not achieve statistical significance, marking a distinct variation in the comparative analysis.

1.7 Organization of the Study

Chapter 1 lays the foundation, introducing the research with a clear presentation of background, problem statement, objectives, research questions and a summary of key findings.

Chapter 2 navigates through prior literature, focusing on horizontal cooperation, the intrinsic characteristics of the shipping industry, and detailed insights into shipping pools.

Chapter 3 outlines the research's methodological approach, detailing the variables and statistical analyses used, grounded in a framework constructed from existing literature.

Chapter 4 presents the study’s crucial findings, highlighting correlations, descriptive statistics, and results from independent t-tests and fixed effect (regression) analyses.

Chapter 5 offers a thoughtful analysis of results, exploring implications and formulating practical recommendations based on comprehensive examination.

Chapter 6 concludes the paper, capturing the essence of the research journey and acknowledging the study's limitations, marking the end of this academic exploration.

Chapter 2 Conceptual Discourse and Literature Review

This research delves into the study of shipping pools, a collaborative strategy among participants. Specifically, it embodies horizontal cooperation among its members. Consequently, this chapter of the literature review will initially introduce the concepts of collaboration and horizontal cooperation. Subsequently, a discussion on the nature of the shipping market, inclusive of its diverse types like liner and tramp, will be undertaken. An in-depth exploration of the bulk shipping market will follow, aiming to unveil why it's imperative to study collaborative opportunities in this sector. Post discussion on shipping pools, a research gap will be discerned.

2.1 Collaboration

Terms such as collaboration, cooperation, and alliances are interchangeably utilized, embodying strategies to enhance the efficiency of transportation companies. For instance, Bailey et al. (2011) illustrated that incorporating pick-up tasks in return routing notably augments operational efficiency. Collaboration exists in multifaceted levels, ranging from arm-length interactions to partnerships, each embodying various depths of cooperative engagement (Naesens et al., 2007). Various structures in collaboration have been identified, such as vertical, horizontal, and lateral forms (Simatupang and Sridharan, 2002). Vertical collaboration flourishes between parties with complementary roles, like manufacturers and distributors. Horizontal collaboration, on the other hand, emerges between entities engaged in analogous activities, such as merging distribution centers. Lateral collaboration integrates both vertical and horizontal aspects, fostering a unique enhancement in flexibility (Simatupang and Sridharan, 2002).

2.2 Horizontal Cooperation

While there is a wealth of research on vertical cooperation, studies on horizontal cooperation are still emerging (Schmoltzi & Marcus Wallenburg, 2011). Defined by the European Union (2001) as "concerted practices between companies operating at the same level(s) in the market," horizontal cooperation encompasses various practices, such as cooperation, collaboration, alliances, and partnership, all contributing to the formulation of horizontal links in supply chains (Cruijssen et al., 2007a).

Following the exploration of horizontal cooperation's foundational concepts, it's crucial to acknowledge its variability in scope and intensity. Distinguished by their organizational structures, horizontal collaborations can either be decentralized or centralized, each with a different level of information accessibility by central authorities (Gansterer & Hartl, 2018). Further categorizations have been proposed, such as alliances being divided into strategic, operational, and management categories, according to Chen et al. (2022). Illustrating these variations, Cruijssen et al. (2007a) devised a framework, as depicted in Figure 1, which comprehensively outlines the various facets of horizontal cooperation.

Figure 1

Types of Horizontal Cooperation

Note. This figure is a modified version of the dimensions of horizontal cooperation based on Cruijssen et al. (2007a)

Continuing from the varied forms of alliances, Cruijssen et al. (2007a) categorize horizontal cooperation based on integration, centralization, and scope as illustrated in Figure 1. Here, Type I partners focus on activity coordination; Type II extends to business planning integration; while Type III delves deeper, integrating operations substantially. Notably, the far-right horizontal integration isn't deemed genuine horizontal cooperation by Cruijssen et al. (2007a). In this spectrum, shipping pools align with Type III, representing a strategic alliance with the highest level of interconnectedness.

2.2.1 Drivers of Horizontal Collaboration

Vertical collaboration in supply chains augments visibility but lacks in bolstering flexibility and sustainability, necessitating modern practices like resource pooling and asset sharing intrinsic to horizontal collaboration (Ben Jouida et al., 2017). Amidst a backdrop of stringent competition, shrinking profit margins, and escalating customer anticipations (Krajewska et al., 2008; Ruijgrok, 2003), innovative strategies such as horizontal logistics cooperation have surfaced as essential survival tactics, especially for small and medium-sized enterprises (SMEs). These collaborative efforts are instrumental in navigating the complexities of the competitive landscape, enhancing operational efficacy, asset utilization, and customer satisfaction (Lee & Song, 2015; Schmoltzi & Marcus Wallenburg, 2011). To systematically harness the benefits of such collaborations, Schmoltzi and Marcus Wallenburg (2011) devised a framework, delineated in Table 1, encapsulating six dimensions and eight factors pivotal for optimizing the potential advantages of horizontal cooperation in logistics.

Table 1
Dimensions and Corresponding Factors of Horizontal Cooperation

Dimensions	Factors
Agreement type	Formality
Organizational scope	Number of companies
Functional scope	Area of cooperation
Geographical scope	Product Complexity
Service scope	
Resource scope	Complementarity
	Importance of the region
	Company size
	Social structure

Note. The table is based on Schmoltzi and Marcus Wallenburg (2011)

Building on the prior discussion, Cruijssen et al. (2007b) articulate that Logistics Service Providers (LSPs) leverage horizontal collaboration for enhancing productivity, diversifying service portfolios, and mitigating operational expenses. Collaboration is not merely a cost-curbing strategy but also a potent tool for elevating service caliber and fortifying market stature. Studies underscore that such symbiotic alliances can markedly slash costs—evidenced by diminished empty return voyages and cost savings ranging from 5 to 30% across various sectors (Adenso-Díaz et al., 2014; Gansterer & Hartl, 2018; Frisk et al., 2010). Ben Jouida et al. (2017) further corroborate this, illustrating that collaborative entities often outperform their non-collaborative counterparts in profitability. Importantly, the merits of collaboration transcend monetary gains, fostering broader ecological benefits, such as curtailed emission levels. Figure 2 succinctly encapsulates the manifold advantages accruing from horizontal cooperation.

Figure 2
Benefits of Horizontal Cooperation

Note. The figure depicts a list of potential benefits of horizontal cooperation based on Cruijssen et al. (2007b)

Continuing the exploration of horizontal cooperation's advantages, pivotal opportunities have been identified that predominantly catalyze transformative impacts within the transport sector. Essential drivers include the promise of diminished operational costs and the fostering of specialized expertise. Such cooperative synergies also pave the way for engaging in bids for substantial contracts, bolstering the potential for elevated service quality and fortifying market presence and share (Cruijssen et al., 2007b). These collectively comprise the vital forces propelling transformative advancements and sustainable competitiveness within the realm of transportation.

2.2.2 Challenges of Horizontal Cooperation

Horizontal cooperation's success trajectory seems to be a diverse landscape across various industries. Research unveils a spectrum of success rates, with failure rates oscillating between a modest 20% to a staggering 50-70% (Schmoltzi & Marcus Wallenburg, 2011; Park and Ungson, 2001; Kale et al., 2002). However, a resurgence of stability has been observed in more contemporary studies, particularly within the domain of Logistics Service Providers (LSP) cooperation. Central issues impeding fruitful cooperation chiefly revolve around equitable allocation and the establishment of a central authority imbued with trustworthiness (Cruijssen et al., 2007b). This underscores the necessity for companies to meticulously calibrate their decision-making processes, ensuring that the strategic alignment of horizontal cooperation resonates harmoniously with their intrinsic organizational attributes (Naesens et al., 2007).

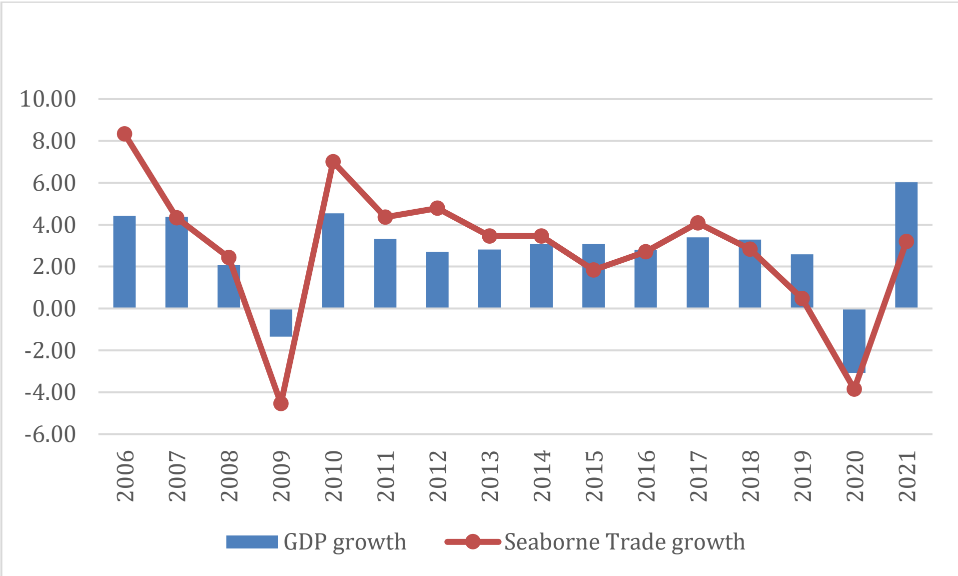
2.3 The Shipping Industry and Collaboration

2.3.1 Nature of the Shipping Industry

The demand for shipping services is derived from economic activities and is contingent upon the state of the global economy. Because of its exposure to international events, the shipping industry is susceptible to global economic volatility and shocks. As shown in Figure 3, it can be seen that seaborne trade is highly correlated with the growth rate of world GDP.

Figure 3

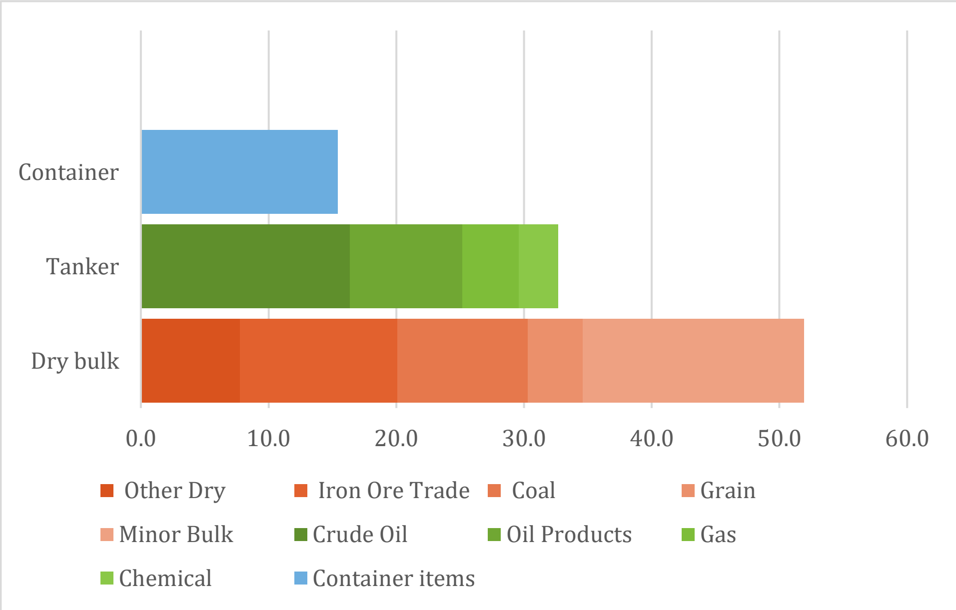
GDP growth and Maritime trade growth (in %)



Note. Global GDP growth data is collected from WorldBank (2023) and Global Maritime Trade data is collected from UNCTAD (2023)

Diving deeper into the shipping industry's intricacies, a multitude of commodities embarks on global maritime journeys. A spectrum of goods, from raw materials to finished products, contributes to the vast and varied cargo types navigating our oceans. Figure 4 visually encapsulates this diversity, offering an organized categorization of the numerous cargo types integral to the global maritime trade network. This categorization further elucidates the extensive and multifaceted nature of sea transportation, underscoring the industry's vast scope and significant role in global commerce.

