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CHRISTINA EVANGELOPOULOU

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Members of the Committee:

- Prof. Vasileios-Christos Naoum - Supervisor
- Prof. Dionysios Polemis
- Prof. Ioannis Lagoudis

The approval of this Master's Thesis by the Department of Maritime Studies of the University of Piraeus does not imply acceptance of the views expressed by the author.

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Abstract

The aim of this thesis is to investigate the accounting framework of shipping companies and the main methods of ship valuation. Initially, the International Financial Reporting Standards (IFRS) and the US Generally Accepted Accounting Principles (US GAAP) are analyzed with emphasis on their applications in shipping and the differences between the two standards. Then, the structure of the freight market, the shipbuilding and used ship market, the demolition market and the factors that affect prices in each market are examined. The main valuation methods are then analyzed – market approach, income and replacement cost approaches - a comparison of their applications is made, and the influence of the chosen accounting framework on them is investigated. The case study that was carried out aims to investigate the valuation methods applied in the financial statements of shipping companies. The conclusions highlight the importance of the chosen valuation methods and accounting framework for shipping companies and some suggestions for future research are presented.

Key words: Vessel valuation, IFRS, US GAAP, Shipping industry, Accounting framework

Περίληψη

Στόχος της παρούσας διπλωματικής είναι η διερεύνηση του λογιστικού πλαισίου των ναυτιλιακών επιχειρήσεων και των κυριότερων μεθόδων αποτίμησης πλοίων. Αρχικά αναλύονται τα Διεθνή Πρότυπα Χρηματοοικονομικής Αναφοράς (ΔΠΧΑ) και οι Γενικά Αποδεκτές Λογιστικές Αρχές των ΗΠΑ με έμφαση των εφαρμογών τους στη ναυτιλία και των διαφορών μεταξύ των δύο προτύπων. Έπειτα, εξετάζεται η δομή των ναυλαγορών, των αγορών νεότευκτων και μεταχειρισμένων πλοίων, η αγορά διάλυσης και οι παράγοντες που επηρεάζουν τις τιμές στην εκάστοτε αγορά. Στη συνέχεια αναλύονται οι βασικότερες μέθοδοι αποτίμησης-προσέγγιση της αγοράς, εισοδήματος και κόστους αντικατάστασης- πραγματοποιείται μία σύγκριση των εφαρμογών τους και διερευνάται η επιρροή του επιλεγμένου λογιστικού πλαισίου σε αυτές. Η μελέτη περίπτωσης που πραγματοποιήθηκε στοχεύει στην διερεύνηση των εφαρμοσμένων μεθόδων αποτίμησης στις οικονομικές καταστάσεις ναυτιλιακών εταιρειών. Τα συμπεράσματα τονίζουν τη σημασία των επιλεγμένων μεθόδων αποτίμησης και λογιστικού πλαισίου για τις ναυτιλιακές εταιρείες και παρατίθενται ορισμένες προτάσεις για μελλοντική έρευνα.

Λέξεις κλειδιά: Αποτίμηση πλοίων, Διεθνή Πρότυπα Χρηματοοικονομικής Αναφοράς, Γενικά Αποδεκτές Λογιστικές Αρχές των ΗΠΑ, Ναυτιλιακή βιομηχανία, Λογιστικό πλαίσιο

1.Introduction

The shipping industry is capital-intensive and exposed to global risk factors. Many of the industry's distinctive characteristics are attributed to the shipping companies' main long-term asset which is the vessel. Shipping accounting has to consider both the international operations, and therefore risks, shipping companies expose themselves to and the peculiarities of their assets. The volatility of the shipping markets and fluctuations in vessel market values also call for an understanding and appropriate use of vessel valuation methods. Vessel valuations are after all essential for many aspects of the shipping industry, including debt financing, insurance coverage, transactions and bookkeeping.

In Chapter 2 of this thesis the distinctive features of shipping companies compared to companies operating in different industries are explained and the importance of shipping accounting is established. The main accounting frameworks used by shipping companies are the International Financial Reporting Standards and the Generally Accepted Accounting Principles (US GAAP), which are both analyzed, focusing on their specific applications in the reporting of shipping companies. Then, the main differences between these standards will be presented.