Figure 4
Seaborne Trade of Various Cargo Types (in %)

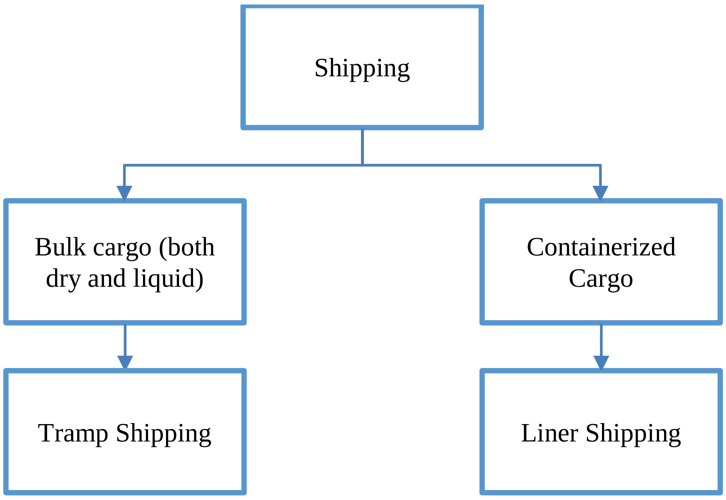


Note. Categories defined by the author. Data source: Clarksons (2023c). Data period: 2022. Presented in the percentage of total seaborne trade.

Following the depiction of various cargo types in Figure 4, a further breakdown of cargo transportation is essential for a nuanced understanding. In alignment with Clarkson's (2015) classification, three distinct categories surface. Bulk shipping dominates, primarily handling expansive, homogeneous cargoes with specialized vessels such as bulk carriers and oil tankers. Specialized shipping emerges next, catering to unique trades like chemicals and vehicles, often intertwining with bulk shipping paradigms. Lastly, liner shipping focuses on smaller, diverse cargo parcels, commonly utilizing containerships. This structured classification underscores the diversity and specialization inherent in maritime cargo transportation.

Following the categorization of cargoes, Figure 5 further clarify the operational differences in shipping types. Liner services offer predetermined routes and schedules, whereas tramp ships provide more adaptable options based on charterer requirements (Fayle, 1932).

Figure 5
Segments of the shipping market



Note. Categorization by Author based on Clarkson (2015) & UNCTAD (2022)

2.3.2 Collaboration in Liner Shipping

Maritime logistics studies have traditionally focused more on liner shipping, overshadowing dry bulk and tanker shipping (Panayides & Song, 2013). Economic globalization has propelled a monumental expansion in fleet sizes, particularly evident in the liner services characterized by their relatively static freight rates, routes, and ports of call. While there's a plethora of literature available on liner alliances, a gap exists in systematic and comprehensive analyses (Chen et al., 2022). The industry has undergone substantial consolidation between 1996 and 2022, marked by the top 20 carriers amplifying their total capacity share from 48% to 91% (UNCTAD, 2022). This evolution has given rise to varied alliance types, including slot chartering and joint fleet vessel pools, reflecting the industry's adaptive strategies (Chen et al., 2022).

2.3.3 Collaboration in Tramp Shipping

Tramp shipping, distinct from liner shipping, operates on a "one ship one cargo" model and is a key player in the highly competitive global market, primarily handling bulk and specialized cargoes (Ma, 2021, p. 169). In a transformative phase during the 1990s, major cargo shippers like oil majors recalibrated their fleets due to increased liability concerns and diminished financial returns (Clarkson, 2015, p. 5). Tramp shipping's economic landscape resembles near-perfect competition, enriched by a vast network of shipbrokers and agents. Its revenue, marked by considerable volatility, sees freight rates demonstrating fluctuations almost twice as vigorous as the S&P 500 index (Clarkson, 2015, p. 6). In terms of cargo, while larger parcels typically navigate through tramp shipping channels, liner shipping mostly accommodates smaller parcels. However, there are intersections in their operational realms, with cargoes like forest products being a notable example where both modes are utilized.

In alignment with the unpredictable nature of the shipping market discussed earlier, both shipowners and cargo shippers continuously grapple with substantial risks (Clarksons, 2015, p. 6). Various mitigating strategies have been adopted, such as vessel ownership, albeit less common now, and diverse chartering methods, including time, spot/voyage, and affreightment contracts. Time chartering, particularly, allows companies to secure tonnage long-term, providing a semblance of stability. Spot chartering, with its flexibility in price negotiations and specific voyage considerations, also plays a pivotal role. Moreover, the strategic establishment of long-term agreements, facilitated by competent agents, acts as a conduit for fostering resilient and sustainable partnerships between shippers and proficient shipowners.

Table 2 categorizes various strategic alliances in tramp shipping, underscoring the versatility of collaborations in the sector (Clarkson, 2015, p.32). Among these, the shipping pool emerges as a prominent model. It uniquely favors shipowners by obviating the need for additional capital and offering immunity against certain competitive legal challenges. This model exemplifies a pragmatic approach in navigating the tumultuous waters of the maritime industry, signifying its marked preference among strategic alternatives.

Table 2
Various Types of Cooperation in Tramp Shipping

	Joint Venture/Consortia	Pool	Space Charter Arrangement
Capital Investment	Yes		
Marketing & customer awareness	Yes	Yes	
Chartering Efficiency	Yes	Yes	Yes
Arranging Cargo contracts (COA)	Yes	Yes	
Logistics & vessel productivity	Yes	Yes	Yes
Operating Cost Efficiency	Yes	Yes	Yes
Administrative cost efficiency	Yes	Yes	
Training	Yes		

Note. Source (Clarkson, 2015, p. 32)

From the previous discussions, it's clear that the shipping market is fiercely competitive, with shipowners facing disparate bargaining powers due to significant fragmentation. In navigating this landscape, the shipping pool emerges as a notably beneficial strategy for alliances, providing a consolidated approach to counterbalance the prevailing disparities and enhance the bargaining prowess of shipowners.

2.4 Shipping Pool

As previously highlighted, shipping pools are predominant in the tramp shipping industry, yet publications on this topic remain scant (Wen et al., 2018). A pivotal reference is William V. Packard's "Shipping Pool" (1995), lauded with the BIMCO prize, which presents an intricate exploration of shipping pools. Packard (1995, p. 3-5) elucidates that these are conglomerations of similar vessels from various owners, unified under a singular administration to optimize chartering and commercial endeavors. The resulting profits are apportioned through a fair-weighted system, enhancing the management efficacy and income of the vessels (Packard, 1995, p. 5). Packard's book meticulously unravels the complexities of shipping pools, highlighting their efficacy in managing commercial activities to enhance vessel income, a feat challenging for individually operated small fleets. It dissects prevalent criticisms such as 'market identity' concerns, portraying them as largely sentimental reservations. Packard (1995) also insightfully navigates the realms of equity finance, validating the adaptability of pool memberships in fulfilling equity investor's necessities. The book serves as a comprehensive guide, encompassing core elements from the pool's structural frameworks to varied contract formats. Moreover, Packard proffers profound insights, enriching the discourse with detailed explorations of aspects like weight allocations, distribution methodologies, and nuanced operational and promotional strategies.

Building on Packard's foundational insights, Haralambides (1996) in his publication, "Economics Of Bulk Shipping Pools," enriches the discourse by blending executive interviews with meticulous market analysis and personal expertise. Haralambides (1996) probes the intrinsic motives steering entities toward the establishment or integration into bulk shipping pools, discerning a conglomerate of motivators such as Contract of Affreightment (CoA), enhanced fleet scheduling, market fortification, risk diversification, and the realization of scale economies.

Central to Haralambides' (1996) exposition is the adaptation of pools to modern shipping imperatives, particularly catering to industrial conglomerates requiring consistent, large-scale cargo movements. Small to medium shipowners find solace in pools, as independent competition for such extensive contracts might prove formidable. Haralambides (1996) clarifies that the genesis of pool alliances doesn't predominantly stem from scale economies due to the inherent capital and operational financial commitments borne by owners.

Haralambides (1996) elucidates the consequential economies of scope yielded by pooling, highlighting benefits like increased load factors, reduced idle times, and fewer ballast legs. He accentuates the global presence achieved through pooling, enhancing organizational profiles, and improving information access via extensive broker and agent networks. Haralambides (1996) navigates through the operational terrains of pools, providing deep insights into their structures, management, and innovative earnings distribution approaches, concluding with a thoughtful exploration of the pools' alignment with competitive legal standards.

Wang (2010) explored the dynamics of strategic cooperation in bulk shipping pools, scrutinizing their rationale and performance across various market segments. The study was insightful, employing a comprehensive approach that compared current evaluations with a historical 1974 list compiled by Drewry Consultant Co. Wang's discussion extended to produce a detailed enumeration of shipping pools, capturing their presence and impact across different market segments at the time, providing a nuanced understanding of their strategic positioning and functionality within the maritime landscape.

Papachristidis and Papachristidis (2015) examined the motivations behind pooling in the shipping industry, pinpointing increased bargaining power and profitability as primary drivers. The study observes that in the highly competitive wet and dry bulk shipping markets, there exists a bargaining imbalance favoring charterers like oil majors and major commodity producers over traditionally small, private ship owners. This disparity has spurred ship owners towards financial, operational, and commercial consolidation, giving rise to large, publicly traded fleets, expanding ship management companies, and the emergence of shipping pools.

The core aim of shipping pools, as highlighted by the authors, is to bolster commercial efficiency and negotiation leverage. The study underscores benefits of pooling such as enhanced visibility, reliability, and deployment efficiency, along with increased earnings, diminished earnings volatility, improved cash flows, and diversified risks. Furthermore, the paper provides insights into common pool structures, allocation systems, and various commercial strategies, including contract types and cash flow considerations.

Wen et al. (2018) conducted a study focusing on a Danish product tanker pool, exploring strategies for overcoming operational challenges, maximizing profits, and ensuring fair profit allocations. They utilized dynamic ship routing, speed optimization, and cooperative game theory to achieve these objectives, and additionally assessed the influence of pool size on profit and vessel utilization.

Järvenpää (2016) delved into analyzing prevailing distribution strategies in shipping pools. He introduced the Energy Efficiency Operational Index (EEOI) as a pivotal metric, suggesting its integration into distribution schemes, and supported this proposal with operational data from five VLCC carriers.

Konstantinos (2015) employed the OLS method, utilizing stock market data from eight tanker shipping companies, to discern whether membership in a pool conferred competitive advantages. He found that the available evidence did not conclusively prove that pool members reap more significant benefits compared to independent operators.

Contrasting trends were noted by Lloydslist, highlighting that dry bulk shipping pools were at a consolidation spectrum's lower end relative to tankers and liners. The report indicates a higher consolidation level in LPG and tankers compared to dry bulk (Lowry, 2015).

On the legal front, Woolich (2015) clarified the competitive implications of shipping pools within EU regulations. He categorized them as either mergers or cooperative arrangements that are short of mergers, explaining that cooperative arrangements do not typically raise competition law concerns, thereby making pooling a potentially favorable strategy for ship owners.

2.5 Research Gap and the Contribution of this Research

The existing literature on "shipping pool" is somewhat limited and primarily qualitative, lacking a comprehensive empirical approach to the concept. Early works such as Packard's (1995) focused on the theoretical existence of shipping pools, while subsequent studies like Haralambides (1996) and Wang (2010) offered qualitative insights into the activities, benefits, rationale, and evaluation of shipping pools. More recent research, like those by Wen et al. (2018), Jarvenpaa (2016), and Konstantinos (2015), have started to delve into more specific and empirical aspects, exploring profit maximization strategies, distribution metrics, and comparative advantages within the shipping pool framework.

Given that shipping pools represent a prevalent form of cooperation in tramp shipping, enabling ship owners to adeptly navigate market changes, there's a pressing need for empirically grounded insights. This is essential for ship owners to make informed decisions regarding the integration of their vessels into pools aligning with their unique characteristics.

This study aims to fortify the existing body of knowledge by empirically evaluating the tangible benefits of bulk shipping pools. It seeks to unravel the causal relationships between vessel participation in shipping pools and the ensuing benefits. The objective is to furnish ship owners with a holistic understanding, aiding in strategic decision-making processes, and concurrently enriching academic discourse by bridging existing research gaps, thereby paving pathways for future explorations in this specialized domain.

Chapter 3 Method and Data

3.1 Research Methods

This research empirically investigates the advantages ships gain from operating within a pool arrangement. Initially, the research will focus on identifying the essential criteria required for evaluating the advantages of such an arrangement. A qualitative approach will be adopted, utilizing pre-existing literature along with official data sourced from tramp shipping companies and pool operators, to establish a robust basis for assessment.

Upon establishing the crucial parameters necessary for evaluating vessel efficiency within a pool arrangement, the next step involves categorizing or grouping ships based on these identified parameters, adhering to industry conventions and practices.

Following the systematic organization and classification of the collected data, the study will employ quantitative methods to discern the empirical advantages experienced by ships operating within various categories of pool arrangements. In its final stages, the study will meticulously analyze the gathered findings, culminating in a thoughtful presentation of recommendations and conclusive insights.

3.2 Criteria for Vessel Selection

The objective of this research, considering the constrained timeframe, is to simplistically and empirically discern the differences between pool and non-pool vessels. Selection criteria for the vessels included in this study depended on the availability of data, primarily focusing on categories where vessel specifications minimally impact business performance.

Decisions regarding the hiring of specific vessel types are influenced by various factors, such as the type and size of the commodity parcel and the designated loading and discharging routes (Alizadeh & Nomikos, 2009). Existing research that delves into the myriad factors influencing freight rates, particularly those associated with specific vessel characteristics, is quite limited. Most studies tend to gravitate towards investigating the impact of macroeconomic variables, analyzed through time series, on freight rates.

As per Alizadeh and Taley (2011a, 2011b), crucial determinants influencing freight rates encompass aspects like the vessel's deadweight, age, and its operational routes, which remain core focal points of this research.

Vessel Category and Age: In the realm of dry bulk shipping pools, particularly in the Panamax and Kamsarmax dry bulk segments, there is a notable scarcity (Lowry, 2015). A comprehensive search across various databases and official websites reveals a limited presence of dry bulk pool operators, with a more pronounced availability of information pertaining to Handysize shipping pools.

Handymax and Handysize vessels typically operate under similar trading patterns. These vessels predominantly engage in the transportation of grain commodities from regions such as North and South America and Australia to destinations in Europe and Asia. They also handle the global distribution of various minor dry-bulk commodities, including but not limited to bauxite, alumina, fertilizers, rice sugar, steel, and scrap (Alizadeh and Nomikos, 2009, p. 32).

To maintain consistency and limit variations within the study, vessels with a deadweight tonnage (DWT) ranging from 30,000 to 40,000 are classified as Handysize for the purposes of this research. This classification approach aims to cultivate a more streamlined and focused examination of the vessels and their operational dynamics within the shipping pools.

Similarly, for tanker, the Aframax vessels were chosen for this study due to the richer availability of pooled vessel data within the Aframax segment, a category that holds a middle ground in the tanker vessel hierarchy. Predominantly, Aframax vessels are engaged in transporting crude oil, with occasional involvement in carrying other oil products (Alizadeh & Nomikos, 2009, pp. 34–35). Their major operational routes encompass journeys from West Africa and the North Sea to the east coast of the United States, as well as from North Africa and the Black Sea to the Mediterranean and northern Europe and from the Persian Gulf to the Far East (Alizadeh & Nomikos, 2009, p. 35).

Furthermore, Gültekin et al. (2021) observed minimal impact of aging on the commercial valuation of dry bulk vessels. This was corroborated by Tamvakis and Thanopoulous (2000), who noted a consistent pattern in freight rates for dry bulk ships, irrespective of vessel age. A similar trend regarding the insignificance of age on freight rates was seen in the Aframax segment (Alizadeh & Talley, 2011a). With the uncertainties such as technological changes and evolving regulations in both wet and dry bulk sectors, there has been an increase in the average age of vessels over time (UNCTAD, 2022, p. xix). Accordingly, this study includes vessels of all ages that meet the specified criteria, aiming for a thorough analysis.

Routes: The relationship between a vessel's size and the type of commodity it transports is closely intertwined. Vessels of certain classifications are typically employed to transport specific commodity types along defined routes (Alizadeh & Nomikos, 2009, p. 29). Sahoo et al. (2009) further elucidate this, noting the existence of fixed routing patterns in tramp services.

For the scope of this research, which encompasses the duration of one full year in 2022, specific criteria have been meticulously established for the selection of non-pool vessels. The chosen vessels are those that have made at least one journey to a particular load-discharge zone, which aligns with the operational routes of vessels within a pool arrangement. This selective approach ensures that the non-pool vessels integrated into the study are operating within comparable routes, allowing for a precise and coherent comparison throughout this annual research period.

Guided by these analytical considerations, vessel categories were meticulously selected for inclusion in the research, as detailed in Table 3.

Table 3 Vessel's criteria for the study

Vessel Type	Vessel category	DWT	Age	Route	Time period
Dry bulk	Handysize	30,000-40,000	Any	At least one common load-discharge zone between a pool and a non-pool vessel within the given time period	From 01-Jan-2022 to 31-Dec-2022
Tanker	Aframax	85,000-119,999	Any		

Note. The load and discharge zones are based on the voyage data provided by AXSmarine (2023)

3.3 Performance Metrics

In the existing body of literature, a substantial focus has been placed on the macroeconomic factors associated with shipping, leaving the microeconomic aspects relatively unexplored (Alizadeh & Talley, 2011a, 2011b). The optimization of seaborne transportation performance is influenced by a delicate balance between incurred expenses and generated income (Rusu, 2015). A pivotal role in cost reduction strategies within maritime logistics has been played by service rationalization, the enhancement of route networks, and the leveraging of economies of scale (Panayides & Song, 2013). Freight, being a primary revenue source, is crucial in the determination of a vessel owner's earnings. A selection of four pivotal variables has been made, based on a comprehensive review of pertinent literature and the feasibility of empirical investigation, to elucidate their influence on either boosting revenue or mitigating costs. A detailed examination has been conducted, considering the vessel group as the independent variable, to uncover the causal relationships that predominantly influence the microeconomic performance metrics in shipping.

Vessel Group: In this study, the vessel group is identified as a categorical variable and used as an independent variable in the research. During regression analysis, it is operationalized as a dummy variable, assigning ‘1’ to pool vessels and ‘0’ to non-pool vessels.

V_g= Vessel group (pool/non-pool) *Eq 3.1*

V_p= 1 *Eq 3.2*

V_{np}= 0 *Eq 3.3*

Where,

V_p = vessel group for pool
V_{np} = vessel group for non-pool

Ballast Voyage Ratio: In the transportation industry, similarities such as the significance of backhaul efficiency are prevalent. Crucial to transportation efficiency is the minimization of empty backhaul trips, which can be enhanced through strategic collaboration (Bailey et al., 2011; Ergun et al., 2007). Specifically in shipping, a 'ballast voyage' refers to a ship's journey without cargo, often undertaken to transition between ports for cargo loading. Unlike typical backhauls, ballast voyages are exclusive to journeys without any cargo.

Elevating operational efficiency, this metric is instrumental in driving commercial gains. By reducing the frequency of ballast voyages, a notable improvement in ship performance is observed, coupled with significant cost reductions. An efficient vessel deployment strategy is quintessential for minimizing ballast voyages, making the ballast voyage ratio an indispensable parameter for evaluating the operational prowess and associated commercial benefits of various vessels.

$$B_{db} = \frac{D_{b\_db}}{D_{l\_db}}$$ *Eq 3.4*

Where,

B_{db}= Ballast-voyage ratio for a given dry bulk vessel

D_{b_db} = distance of total ballast voyages during the period for a given dry bulk vessel

D_{l_db} = distance of total laden voyages during the period for given dry bulk vessel

$$B_t = \frac{D_{b\_t}}{D_{l\_t}} \quad \textit{Eq 3.5}$$

Where,

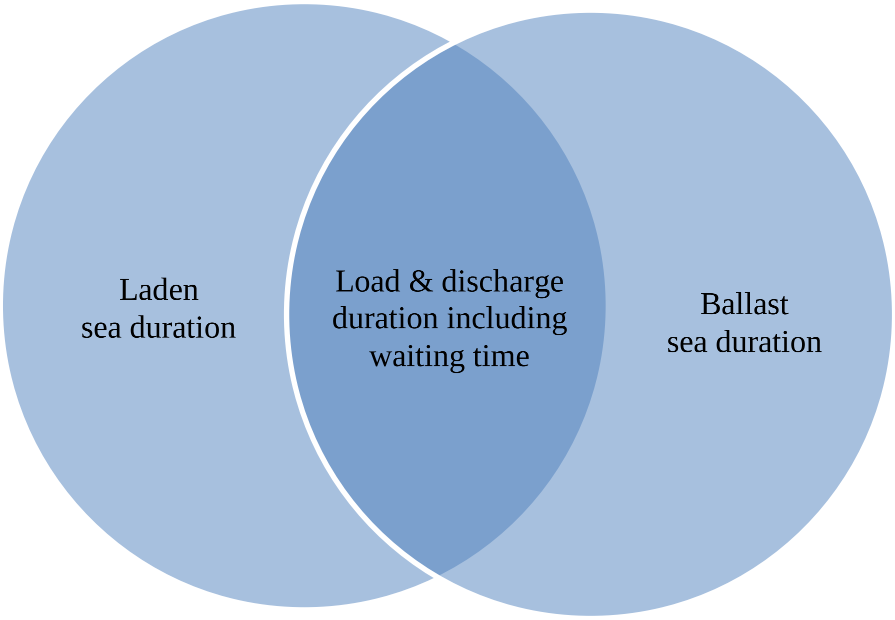
B_t= Backhaul ratio for a given tanker vessel

D_{b_t} = distance of total ballast voyages during the period for a given tanker vessel

D_{l_t} = distance of total laden voyages during the period for a given tanker vessel

Laid-up Ratio: The laid-up ratio is a pivotal metric in assessing a vessel's commercial efficiency, reflective of strategic operational pauses by ship owners during revenue dips below certain thresholds (Mossin, 1968; Stopford, 2009, p. 165). In response to short-term market fluctuations, owners and charterers meticulously calibrate vessel operations, choosing to lay up ships to navigate economic viability and market responsiveness (Peachey, 2022). A minimized laid-up ratio is fervently pursued, encapsulating the fundamental objective of ensuring continuous vessel operation and revenue generation, as vessels predominantly earn while actively operating. This dynamic operational adjustment elucidates the vital commercial strategies leveraged in maritime economics.