Chapter 3 revolves around the 4 shipping markets, as categorized by Stopford- the freight market, the shipbuilding market, the sale and purchase market and the demolition market- so that the factors affecting their rates can be understood. Based on the existing literature, factors affecting freight rates, newbuilding prices, secondhand vessel prices, and scrap prices are examined.

In Chapter 4 the importance of vessel valuation for various shareholders of the maritime sector is explained as well as the challenges specific to the volatility of the markets. The importance and adversities of vessel valuations constitute important information so that the valuation methods presented, analyzed, and compared with one another are thoroughly understood. In this chapter the selected accounting framework's effect on valuation metrics is briefly discussed.

Finally, the financial reports of ten publicly listed shipping companies are evaluated to extract information regarding the application of the vessel valuation methods encountered in the literature used and suggestions for further research are made.

2.Aspects and accounting framework of shipping companies

Accounting plays a critical role in evaluating a company's overall performance and internal controls. It systematically records and analyses financial events while also exporting quantifiable results and statistical data. Ultimately, all these are reflected in the financial statements produced through the accounting process. Additionally, accounting supports the monitoring of a company's assets and changes in its financial position. This information provides the necessary tools for decision-makers and stakeholders to make informed choices about the company's strategy and operations.

Accounting representation is crucial for companies and varies widely by company characteristics. An entity's size, operations and regulatory environment are parameters affecting its financial management. While the accounting framework is shaped by local standards for shipping companies operating in an international environment, the adoption of international accounting standards is especially important. Standards such as IFRS, IAS and US GAAP ensure the transparency and comparability of a company's accounting standards across the globe.

This chapter aims to introduce some distinctive features of shipping companies and, subsequently, of shipping accounting. By recognising the main areas of activity in which these standards are implemented in the shipping industry, IFRS and US GAAP standards are analysed and then compared based on their key differences.

2.1 Distinctive features of shipping companies

A shipping company is the economic entity whose core business revolves around vessels, either as a shipowner or ship operator, and, more generally, as an organization that manages or exploits ships it owns or ships owned by third parties to provide maritime transport services. (Protopsaltis and Sarakostidis, 2003) Shipping is a capital-intensive industry with large investment risks. High fixed costs, such as depreciation and interest, constitute a large share of the total expenses and render operating costs relatively inelastic. (Protopsaltis and Sarakostidis, 2003)

Many of the industry's distinctive characteristics are related to the shipping companies' main long-term asset which is the vessel. As an organization, the shipping company is divided between its production units, the vessels, and its on-shore management company (Theotokas, 2019). Each vessel is in constant motion and may operate in different parts of the globe, miles away from the company's headquarters. (Theotokas, 2019)

The global nature of the shipping sector, especially the part pertaining to bulk and liner trade, exposes the company and its assets to risks such as weather conditions, war, piracy and pollution. Consequently, income and expenses as they incur during a vessel's voyage are unpredictable compared to other businesses whose financial flows are more stable and thus easier to estimate. (Protopsaltis and Sarakostidis, 2003)

The following areas reveal other distinctive characteristics with implications for a company's accounting practices and financial reporting:

1. Different flags

A vessel's port of registry is crucial for its legal and tax regime, and its flag state. These characteristics can affect the vessel's earning ability, for example a vessel's flag state can limit its access to certain ports. Different flag states also have different registration fees and compliance costs which should all be considered upon the vessel's registration. (Protopsaltis and Sarakostidis, 2003) The tax regime under which a vessel operates is also important for its accounting treatment. An example would be the tonnage tax for EU-flagged vessels, the owners of which are taxed based on the amount of tonnage in

operation at a flat rate and not on the company's profit and loss. (Leggate and McConville, 2005) In many shipping companies there is not one selected flag state but a variety based on the age, condition, gross weight or preferred trading route for each vessel. The company's accounting department should therefore treat a vessel's flag as a financial variable.