Figure 6 Total Voyage Duration Used in the Laid-up Ratio Calculation



Note. In the calculation of laden voyage duration in Eq 3.6 and Eq 3.7, the waiting time in the middle portion of the Venn diagram is included as the vessel is under business and earning revenue.

$$L_{db} = \frac{T \quad - T_{db}}{T}$$ *Eq 3.6*

Where,

L_{db} = laid-up ratio of a given dry bulk vessel in a given time period

T_{db} = duration of total voyage time including the waiting time for a given dry bulk vessel

T = total time of a given year (t) (365 days x 24 hours x 60 minutes = 525,600 minutes

$$L_t = \frac{T \quad - T_t}{T}$$ *Eq 3.7*

Where,

L_t = laid-up ratio of the given tanker vessel in the given time period

T_t = duration of total voyage time including the waiting time of a given tanker vessel

T = total time of a given year (t) (365 days x 24 hours x 60 minutes = 525,600 minutes

Utilization Ratio: The utilization ratio is central to the operational and commercial dynamics of shipping, playing a crucial role in the strategic formation of shipping pools (Clarkson, 2015, p. 33). Primarily in bulk shipping, encompassing both wet and dry cargoes, the focus leans heavily towards transporting substantial quantities, ideally maximizing the shipload (Panayides et al., 2011). This resonates with maritime economic theories, where enhanced vessel capacity utilization correlates with elevated freight rates, signifying operational efficiency and commercial viability (Adland et al., 2018).

Within this analysis, the operational efficiency is discerned through the evaluation of shipload percentages against the vessel's overarching capacity. The intricate balance weighs the cargo's density against the ship's total deadweight tonnage (dwt), aiming to optimize commercial operations closely aligned with full payloads (Stopford, 2009, p. 246). Particularly during economic recessions, adapting to part cargoes becomes a prevalent strategy among dry bulk and tanker vessels to maintain a semblance of operational continuity.

Conclusively, this study upholds the presumption that achieving a carrying weight proximal to the vessel's dwt heralds commercial optimization. Empirical data guiding this exploration is meticulously curated from the load-to-draft ratios, as articulated in the AXSmarine voyage data.

$$U_{db} = \frac{\sum L_{db}}{N_{db}} \qquad \textit{Eq 3.8}$$

Where,

U_{db}= Utilization-ratio of a given dry bulk vessel

L_{db} = voyage load to draft ratio of each of the laden voyages during the period for a given dry bulk vessel

N_{db}= total number of laden voyages of a given dry bulk vessel

$$U_t = \frac{\sum L_t}{N_t} \qquad \textit{Eq 3.9}$$

Where,

U_t= Utilization-ratio of a given tanker vessel

L_t = voyage load to draft ratio of each of the laden voyages during the period for a given tanker vessel

N_t= total number of laden voyages of a given tanker vessel

Freight surplus ratio:

The ‘Freight Surplus Ratio’ serves as a fundamental parameter designed to scrutinize the economic leverage of pool vessels in the maritime industry, correlating significantly with their bargaining prowess (Papachristidis & Papachristidis, 2015). Pool vessels inherently exhibit enhanced bargaining latitude, fostering beneficial contractual stipulations and elevated fixture frequencies. Such attributes invariably underpin the contours of heightened profitability, thus reinforcing a formidable bargaining stance (Papachristidis & Papachristidis, 2015).

A vessel group is considered to have stronger bargaining power when it secures higher freight rates compared to the average. In this scenario, the enhanced freight rates symbolize a more robust negotiating position within the market, indicative of a heightened ability to optimize earnings and operational efficiency.

Insight into influential factors on these rates is garnered through the examination of the relationship between the Baltic Index and the actual rates achieved by specific vessels. For the analysis, fixture data, predominantly available as time charter rates for dry bulk vessels and spot rates for tankers, were employed.

Historical rates, archived in a database, were retrieved and subjected to comparative analysis. A calculation of the difference between the historical rates and the Baltic Index was conducted for dry bulk vessels. In the realm of oil transportation involving tankers, the "worldscale" system is applied, wherein a comparison against a standardized rate known as "Worldscale 100" allows for the derivation of surplus or profit values.

$$S_{db} = \frac{\sum(F_{db} - I)}{I} \qquad \textit{Eq 3.10}$$

Where,

S_{db} = freight surplus ratio for a given dry bulk vessel

F_{db} = fixture rate of the given dry bulk vessel for a particular date

I = BSHI index for the fixture date

$$S_t = \frac{\sum(F_t - WS)}{WS} \qquad \textit{Eq 3.11}$$

Where,

S_t = freight surplus ratio for a given tanker vessel

F_t = fixture rate of the tanker vessel for a particular date

WS = worldscale 100

3.4 Data Cleaning

Data cleaning is an important step in any research study, as it ensures that the data is accurate, consistent, and complete. In this research study, both qualitative and quantitative methods were used to clean the data.

First, the primary dataset was qualitatively examined for any strange or impossible values. For example, a negative value for the laid-up ratio would be impossible, so it would be removed from the dataset.

Some outliers in the utilization ratio were qualitatively deemed improbable but not impossible. In these cases, a quantitative approach was used. All data pertaining to the variable was transformed into z-scores using SPSS, and only values falling between -3 and 3 of the z-score were considered for further analysis.This quantitative approach helped to identify and remove outliers that were not immediately obvious from the qualitative examination of the data.

In total, less than 5% of the total data was lost after cleaning. This suggests that the data cleaning process was effective in identifying and removing errors and inconsistencies without losing too much of the original data.

3.5 Statistical Methods

Descriptive Statistics: The data were summarized and analyzed using various measures such as mean, median, standard deviation, skewness, and kurtosis to provide an encompassing overview of the general trends and patterns observed.

Correlation Analysis: An exploration of the potential relationships among various dependent variables was undertaken. The Pearson correlation coefficient was utilized in Microsoft Excel to assess the strength and direction of linear associations between different pairs of variables (Pearson, 1896).

Independent Sample t-test: Employing the independent samples t-test facilitated the assessment of any significant differences between two distinct vessel groups: pools and non-pools (Gosset, 1908). This helped in deciphering whether the observed differences in the data were statistically significant.

.

The equation for the two-sample t-test is as follows:

$$y = a + b\,x \qquad Eq\ 3.12$$

$$b = t \times s_p \sqrt{\frac{(n_A + n_B)}{(X_A - X_B)}} \qquad Eq\ 3.13$$

$$S_p = \sqrt{(\,S_A{}^2\,/\,n_A + S_B{}^2/n_B))} \qquad Eq\ 3.14$$

Null hypothesis (H0): The mean of the two groups is equal. *Eq 3.15*

Alternative hypothesis (H1): The mean of the two groups is not equal. *Eq 3.16*

Where,

y is the continuous variable for two groups

a is the constant for means

b is the coefficient of the dummy variable

x is the dummy variable for two groups

group A refers to pool vessels

group B refers to non-pool vessels

t is the t-statistic

X_A is the mean of the continuous variable for group A

X_B is the mean of the continuous variable for group B

s_p is the standard deviation for both groups

S_p is the standard deviation

S_A is the standard deviation of the dependent variable in group A

S_B is the standard deviation of the dependent variable in group B

n_A is the sample size of group A

n_B is the sample size of group B

The analysis was carried out individually for each of the four dependent variables using SPSS, focusing on both the pool and non-pool vessel groups. In this study, a significance level of 0.10 is assumed, representing a 10% probability of rejecting the null hypothesis if it is actually true.

Regression Analysis (Fixed Effect Model): A fixed effects model was utilized to estimate the impact of the categorical independent variable (vessel group) on continuous dependent variables, like the ballast-voyage ratio and others, at a 10% significance level. Within SPSS, non-pool vessel groups were assigned a value of 0, and pool vessel groups had a value of 1. This model, adept at controlling for unobserved individual differences that might affect the dependent variables, enables the estimation of the causal effect of the independent variable, ensuring the influence of unobserved individual variances is considered (Borenstein et al., 2010).

$$B_{db} = \beta_0 + V_p\beta_1 + u_t \qquad \text{Eq 3.17}$$

B_{db}= Ballast-voyage ratio for dry bulk vessels, β_0 = constant, u_t = error term, V_p = vessel group for the pool (as per Eq 3.2) , β_1= Coefficient

$$L_{db} = \beta_0 + V_p\beta_2 + u_t \qquad \text{Eq 3.18}$$

L_{db} = laid-up ratio for dry bulk vessels , β_0 = constant, u_t = error term, V_p = vessel group for the pool (as per Eq 3.2) , β_2= Coefficient

$$U_{db} = \beta_0 + V_p\beta_3 + u_t \qquad \text{Eq 3.19}$$

U_{db}= Utilization ratio for dry bulk vessels, β_0 = constant, u_t = error term, V_p = vessel group for the pool (as per Eq 3.2), β_3 = Coefficient

$$S_{db} = \beta_0 + V_p\beta_4 + u_t \qquad \text{Eq 3.20}$$

S_{db} = freight surplus ratio for a given dry bulk vessel, β_0 = constant, u_t = error term, V_p = vessel group for pool (as per Eq 3.2) β_4 = Coefficient

$$B_t = \beta_0 + V_p\beta_5 + u_t \qquad \text{Eq 3.21}$$

B_t= Ballast-voyage ratio for tanker vessels, β_0 = constant, u_t = error term, V_p = vessel group for the pool (as per Eq 3.2), β_5= Coefficient

$$L_t = \beta_0 + V_p\beta_6 + u_t \qquad \text{Eq 3.22}$$

L_t = laid-up ratio for tanker vessels , β_0 = constant, u_t = error term, V_p = vessel group for the pool (as per Eq 3.2), β_6= Coefficient

$$U_t = \beta_0 + V_p\beta_7 + u_t \qquad \text{Eq 3.23}$$

U_t= Utilization ratio for tanker vessels, β_0 = constant, u_t = error term, V_p = vessel group for pool (as per Eq 3.2), β_7 = Coefficient

$$S_t = \beta_0 + V_p\beta_8 + u_t \qquad \text{Eq 3.24}$$

S_t = freight surplus ratio for a given tanker vessel, β_0 = constant, u_t = error term, V_p = vessel group for pool (as per Eq 3.2), β_8= Coefficient

3.6 Software Tools

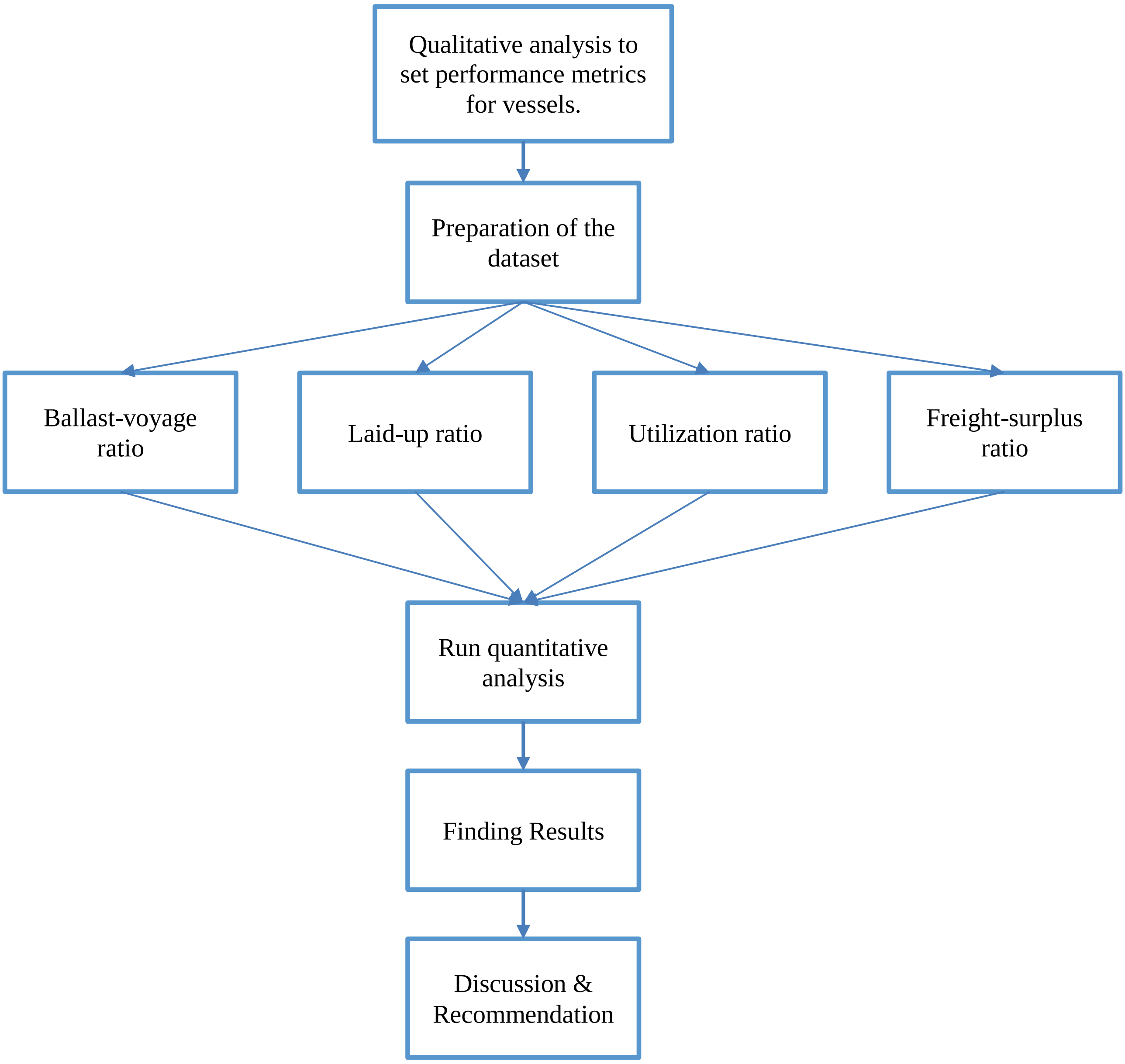
The entire analysis was executed using specialized statistical software tools, namely SPSS and Microsoft Excel, ensuring precision and reliability in the examination of data (Microsoft Excel, 2023; IBM SPSS Statistics, 2023).

3.7 Data Source

Comprehensive data were systematically compiled from a variety of reputable sources to ensure accuracy and depth in analysis. Official publications of pool operators, databases, and esteemed maritime websites such as Lloyds List and Tradewindnews were instrumental in this collection. Additionally, AXSmarine contributed valuable voyage information. A wealth of fixture data and specific pool operator details were further enriched by contributions from both Clarksons and AXSmarine, fortifying the dataset with essential components for a thorough analysis (Clarksons, 2023c; AXSmarine, 2023).

Figure 7

Research Framework



Chapter 4 Findings

4.1 Findings for Tanker (Aframax) Vessels

Pool Vessels: Utilizing a variety of databases and gathering information from the official websites of pool operators in accordance with the criteria set out in Chapter 3, a comprehensive list of 76 tanker pool vessels was compiled, as noted in Clarksons (2023b).

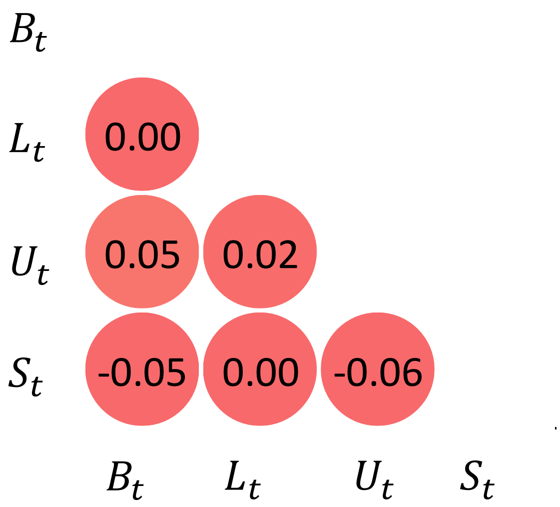
Non-Pool vessels: As outlined in Chapter 3, the selection of non-pool vessels was guided by their operational areas. The criteria specified that non-pool vessels were only included in the analysis if they shared at least one loading or discharge port with pool vessels, indicating a commonality in trading activities. Under these conditions, a total of 848 tanker vessels, encompassing both pool and non-pool categories, met the selection criteria.

Voyages: The AXSmarine database was employed to gather an extensive set of data on laden and ballast voyages for all ships. This data was then meticulously filtered to focus exclusively on the year 2022 and specifically on Aframax tanker vessels. This refined dataset disclosed a total of 8,058 laden voyages and 7,341 ballast voyages (AXSmarine, 2023). Utilizing Power Query in Excel for further data refinement, the study pinpointed 729 laden voyages and 608 ballast voyages associated with pool vessels under the defined criteria. Similarly, for non-pool vessels, the analysis identified a total of 7,123 laden voyages and 6,551 ballast voyages.

4.1.1 Correlation Results for Tankers

Figure 8

Results of Pearson Correlation for Tanker Vessels



Note: B_t, L_t, U_t, S_t represent the variables of Ballast-voyage ratio, Laid-up ratio, Utilization ratio, and Freight-surplus ratio respectively for tanker vessels as mentioned in Chapter 3. Color code is used as green when the correlation value is around 1 and red when the correlation value is around 0.

The correlation results display the Pearson correlation coefficients for all possible pairings of variables. In this specific analysis, it's noted that none of the correlation coefficients approach a value near 1. This suggests that there are no strong correlations present among the variables under consideration.

4.1.2 Descriptive Statistics Results for Tankers

Table 4
Result of the Descriptive Statistics for Tanker Vessels

V_g	Descriptive Statistics	B_t	L_t	U_t	S_t
Pool	Mean	0.99	0.23	0.84	1.14
	N	76.00	76.00	76.00	62.00
	Std. Deviation	0.73	0.15	0.05	0.60
	Kurtosis	25.04	0.93	4.37	1.15
	Skewness	4.03	1.08	-0.16	0.97
Non-pool	Mean	1.14	0.24	0.88	0.98
	N	848.00	848.00	848.00	446.00
	Std. Deviation	0.67	0.18	0.05	0.64
	Kurtosis	7.37	2.37	-0.22	2.66
	Skewness	2.04	1.52	0.14	0.94

Note: V_g, B_t, L_t, U_t, S_t represent the variables of Vessel group, Ballast-voyage ratio, Laid-up ratio, Utilization ratio, and Freight-surplus ratio respectively as mentioned in Chapter 3. N represents the total number of observations.

The ballast-voyage ratio for tankers averages 0.99 for the pool vessel group and 1.14 for non-pool vessels, indicating a higher average for the non-pool group. The standard deviation of the ballast-voyage ratio for pool vessels is 0.73, slightly more than the 0.67 for non-pool vessels. In terms of kurtosis, the pool group's tankers show a significantly higher value at 25.04, compared to 7.37 for non-pool vessels, suggesting a more distinct peak in the pool group's distribution. Additionally, both groups of tankers exhibit positive skewness in their ballast-voyage ratio distributions, with the pool group at 4.03 and the non-pool group at 2.04.

The laid-up ratio for tankers is similar between the groups, with pool vessels at 0.23 and non-pool vessels at 0.24. The standard deviation of this ratio for pool tankers is 0.15, slightly less than the 0.18 for non-pool vessels. In terms of kurtosis, non-pool tankers have a higher value of 2.37 compared to 0.93 for pool vessels. Both groups of tankers also exhibit positive skewness in their laid-up ratios, with pool vessels at 1.08 and non-pool vessels at 1.52.

The utilization ratio average is higher for non-pool vessels at 0.88, compared to 0.84 for pool vessels. The standard deviation is identical for both groups at 0.05. The pool group's tanker utilization ratio has a kurtosis value of 4.37, which is more sharply peaked compared to -0.22 for the non-pool group. The skewness of the utilization ratio for pool tankers is slightly negative at -0.16, while for non-pool tankers, it is slightly positive at 0.14.

In the case of the fixture-surplus ratio for the tanker vessels, the average is higher for pool vessels at 1.14, compared to 0.98 for non-pool vessels. The standard deviation for this ratio is relatively similar, with 0.60 for pool vessels and 0.64 for non-pool vessels. The kurtosis for the pool group's tanker fixture-surplus ratio is 1.15, which is flatter compared to 2.66 for the non-pool group. Both groups of tankers exhibit positive skewness in their fixture-surplus ratio distributions, with the pool group at 0.97 and the non-pool group close behind at 0.94.

4.1.3 Independent Sample t-test Results for Tankers

Table 5
Results for Independent Sample t-test for Tanker Vessels

Variables	t-statistic	p-value	Mean Difference	Std. Error Difference	90% *CI of the Difference	
					Lower	Upper
B_t	-1.84	0.07	-0.15	0.08	-0.28	-0.02
L_t	-0.77	0.44	-0.02	0.02	-0.05	0.02
U_t	-6.76	0.00	-0.04	0.01	-0.05	-0.03
S_t	1.80	0.07	0.16	0.09	0.01	0.30

Notes. $B_t, L_{t,} U_{r,} S_t$ are the Ballast-voyage ratio, Laid-up ratio, Utilization ratio, and Freight-surplus ratio as mentioned in Chapter 3. The p-value is provided for a two-tailed hypothesis test with a significance level of 0.10. *CI stands for confidence Interval.