2.Non accounting records

Shipping companies keep some non-accounting records that are, however, useful tools for their accounting departments and are not met in other industries. Such records may depend on company procedures, the ship's logbook, crew register, or the fuel, lubricant, and water consumption logbook. (Protosaltis and Sarakostidis, 2003)

3.Foreign currency

Accounts in foreign currency that are common in shipping companies are personal accounts like deposits or loan obligations, cash accounts and the master's general account. As previously mentioned, shipping is a global industry and vessels can operate in different parts of the globe. Cross-border financing and expenses in different regions result in obligations in obligations expressed in different currencies. Bookkeeping in foreign currencies requires methods like recording transactions at the equivalent using the exchange rate at the transaction date, the accounting rate method and the Gabriel Faure method. Companies may also maintain separate books or records for each currency. (Protosaltis and Sarakostidis, 2003)

4. Master's account

The responsibility of onboard management is borne mainly by the ship's captain. The Master's General Account is prepared by the captain and constitutes a financial statement through which an economic report for the relevant period is submitted to the shipping company. Depending on the company's policy, this period may be a voyage, a month or more. The Master's General Account represents a detail statement of his transactions and is accompanied by the necessary documentation. The account may

include the crew payroll statement, cost of provisions, expenses during the voyage, and the master's cash account. (Protopsaltis and Sarakostidis, 2003)

5.Type of vessel

Depending on the type of ship and its contractual arrangements revenue and expenses appear to be quite different. For example, a passenger's ship revenue source is the passenger's tickets, while the revenue for tankers and bulk carriers stems from their type of employment. This may involve a spot voyage, a time charter, participation in a pooling arrangement etc. (Protopsaltis and Sarakostidis, 2003) Cost structures are also diverse based on the vessel's type, speed, fuel prices etc. A Very Large Crude Carrier (VLCC) typically incurs higher operational expenses and fuel costs than a container vessel. On the other hand, container vessels are burdened by higher costs for cargo handling at terminals. (Kavussanos and Visvikis, 2018)

It is evident that accounting in shipping presents certain peculiarities due to the nature of shipping companies. The need to accurately account for revenue recognition, operational costs, and international transactions is essential for the effective financial management of a shipping company. It is thus apparent that the specific requirements of shipping accounting need to be thoroughly understood and carefully met.

2.2. The role of shipping accounting

The management and administration of shipping companies is part of maritime economics and as expected also affects the relevant sector of accounting. Shipping accounting is a branch of private accounting, also referred to as industry or corporate accounting. More specifically, shipping accounting deals with the economic unit of the shipping enterprise. While there are no substantial differences in the required account types and volume compared to other enterprises, shipping accounting involves distinctive transactions specific to maritime activity, as previously mentioned. (Protopsaltis and Sarakostidis, 2003)

Banks and shareholders alike rely on the accurate presentation of a company's financial position. The majority of vessel acquisitions are financed through bank loans and in order for the bank to assess the investment risk, evaluate the company's

creditworthiness and decide on the loans terms it is necessary that the company's accounting reports are maintained diligently. The shareholders' investment decisions are also guided by their evaluation of these reports.

On a management level, accounting data aiding in optimizing operational efficiency and decision making is essential in the high-stakes market that is maritime transportation. Additionally, the high operating costs and value of the assets require proper tracking and compliance with the current accounting standards.

The most common accounting standards in the shipping sector are IFRS and US GAAP. The global activity of the shipping in industry has created the need for a uniform accounting system that allows transparency and comparability. To achieve these, some generally accepted accounting principles have been established.