Regarding the ballast-voyage ratio for tankers, there is a statistically significant difference in the means of the two groups (t(922) = -1.84, p = 0.07), providing statistical evidence of a difference in the ballast-voyage ratio between the two ship groups.

For the laid-up ratio, the analysis shows no statistically significant difference in the means of the two groups (t(922) = -0.77, p = 0.44), indicating a lack of statistical evidence to suggest a difference in the laid-up ratio between the two ship groups.

When examining the utilization ratio, there is a statistically notable difference in the means of the two groups (t(922) = -6.76, p = 0.00), signifying clear statistical evidence that the utilization ratio varies between the two ship groups.

In the case of the freight-surplus ratio, the means of the two groups show a statistically significant difference (t(506) = 1.80, p = 0.07), pointing to statistical evidence that the freight-surplus ratio differs between the two ship groups.

4.1.4 Fixed Effect (Regression) Results for Tankers

Table 6
Regression Results of Aframax Tanker Pools

Model		Coefficients	Standard Error of the coefficients	t statistic	p-value
B_t(Eq 3.21)	Constant	1.14	0.02	49.02	0.00
	V_p	-0.15	0.08	-1.84	0.07
L_t (Eq 3.22)	Constant	0.24	0.01	39.99	0.00
	V_p	-0.02	0.02	-0.77	0.44
U_t (Eq 3.23)	Constant	0.88	0.00	486.32	0.00
	V_p	-0.04	0.01	-6.23	0.00
S_t (Eq 3.24)	Constant	0.98	0.03	32.47	0.00
	V_p	0.16	0.09	1.80	0.07

Note: 10% significance level is assumed. Dependent variables for Equations Eq 3.21, Eq 3.22, Eq 3.23, and Eq 3.24 are ballast voyage ratio, laid-up ratio, utilization ratio, and freight surplus ratio, respectively, as mentioned in Chapter 3. V_g is an independent dummy variable for the pool vessel group. Adjusted R square for Eq 3.21 is 0.003, Eq 3.22 is 0.00, Eq 3.23 is 0.04, and Eq 3.24 is 0.004.

In the ballast-voyage ratio model, B_t(Eq 3.21), the coefficient for the pool vessel group dummy variable is -0.15 (t= -1.84, p = 0.07), indicating a negative correlation with the vessel group. This suggests that pool group vessels had fewer ballast voyages compared to non-pool vessels, implying less ballast travel. This relationship was statistically significant at the 10% level.

In the laid-up ratio model L_t(Eq 3.22), the coefficient for the pool vessel group dummy variable is -0.02 (t= -77, p = 0.44). This denotes a negative impact on the laid-up ratio, suggesting that pool vessels spent less time laid up. However, this relationship was not statistically significant at the 10% level, meaning that a causal link cannot be established, and the model does not show a statistically significant negative relationship.

In the utilization ratio model U_t(Eq 3.23), the pool vessel group dummy variable's coefficient is -0.04 (t= -6.23, p = 0.00), indicating a negative correlation. This implies that pool group vessels had a lower utilization ratio. The relationship was statistically significant, confirming a statistically significant negative relationship, and the model's low standard error enhances its reliability.

In the freight-surplus ratio model, S_t(Eq 3.24), the coefficient for the vessel group dummy variable is 0.16 (t= 1.80, p = 0.07), showing a positive impact on the freight-surplus ratio. This means pool vessels achieved higher freight rates. The relationship was significant at the 10% level, indicating a positive statistical correlation. The model's low standard error suggests this relationship is reliably explained.

4.2 Findings for Dry Bulk (Handysize) Vessels

Pool Vessels: For the dry bulk sector, a comprehensive list of 49 pool vessels was assembled using a variety of databases and gathering information from the official websites of pool operators that aligned with the criteria established in Chapter 3 (Clarksons, 2023b; TMA Bulk, 2023; Hanseatic, 2023).

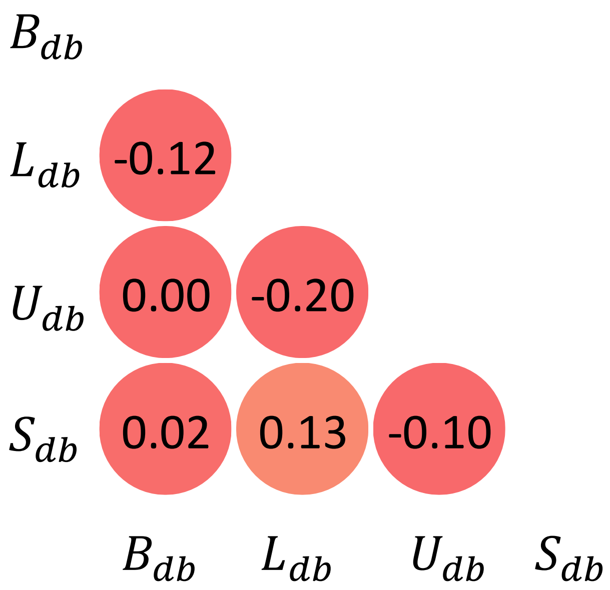
Non-Pool vessels: The criteria detailed in Chapter 3 focused on the inclusion of non-pool vessels that operated within the same loading and discharging zones as pool vessels. This was based on the premise that non-pool vessels operating in these specific areas at least once were likely engaged in similar trading activities. Following these guidelines, the study successfully identified a total of 1,743 non vessels that met the selection criteria, particularly within the dry bulk segment.

Voyages: The AXSmarine database was employed for compiling a comprehensive dataset of laden and ballast voyages specific to dry bulk vessels. This data was then meticulously filtered to focus on the calendar year 2022 and on vessels matching the established criteria. Post-filtering, the study identified a total of 15,229 laden voyages and 12,045 ballast voyages. Within this dataset, pool vessels accounted for 304 laden voyages and 236 ballast voyages that conformed to the criteria. In comparison, non-pool vessels contributed to a larger share, with 14,588 laden voyages and 11,560 ballast voyages.

4.2.1 Correlation Results for Dry Bulks

Figure 9

Results of Pearson Correlation for Dry Bulk Vessels



Note. B_{db}, L_{db}, U_{db}, S_{db} represent the variables of Ballast-voyage ratio, Laid-up ratio, Utilization ratio, and Freight-surplus ratio respectively as mentioned in Chapter 3. Color code is used as green when the correlation value is around 1 and red when the correlation value is around 0.

The correlation results for dry bulk vessels display Pearson correlation coefficients for all possible variable combinations. In this analysis, it's noted that none of these coefficients approach a value close to 1, suggesting a lack of strong correlations among the variables under study. This mirrors the findings observed in the tanker segment.

4.2.2 Descriptive Statistics for Dry Bulks

Table 7

Result of the Descriptive Statistics for Dry Bulk Vessels

V_g	Descriptive Statistics	B_{db}	$L_{db,}$	U_{db}	S_{db}
Pool	Mean	0.79	0.24	0.95	0.09
	N	49.00	49.00	49.00	18.00
	Std. Deviation	0.70	0.11	0.03	0.31
	Kurtosis	5.27	0.45	0.27	-1.39
	Skewness	2.20	0.48	0.20	0.20
Non-pool	Mean	0.81	0.23	0.94	0.03
	N	1743.00	1743.00	1743.00	284.00
	Std. Deviation	0.65	0.14	0.04	0.32
	Kurtosis	6.54	4.36	3.30	0.68
	Skewness	2.14	1.66	-0.56	0.83

Note. $V_g, B_{db}, L_{db,} U_{db,} S_{db}$ represent the variables of Vessel group, Ballast-voyage ratio, Laid-up ratio, Utilization ratio, and Freight-surplus ratio respectively as mentioned in Chapter 3. N represents the total number of observations.

For dry bulk vessels, the ballast-voyage ratio averages 0.79 for the pool group and 0.81 for non-pool vessels, indicating a marginally higher average for the non-pool group. The standard deviation of this ratio is 0.70 for pool vessels and 0.65 for non-pool vessels, suggesting greater variability in the non-pool group. Kurtosis values show that the distribution is more peaked for non-pool vessels at 6.54 compared to 5.27 for pool vessels. Both groups exhibit positive skewness in their ballast-voyage ratios, with pool vessels at 2.20 and non-pool vessels at 2.14.

The laid-up ratio averages are closely matched, with pool vessels at 0.24 and non-pool vessels at 0.23. The standard deviation is slightly higher for non-pool vessels at 0.14, compared to 0.11 for pool vessels, indicating more variability in their laid-up ratio. Kurtosis reveals a more pronounced peak in the distribution for non-pool vessels at 4.36, versus 0.45 for pool vessels. The laid-up ratio is more positively skewed for non-pool vessels (1.66) compared to pool vessels (0.48).

In terms of utilization ratios, averages are similar for both groups: 0.95 for pool vessels and 0.94 for non-pool vessels. The standard deviation of the utilization ratio is marginally higher for non-pool vessels at 0.04, compared to 0.03 for pool vessels. Kurtosis for non-pool vessels is higher at 3.30, indicating a more peaked distribution than the pool group's 0.27. Skewness is positive at 0.20 for pool vessels and negative at -0.56 for non-pool vessels.

Finally, the fixture-surplus ratio average is higher for pool vessels at 0.09, compared to 0.03 for non-pool vessels in the dry bulk segment. The standard deviation is relatively similar, with 0.3 for pool vessels and 0.32 for non-pool vessels. Kurtosis shows a flatter distribution for pool vessels at -1.39 and a more peaked one for non-pool vessels at 0.68. Skewness reveals a positive skew for pool vessels (0.20) and a negative skew for non-pool vessels (0.83).

4.2.3 Independent Sample t-test Results for Dry Bulks

Table 8
Results for Independent Sample t-test for Dry Bulk Vessels

Variables	t-statistic	p-value	Mean Difference	Std. Error Difference	90% *CI of the Difference	
					Lower	Upper
B_{db}	-0.20	0.84	-0.02	0.09	-0.17	0.14
L_{db}	0.38	0.70	0.01	0.02	-0.02	0.04
U_{db}	0.83	0.40	0.00	0.00	-0.00	0.01
S_{db}	0.70	0.48	0.06	0.08	-0.07	0.19

Notes. $B_{db}, L_{db}, U_{db}, S_{db}$ are the Ballast-voyage ratio, Laid-up ratio, Utilization ratio, and Freight-surplus ratio as mentioned in Chapter 3. The p-value is provided for a two-tailed hypothesis test with a significance level of 0.10. *CI stands for confidence interval.

In the analysis of dry bulk vessels, the ballast-voyage ratio showed no statistically significant difference in means between the two groups (t(1790) = -0.20, p = 0.84), indicating no statistical evidence of a difference in the ballast-voyage ratio between the two groups.

Similarly, for the laid-up ratio, the means of the two groups were not significantly different ($t(1790) = 0.38$, $p = 0.70$), providing no statistical evidence of a difference in the annual laid-up ratios between the groups.

Regarding the utilization ratio, the analysis revealed no statistically significant difference between the two groups ($t(1790) = 0.83$, $p = 0.40$), suggesting that there is no statistical evidence of a difference in utilization ratios between the groups.

For the freight-surplus ratio, the means of the two groups were also not significantly different ($t(300) = 0.70$, $p = 0.48$), indicating no statistical evidence of a difference in the freight-surplus ratio between the groups.

In conclusion, the t-tests for equality of means across all evaluated variables showed no statistically significant differences between the means of the two groups of dry bulk ships. This suggests that both groups have similar performance across ballast-voyage, laid-up, utilization, and freight-surplus ratios.

4.2.4 Fixed Effect (Regression) Results for Dry Bulks

Table 9
Regression Results for Dry Bulk Pools

Model		Coefficients	Standard Error of the coefficients	t statistic	p-value
B_{db}(Eq 3.17)	Constant	0.81	0.02	52.20	0.00
	V_g	-0.02	0.09	-0.20	0.84
L_{db} (Eq 3.18)	Constant	0.23	0.00	70.52	0.00
	V_g	0.01	0.02	0.38	0.70
U_{db} (Eq 3.19)	Constant	0.94	0.00	887.95	0.00
	V_g	0.00	0.01	0.60	0.55
S_{db} (Eq 3.20)	Constant	0.03	0.02	1.79	0.08
	V_g	0.06	0.08	0.70	0.49

Note: 10% significance level is assumed. Dependent variables for Eq 3.17, Eq 3.18, Eq 3.19, and Eq 3.20 are ballast voyage ratio, laid-up ratio, utilization ratio, and freight-surplus ratio, respectively, the independent variable is V_g is the independent dummy variable for vessel pool group as mentioned in chapter 3. Adjusted R square for Eq 3.17 is -0.001, Eq 3.18 is 0.00, Eq 3.19 is 0.00, and Eq 3.20 is -0.002.

In the dry bulk model for the ballast-voyage ratio B_{db}(Eq 3.17), the pool vessel group's coefficient is -0.02 (t= -0.20, p = 0.84), implying a negative effect on the ballast-voyage ratio. This suggests that pool vessels engaged in fewer ballast voyages than non-pool vessels. However, the relationship is not statistically significant at the 10% level, indicating insufficient evidence for a causal relationship.

For the laid-up ratio in model L_{db} (Eq 3.18), the coefficient for the pool vessel group is 0.01 (t= 0.38, p = 0.70). This small coefficient, near zero, along with its t-statistic and p-value, shows that the result is not statistically significant, providing no substantial evidence of causality.

In the utilization ratio model U_{db} (Eq 3.19), the pool vessel group's coefficient is effectively zero (0.00, t= 0.60, p = 0.55), indicating no impact on the utilization ratio. The t-statistic and p-value confirm that this result is not significant, suggesting no evidence of a causal effect.

Lastly, in the freight-surplus ratio model S_{db} (Eq 3.20), the coefficient for the pool vessel group is 0.06 (t= 0.70, p = 0.49), hinting at a positive effect on the freight-surplus ratio, which could mean higher freight rates for pool vessels. However, the relationship's significance level, as indicated by the t-statistic and p-value, is not high enough to statistically confirm a causal link.

Chapter 5 Discussion

5.1 Analysis of the Findings

1. ***Performance Metrics:*** Four key performance metrics - the ballast-voyage ratio, laid-up ratio, utilization ratio, and freight-surplus ratio - have been established as reliable indicators of a ship's performance, as evidenced by their lack of correlation with each other according to Pearson correlation findings. Each metric plays a distinct role; for example, the freight-surplus ratio is pivotal in directly boosting a vessel's revenue, providing significant commercial leverage. The utilization ratio and ballast-voyage ratio collectively represent operational efficiency and commercial effectiveness.

   The independence of these metrics suggests that effective vessel operation can simultaneously result in a lower ballast voyage and a higher freight rate. This highlights the influence of chartering strategies and operational flexibility on overall vessel performance. Enhanced negotiation skills and a robust fleet strengthen a ship operator's ability to secure higher freight rates while minimizing ballast voyages.

   Expanding the investigative lens to the study's broader spectrum revealed that the laid-up ratio remains largely uninfluenced by the independent variables explored, particularly in the contexts of tankers and dry bulk vessels. Conclusively, paramount indicators such as the fixture surplus, utilization ratio, and ballast-voyage ratio are affirmed as integral benchmarks for optimizing commercial operations in ship functionalities.

2. ***Impact of Tanker Pools:*** For tankers involved in shipping pools, several variables have been identified to influence their participation in the pool, namely, the ballast-voyage ratio, the laid-up ratio, the utilization ratio, and the

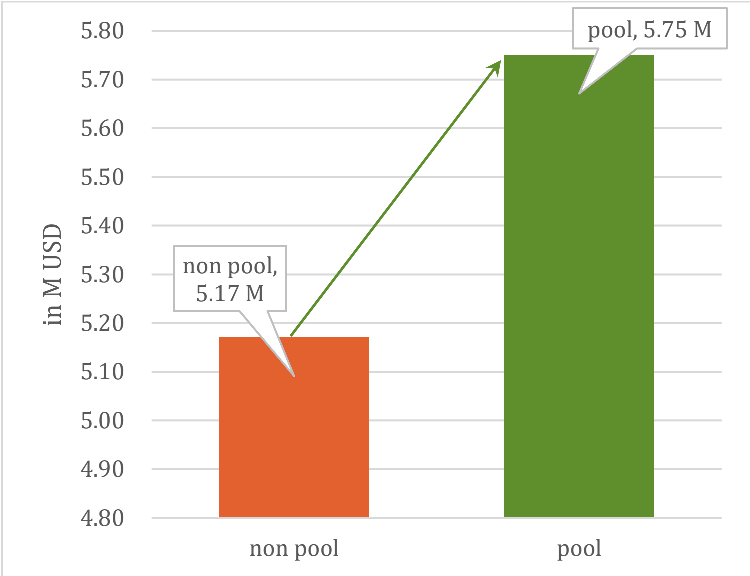
freight-surplus ratio. Compared to non-pool vessels, pool vessels display reduced ballast movement, aligning with Packard’s (1995, p. 1) observation that pool operators manage commercial functions with enhanced efficacy. This also aligns with industry experts' perspective that pooling minimizes ballast legs (Peachey, 2022).

Moreover, it’s noted that pool vessels typically garner higher freight rates in comparison to non-pool vessels. This trend is in line with Packard’s (1995, p. 73) viewpoint, which posits profit maximization as a core aim of forming pools. However, a counterpoint is observed in the correlation between the utilization ratio and pool vessels, with a negative relationship being prominent. Citing Haralambides (1996), the flexibility of pool operators to acquire a Contract of Affreightment (CoA) allows for the discretionary allocation of cargo, which may not always optimize each ship’s capacity.

This occurrence could be attributed to the pool operators striving to optimize the usage across all vessels, aiming for a harmonious satisfaction amongst all members. Ensuring equitable profit distribution amongst members remains a formidable challenge for shipping pools (Wen et al., 2018). Despite the observed negative correlation with the utilization ratio, it’s noteworthy that pool vessels generally command higher earnings compared to their non-pool counterparts. For illustrative clarity, consider a hypothetical scenario where both pool and non-pool vessels, each with a capacity of 100,000 MT, undertake an equal number of loaded trips (10) at a consistent freight rate ($6/MT), showcasing a distinct earnings differential favoring pool vessels.

Figure 10

Earnings of Pool and Non-Pool Tanker Vessels



Note. Based on the collected data, it is inferred that the utilization rates stand at 84% for pool vessels and 88% for non-pool vessels. Each vessel is estimated to have a capacity of 100,000 MT. It's also assumed that the freight rate will be $6 per MT, and annually, each vessel is expected to undertake ten laden voyages.

Figure 10 depicts that despite the lower utilization ratio of pooled tanker vessels, they still manage to yield considerably higher earnings compared to non-pool vessels. Specifically, vessels in a shipping pool have the capacity to garner an extra amount that surpasses half a million dollars ($0.57M) on an annual basis. This notable difference in earnings symbolizes a significant financial boon for vessels integrated into a shipping pool.

3. ***Dry Bulk Shipping Market:*** The research outcomes suggest that dry bulk vessels participating in a shipping pool don't have statistically significant advantages over non-pool vessels. This aligns with some industry experts' opinions, suggesting a lack of potential for "meaningful consolidation" in the dry bulk sector, categorizing it at the minimal end of the consolidation

spectrum (Lowry, 2015). The reason behind this could be attributed to the unique market characteristics inherent to the sector.

In contrast to the tanker segment, which primarily deals with a limited number of oil majors, the dry bulk sector encounters a diverse array of shippers due to the multitude of product categories available. The market sees a more fragmented assembly of both buyers and sellers (McConville, 1998). Particularly in segments like Handysize, commercial efficiency might not be profoundly impacted by organizational commercial strategies due to prevailing market fragmentations, geopolitical risks, and uncertainties in economic policies.

A difference in market responses between the dry bulk and the tanker segments has also been noted (Angelopoulos et al., 2020). Initial studies, like the one by Beenstock and Vergottis (1993), highlighted key influential factors such as oil prices, global economic activity, and industrial output as determinants in global shipping trends. Conversely, subsequent research by Grammenos and Arkoulis (2002) unveiled an absence of significant correlation between industrial production and the stock returns of shipping enterprises. Instead, broader macroeconomic elements appeared to exert more substantial influence which perhaps is in more alignment with the dry bulk shipping market. This suggests that while microeconomic factors like industrial production may not significantly impact the stock returns of shipping companies, as indicated by Grammenos and Arkoulis (2002), it is the broader macroeconomic elements that seem to hold more sway, aligning more closely with the market dynamics observed in the dry bulk shipping sector.

In conclusion, the dry bulk market portrays unique susceptibilities, heavily influenced by global macro factors, while its intrinsic structural attributes seem to play a minor role in determining market performance.

4. ***Bargaining Power:*** Joining a shipping pool offers ship owners improved bargaining strength, ultimately leading to increased profits, as indicated by

Papachristidis & Papachristidis (2015, p. 269). In this study, the freight-surplus ratio is utilized as a gauge of bargaining power, given its correlation with elevated earnings. A statistically significant positive relationship has been observed between the freight-surplus ratio and pool vessels, specifically in the tanker category, signifying their enhanced negotiation capabilities. Contrarily, this study's findings reveal that such an assertion is inapplicable to dry bulk pools.

5. ***Factors of Laid-up Ratio:*** This study's findings reveal that in both the dry bulk and tanker sectors, a vessel's unemployment duration is consistent regardless of its affiliation with a pool. It highlights that the established relationship inadequately elucidates the dependent variable, the laid-up ratio. This contradicts the prevalent industry notion that pooling operations diminish employment waiting periods (Peachey, 2021). Thus, it is inferred that external factors like the global economy and fleet size wield significant influence over the laid-up ratio of a ship.

5.2 Implications

1. ***Ship Owner's Decision Making:*** Ship owners need to remain vigilant of the global economy and make decisions grounded in macroeconomic considerations, irrespective of their commercial operations' quality, to minimize the idle time of their ships. A failure to base decisions on comprehensive analysis may result in their vessels remaining unutilized. This notion is particularly relevant in the context of dry bulk shipping, where the absence of statistically proven benefits from shipping pools suggests that owners with extensive market knowledge are less likely to participate in such pools. Nevertheless, this doesn't rule out the usefulness of dry bulk shipping pools, as companies might choose to join them for a variety of specific reasons, which are detailed in the initial point of the recommendations section.