In summary, they can be described as follows:

- The historical cost principle: Assets are recorded at their acquisition cost.
- The revenue realization principle: Revenue is recognised when it is earned, regardless of when cash is received. This principle is followed in accrual accounting.
- The matching principle: Revenue and expenses are codependent and should both be reported in conjunction with each other.
- The objective principle: All parties are assumed to be acting with the utmost transparency and honesty.
- The consistency principle: Accounting methods and standards remain the same throughout the financial reporting process.
- The conservatism principle: Accountants treat with diligence and with caution every entry, data verification and documentation.
- The materiality principle: All monetary information significant to the entity's financial position is reported. (Protosaltis and Sarakostidis, 2003)

2.3 International Financial Reporting Standards (IFRS)

The International Financial Reporting Standards (IFRS) are developed and published by the International Accounting Standards Board (IASB). These standards are required in some of the most important capital markets worldwide and in 2005, the European

Union required companies listed in major European stock exchanges to adopt International Financial Reporting Standards. A great number of firms globally have also been reporting under the IFRS. Any issues that arise from the application of the IFRS Accounting Standards are reported to the competent authority, which is the IFRS Interpretations Committee. (Georgiou, 2010)

In the shipping industry, the interpretation and application of IFRS principles pose unique challenges. The characteristics of the assets, obligations and contractual agreements define shipping accounting and differentiate it from other sectors. The main areas shipping companies have to place their focus on when applying the IFRS standards are the following:

1. Cost capitalization
2. Depreciation and residual value
3. Assets held for sale
4. Impairment of non-financial assets
5. Leasing
6. Consolidation and joint arrangements
7. Revenue and costs
8. Financial instruments

(KPMG International, 2012)

2.3.1. Capitalization Cost

A newly built or purchased vessel has to be recorded in the company's accounts at its cost. The cost includes several components, starting with the cost of purchasing a slot in the shipyard and securing a space on the shipyard's schedule. The installments at the shipyard are staged and design changes drastically change the total cost. During the vessel's concept and preliminary design stages the cost and revenue generating capability are apparent. The shipyard, however, may quote a definitive price after the contract design is completed and a set of specifications and drawings have been submitted in order to proceed with developing the detailed design. Further revisions may be necessary until the vessel is delivered driven by market demand or regulatory changes. (Lin and Shaw, 2017)

The cost also includes a vessel's financing and hedging expenses. Under IAS 23: *"Borrowing costs that are directly attributable to the acquisition, construction or production of a qualifying asset form part of the cost of that asset. Other borrowing costs are recognized as an expense."* (IFRS Foundation, 2007)

Other than interest expenses as calculated in IFRS 9 with the effective interest method, foreign exchange differences that are considered adjustments to interest cost are also regarded as borrowing costs. Interest related to lease liabilities, as recognized under IFRS 16, is also included in borrowing costs. (IFRS Foundation, 2022)

When a loan is undertaken for a specific qualifying asset calculating the borrowing cost is fairly simple. Complications arise in circumstances where a group's funds are raised from multiple lenders with different interest rates and redistributed to entities within the group or in cases where loans linked to foreign currencies are undertaken. In order to estimate the amount of borrowing costs to be capitalized using a capitalization rate, a weighted average interest rate is applied to the total outstanding borrowings of the entity. Notably, the capitalization of borrowing costs for the construction of a vessel should align with the period in which construction costs are capitalized. (KPMG International, 2012)

Vessel construction contracts that are signed in a currency different from the main currency used by the company can be considered as hedged items. In this case, hedging is applied to reduce the currency risk. If the hedging strategy used is a cash flow hedge, then the effective portion is recognized in other comprehensive income (OCI) as a cash flow reserve and the ineffective portion is recognized is recorded through the profit and loss account.

Costs necessary for the operation of the vessel are eligible for capitalization and that includes repositioning costs from the shipyard to the nearest major port. Operating losses during the first voyage's commencement are expensed as incurred. For a newly constructed vessel to be operational it is necessary that an initial inspection for its certification is conducted. The certificates are mainly issued by the chosen classification society and flag administration. When purchasing a second-hand vessel, the repositioning costs are not eligible for capitalization because usually in Sale and Purchase (S&P) contracts ownership is transferred at a port of convenience.