Contrarily, the situation in tanker vessel shipping pools is different. Tanker vessel shipping pools demonstrate significant advantages in terms of established performance criteria, making them more attractive for tanker owners. This difference underscores the importance of understanding the unique dynamics of each market segment—dry bulk and tanker—and tailoring strategies accordingly, especially when macroeconomic factors play a substantial role in the shipping industry.

2. ***Chartering Strategy and Policy:*** For tankers, it is clear that pool operators prioritize vessel engagement over transportation at full capacity, resulting in heightened costs for cargo owners or charterers. Thus, in the case of a Contract of Affreightment (CoA), a charterer may incorporate a clause in the agreement to ensure utilization of the vessel's maximum capacity, aiming to curtail transportation expenses. This stands in contrast to the common academic and industry assumption that pool vessels operate at a higher load factor (Haralambides 1996, Peachey 2022); this study unveils that pool vessels may actually exhibit a lower load factor.
3. ***Tanker vs Dry Bulk Shipping Pools:*** This study's findings reveal a lack of statistically significant advantages in participating in a dry bulk pool, potentially explaining why shipping pools are less prevalent in the dry bulk sector compared to the tanker market. These results align with a broadly recognized industry observation, confirming that dry bulk pools are notably less ubiquitous than tanker shipping pools.
4. ***Commercial Efficiency and Laid-up Ratio:*** Regardless of a ship operator's efficiency in commercial and operational realms, such proficiency is futile if the vessel remains unemployed. The study's findings suggest that a vessel's internal performance metrics are insufficient in elucidating its employment prospects, which seem to be more dependent on external variables like the global economy. This aligns with prior academic insights (Stopford, 2009; Ma, 2021), underscoring the imperative for shipowners to remain attuned to global market fluctuations to make informed and effective decisions.

5.3 Recommendations

1. ***Pooling Decisions:*** Empirical evidence reveals distinct advantages of tanker pools, showcasing them as a viable option for ship owners. The scenario, however, differs for dry bulk pools, where statistically proven benefits seem to be lacking, especially in the Handysize segment. It might not be the most judicious decision for knowledgeable ship owners to place vessels in dry bulk pools.

   Operating ships is an intricate task that necessitates specialized knowledge (Cariou & Wolff, 2011). In this context, cooperation emerges as a pivotal element, fostering a conducive environment for knowledge acquisition (Song & Lee, 2012). Engaging within a cooperative framework enables owners to assimilate essential business insights and operational efficiencies requisite for commercial vessel operations.

   The study suggests that tanker owners should consider joining shipping pools to enhance operational effectiveness and performance outcomes, as vessels within these pools have been associated with superior results. So, participation in a shipping pool can be particularly beneficial for small and medium-sized owners. Furthermore, Baştuğ and Deveci (2021) indicate that charterers tend to lean heavily on personal experience in decision-making, amplifying the entry challenges for small and medium-sized owners in navigating the market independently.

   However, for larger or medium-sized tanker owners equipped with substantial market experience, operating autonomously may remain a feasible option. Despite this, participation in pooling presents a strategic avenue, facilitating performance evaluation against established benchmarks and optimizing operational efficiencies through the reduction of administrative overheads by enabling the outsourcing of certain vessel operations.

Shipping pools stand as a paradigm of outsourcing, serving as strategic conduits that enable businesses to streamline their focus towards core competencies, a concept articulated by Cariou and Wolf (2011). They present a tactical framework particularly instrumental for investors seeking to diversify their portfolios via ship investments or for ship owners navigating towards diversification strategies beyond their dominant market segments. Despite the absence of statistically significant benefits identified in prior discussions regarding dry bulk pools, engaging in such pools can still be strategically rational. It allows for the leveraging of efficiencies, cost minimization, and the maintenance of professional standards in operational dynamics, as underscored by Panayides (2001). Thus, participation in dry bulk pools can still emerge as a beneficial strategy, providing nuanced operational and strategic advantages.

The characteristics of a ship owner, including the size, nature (public or private), and age of the company, significantly influence the decision to engage in shipping pools as a strategic form of outsourcing. Research suggests a nuanced interplay between these factors, crafting a non-linear pathway in the outsourcing decision (Cariou & Wolf, 2011). For instance, smaller owners with fewer vessels may seek pooling for additional expertise, while medium-sized firms might use it for benchmarking and strategic performance measurement. In contrast, larger companies may utilize pooling to optimize administrative efficiencies, navigating the complexities that burgeon with scale (Panayides and Cullinane, 2002; Mitroussi, 2003). Each decision is finely calibrated, reflecting the intricate interplay of organizational size, maturity, and strategic focus in the dynamic tapestry of shipping pool participation.

2. ***Investment Decisions and Chartering Policy:*** Investing in vessels primarily involves two key revenue streams: asset play and freight. For banks and shipowners looking to invest, it is imperative to understand that the success of their investment, reflected in the laid-up ratio, doesn't solely depend on commercial efficiency. Various macroeconomic factors also considerably

influence this ratio. Hence, investors must be vigilant, consistently monitoring macroeconomic activities to make sound investment decisions that are not merely based on commercial efficiency.

Charterers and shippers, who play a crucial role in freight rate negotiations, must also be attuned to macroeconomic events to navigate through the negotiations effectively. Armed with the knowledge of potential future shifts in the laid-up ratio for vessels, they can strategically adjust their freight negotiations. For example, foreseeing an increase in the laid-up ratio allows them to lower the freight in ongoing negotiations.

In the realm of shipping pools, incorporating capacity utilization emerges as a pivotal aspect for all parties, including charterers, shipowners, and pool operators. Charter agreements can thoughtfully stipulate this, enabling a collaborative negotiation process where ship owners and pool operators can work towards accommodating this crucial parameter in their arrangements. This comprehensive approach ensures that investment and negotiation strategies in vessel operations are adaptive, informed, and resilient against market uncertainties.

3. ***Shipping Pool Business Models:*** There is potential for refinement and advancement within the business models of both tanker and dry bulk shipping pools. Tanker pools, specifically, should formulate strategies to enhance their utilization rates to align with, or surpass, the industry average. Ignoring this vital metric may lead to a gradual erosion of the client base, affecting both ship owners and charterers. Regarding the dry bulk sector, operators need to infuse fresh approaches into their business strategies. Replicating the tanker pool model has proven insufficient, as the findings of this study indicate—it has not significantly improved the fortunes of dry bulk vessels nor has it been attractive enough for shipowners.

   Specialization could serve as a strategic pivot for dry bulk shipping pools. By offering customized services for the transport of specialized commodities, such as forest products, they could carve out a distinctive presence in the market. Given that marketing services in the shipping industry demands a nuanced understanding, different from marketing tangible goods, dry bulk operators can also explore options to customize their offerings to better satisfy the diverse demands of each client (Panayides, 2001, pp. 43-44).

Chapter 6 Conclusion and Limitations

6.1 Concluding Remarks

The shipping industry's global scale and its vulnerability to unexpected events contribute to its significant market volatility. At the same time, customer needs are growing increasingly intricate. In response, companies within the industry are continuously exploring strategic approaches to navigate these market fluctuations. Horizontal cooperation stands out as a common strategy across various transportation sectors, including shipping, to enhance business performance. This cooperative approach manifests differently within segments of the industry: liner shipping firms tend to form alliances, while those in the dry and wet bulk sectors often rely on shipping pools as their primary method of collaboration.

Building on the strategic significance of horizontal cooperation in the shipping industry, it's worth noting that the existing literature on shipping pools is quite sparse. While the touted advantages of shipping pooling include increased bargaining power, higher earnings, reduced waiting times, and overall improved commercial performance, there has been a noticeable gap in empirical research to validate these benefits. Therefore, this study aimed to provide an empirical analysis to verify the potential benefits of incorporating ships into a shipping pool, considering both dry bulk carriers and tankers.

To assess the performance of shipping pools, four key independent variables were identified: the ballast-voyage ratio, laid-up ratio, utilization ratio, and freight-surplus ratio. These metrics were selected based on a qualitative evaluation that incorporated insights from existing literature, industry norms, and the availability of relevant data. Subsequently, data sets for vessels within and outside of shipping pools were compiled in accordance with these performance indicators.

A t-test was applied to ascertain whether the performance differences between pooled and non-pooled vessels were statistically significant across the four identified variables. Additionally, a fixed effect regression model was employed to further explore the relationship between the classification of the vessel group and the performance metrics.

In the tanker segment, statistically significant differences were noted in three of the four variables when comparing pooled and non-pooled vessels, with the laid-up ratio being the exception. Conversely, for dry bulk vessels, no statistically significant performance differences were observed between the two groups.

When examining causal relationships, a negative correlation was identified between pool vessels and the ballast voyage ratio, laid-up ratio, and utilization ratio, while a positive correlation was found with the freight surplus ratio. For the dry bulk sector, these correlations did not reach statistical significance, suggesting that the data does not support a definitive conclusion about the relationship. In the tanker segment, however, all correlations except for the laid-up ratio were statistically significant, indicating that participation in a shipping pool is associated with a notable impact on vessel performance.

Drawing from the study's results, it can be inferred that in the tanker sector, being part of a shipping pool significantly influences vessel performance. This is evident from the positive association between pool participation and an increase in freight earnings, along with a decrease in ballast voyages. However, such a definitive conclusion cannot be extended to the dry bulk sector due to a lack of substantial empirical backing. This disparity in evidence could be a contributing factor to the prevalence of shipping pools in the tanker industry compared to their scarcity in the dry bulk sector. Interestingly, the study also discovered a negative correlation with the utilization ratio in shipping pools. This suggests that pools are more focused on distributing work across all vessels in the pool rather than maximizing the capacity of individual vessels.

The insights gleaned from this study carry significant implications for the bulk shipping industry. It highlights a distinct divergence in shipping pool performance between the tanker and dry bulk sectors. While shipping pools have been effective for tankers, this model doesn't appear to be as beneficial for dry bulk vessels. This suggests that operators in the dry bulk space should contemplate updating their business strategies to enhance the benefits beyond what their current models offer. For tanker vessels, the evidence points to a clear advantage for those within pools compared to their non-pool counterparts. Yet, it's noteworthy that the utilization ratio for pooled tankers falls short relative to non-pooled ones, which could imply potential revenue losses for shippers. This finding proposes that charterers might consider incorporating terms in their agreements that require pool operators to fully utilize the capacity of the vessels. Additionally, there's room for pool operators to develop strategies that optimize each vessel's capacity utilization—a topic that warrants further investigation.

6.2 Limitations

The study is subject to certain limitations that could have a bearing on the research question and potentially affect the findings. Firstly, the research relied on cross-sectional data because historical records concerning pool operators were not available. Should such historical data become available in the future, it would be valuable to revisit the study to examine the longitudinal results.

Furthermore, this research proceeds on the assumption that all vessels cataloged in the shipping pools were consistently under the purview of these pools for the entire 2022 study period. It's essential to recognize that this might not accurately represent the operational status of these vessels. Some may have spent a portion of the year operating independently or could have exited the shipping pools at various points during the study period.

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