After the delivery of a vessel certain costs are also capitalised during its life. Modifications aiming to increase the vessel's operating efficiency and life for example, as well as those undertaken to ensure compliance with new regulations may also be considered costs eligible for capitalization. (KPMG International, 2012)

2.3.2. Depreciation and residual value.

A vessel's depreciation begins once its construction is complete and it is deemed operational. While there is a variety of methods included in IAS 16, shipping companies usually opt to depreciate their vessels using a straight-line method. (IFRS Foundation, 2020)

The calculation of a vessel's depreciation entails that the asset's useful economic life and residual value is examined. A vessel's useful economic life is generally around 25 years but it is heavily dependent on factors such as the type, maintenance, regulations, and market conditions. In practice, the engineering life is not equated to the useful life for a variety of reasons including but not limited to the vessel's deployment, maintenance cost etc.

Similarly, the residual value is the expected amount the company could receive by selling the vessel at the end of its useful life, an estimate made by comparing it to similar cases not accounting for future inflation. For a vessel approaching the end of its useful life, meaning that there do not seem to be any employment opportunities, using the steel price to calculate residual value is a valid approach.

All of the above methods and estimation assumptions should be disclosed under IAS 16, as well as the accumulative depreciation and depreciation charge, keeping the ranges as specific as possible. Furthermore, under IAS 16 Property, Plant and Equipment (PPE): *“Each part of an item of property, plant and equipment with a cost that is significant in relation to the total cost of the item shall be depreciated separately.”* (IFRS Foundation, 2020)

Significant parts with the same useful life and depreciation method may be grouped together. When significant parts are depreciated separately, the remaining parts should also be depreciated with approximation methods if they are considered to also present varying useful lives. It is reported that shipping companies choose to regard the vessel

as one item with no further physical components to be depreciated separately if there is no evidence against this. One would assume however that in cases where equipment is replaced it would be depreciated separately from its older counterparts.

Non-physical components fall also under this rule. This can refer to overhauls or major inspections. Dry dock inspections are accounted for separately and the expenses for the survey and jobs performed are depreciated over the period until the next dry dock occurs. A dry dock is mandatorily presented in regular intervals (maximum 36 months) during the vessel's life with, high costs, so the impact on financial presentation is quite important. (KPMG International, 2012)

2.3.3. Assets held for sale

Looking into IFRS 5 Non-current Assets Held for Sale and Discontinued Operations, depreciation is suspended for assets meeting the criteria to be classified as held for sale. Qualifying assets should be ready for immediate sale upon request and the entity should prove its commitment to selling the asset. For a shipping company that would mean contacting a broker, providing the necessary documentation, reviewing offers, and carrying out any necessary inspections. Unless circumstances outside the owner's control are met then the vessel is expected to be sold within a year of its classification as a qualifying asset. The asset should be measured at the lower of its carrying amount and fair value less costs to sell, for example brokerage fees. There is a strict distinction when reporting assets acquired by directly purchasing them and assets acquired through mergers. (IFRS Foundation, 2004; KPMG International, 2012)

2.3.4. Impairment of non-financial assets

Testing an asset for impairment aims at figuring out whether its carrying amount is not too high relative to the future benefits it may generate for the company. An asset is impaired when its recoverable amount is less than its carrying amount upon comparison, meaning that its carrying value needs to be reduced.

Under IAS 36 the recoverable amount is the higher of the fair value less costs to sell or the value in use. Fair value is described as the expected received amount from the sale of an asset, in this case a vessel, subtracting any necessary costs relating to the sale

procedure, such as legal or brokerage fees. Value in use, on the other hand, is the present value of the expected future cash flows if the company continues using the asset or CGU. (IFRS Foundation, 2021)

The factors to consider when accurately predicting future cash flows are the vessel's chartered or spot rates, its operating days (days at sea), OPEX, and its useful economic life. The only maintenance costs considered are dry-docking cash flows, as they are necessary for the vessel's operability. Cashflow projection in shipping companies is complicated due to the charter agreements and cyclical nature of their operations. This justifies adjustments in the five-year horizon suggested under IAS 36. (KPMG International, 2012)

To calculate the discount rate applied to future cashflows the weighted average cost of capital (WACC) is adjusted to reflect the market participant's discount rate. To arrive at this result, chartering arrangements risks, terminal value and risks associated with type of vessel at hand have to be taken into account.

Usually, directly using a post-tax discount rate, such as WACC, despite IAS dictating that a pre-tax discount rate should be used, would be incorrect. However, tonnage taxes in shipping companies under IAS 12 are not considered income taxes and therefore do not violate IAS 36 when calculating discount rates.

To examine asset impairment usually, the individual asset cash flow generation would be taken into account. In the case of shipping companies that is fairly difficult because a vessel is operated in the context of a fleet of vessels with similar characteristics. According to IFRS 8 Operating segments, a fleet falls under the description of an operating segment since its vessels present similar economic characteristics. Cash generating units cannot be larger than an operating segment and asset groups need to be grouped into the smallest possible pool. It is suggested that in order to assess which groups of assets produce independent cash flows it is useful to consider revenue separation and asset separation.

Individual asset testing is easier when dealing with highly specialized vessels such as heavy lift ships or when chartered to an individual customer on specific terms. Applying this to liner companies is almost impossible due to their highly integrated operations.

Vessels are highly susceptible to impairment triggers due to the volatile nature of the market in which they operate. Drops in freight rates, lower newbuilding and resale prices affect existing vessels' fair market value and possibly mean that their carrying amount is currently overstated. Additionally, a weak market leads to many vessels being laid up since their operating costs far exceed their possible profits, thus impeding their capability to produce cashflows. Other triggers for impairment include major damage to the vessel that obstructs its normal operational capabilities, as well as regulations affecting the vessel's compliance with maritime regulations. The latter, depending on the regulations and depending on if the stage of enforcement of the regulation, implies different things for the vessel's chartering potential or operation viability all together.

In the case of newbuildings, the market's volatility can affect impairment before delivery. If the construction cost is higher compared to the fair value or estimated value in use and contract cancellation entails a penalty, the contract may be considered a liability under IAS 37 Provisions, Contingent Liabilities and Contingent Assets. When it is determined that the contract fulfilment or cancellation damages far outweigh any benefits, an impairment loss is recognised before a provision for the contract is recognized. (IFRS Foundation, 2020)

Reversal of impairment

At the reporting date, if there is evidence that the recoverable amount increases (not if it arises by accounting of the discount), the company is able to reverse the impairment. In this case, depending on which amount is lower, the carrying amount can be increased to the recoverable amount or to the carrying amount before the impairment, with depreciation accounted for as well. Impairment reversals are recognised in the income statement or to other comprehensive income if they have been revaluated.

2.3.5. Leasing

In January 2016, IASB issued IFRS 16 Leases, which affected the previous standards as set by IAS 17. Before IFRS 16, the main objective of lease accounting as set by IAS 17 was whether an arrangement fell under a finance lease or an operational lease. This distinction was critical when assessing if an arrangement should be presented in the

balance sheet, as seen in the case of finance leases. The new standard, however, with the few exceptions of short-term leases and leases of low-value assets, requires that all lease agreements be recognised in the lessee's balance sheet. (PwC, 2016)

The effects of IFRS 16 are especially important for the shipping industry because bareboat charter agreements and time charter contracts are classified as leases. More specifically, the definition of a lease is a contract that conveys the right to use an explicitly or implicitly identifiable asset, in our case a vessel, for a certain period of time in exchange for consideration.

The main implications of the new standard application are its results on key accounting metrics. Under previous accounting standards most charter contracts fell under an operating lease and thus liabilities were not present on the balance sheet. Under IFRS 16, including lease liabilities on the balance sheet has a direct effect on net debt and gearing. A front-loaded interest expense reduces net assets. The decrease is justified because although both lease liabilities and right-of-use assets are recorded on the balance sheet at the same time, lease liabilities decrease more slowly in the early years than right-of-use assets, which are amortized on a straight-line basis.

Other than its effect on the charterer's balance sheet, the recognition of interest expense on the lease liability and asset depreciation on the income statement, is making expenses appear higher at the beginning of a lease period. The result is an increase of Earnings Before Interest and Taxes (EBIT) and Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA) for companies with a substantial number of operating leases. Additionally, previously classified operating leases will now not be presented in operating cash flows at their entirety. The principal portion must be classified within financial activities and payments that reflect interest as an operating cash flow.

The above accounting metrics can influence debt capacity, investor perceptions, management decisions and thus affect charterer's behaviour when negotiating new contracts since the accounting effects of new contracts are vital to the company's performance. (PwC, 2016)

2.3.6. Consolidation and joint arrangements

It is increasingly prevalent in the current environment that companies organize their activities under a group structure, a decision mostly associated with risk diversification. Such is the case for many shipping companies that exist in a corporate group and are recognised under the law as separate legal entities. (Yeo, 2012) To navigate financial reporting in this landscape several International Accounting Standards and International Financial Reporting Standards are being used.

Under IFRS 10, an investor is considered to be a parent when they have control over an investee, are entitled to variable returns that they have the power to influence. In this sense power is defined as the capability to direct the activities affecting the returns. When the previously mentioned three criteria are met, under IFRS 10 the parent is required to present consolidated financial statements using uniform accounting policies with the subsidiaries. An exception to the above are investment entities that are not required to consolidate their financial statements. Instead, under IFRS 9 should calculate investment at fair value through profit or loss.

For joint arrangements, meaning joint ventures or joint operations in which parties that have joint control and are bound by a contractual arrangement, IFRS 11 is consulted for the financial reporting. Decisions regarding activities tied to returns have to be reached by consensus. Entities that have an interest in joint arrangements should apply IFRS 12 providing disclosures to users of its financial statements. The aim of these disclosures should be to inform users of the characteristics of their holdings in their entity and risks associated with them, as well as how they influence its cash flows, financial position and performance. (KPMG LLP and KPMG IFRG Limited, 2025)

With respect to business combinations, IFRS 3 suggests that all acquired liabilities and assets are recorded at fair value at their acquisition dates. IFRS 3 includes guidelines on identifying and evaluating in the financial statements any goodwill acquired or gain from a bargain purchase. To accurately define the acquirer, IFRS 10 is usually adequate. Complementary to the above, the main International Accounting Standards addressing aspects of accounting for investments in other entities and reporting the relationship between all parties involved are IAS 27 Separate Financial Statements, IAS 28 Investments in Associates and Joint ventures, and IAS 24 Related Party Disclosures.

According to IAS 27, when an entity presents separate financial statements, investments should be accounted for at cost, based on IFRS 9 or by applying the equity method. The application of the equity method is outlined in IAS 28, under which in a joint arrangement the initial investment is recognized at the acquisition cost. Afterwards, the carrying amount is adjusted to reflect the investors share of the profit or loss. The investment's carrying amount is further reduced upon receipt of distributions, and further adjustments are made when changes occur in ownership interest or share in the investee's other comprehensive income (IFRS Foundation, 2014; IFRS Foundation, 2017). Lastly, IAS 24 as a main objective aims to ensure the necessary transparency in disclosing the relationship between the related parties and transactions possibly affecting the financial position and profits and loss. (KPMG LLP and KPMG IFRG Limited, 2025)

Shipping pools in the shipping industry are the main arrangements in which the above accounting standards are applied. Depending on the specifications of the pool arrangement the accounting outcome is affected. The most common structures are:

- The company controls the pool and therefore presents consolidated financial statements
- The pool is considered a joint operation and the company has to recognize its share in the pool's revenue, expenses, assets and liabilities in its statements
- The company charters a vessel into the pool and therefore only the net income is recorded.

Most commonly, pools fall under the second category. They are recognized as separate legal entities and usually have clear rights to assets and obligations for liabilities stemming from the pool. (KPMG International, 2012)

2.3.7. Revenue and Cost

In May 2014 IFRS 15; *Revenue from contracts with customers* was issued by FASB and IASB to replace, among other standards, IAS 18 and ASC Topic 606 in providing the framework for revenue recognition. The standard was considered effective starting at 1 January 2018.

Because the IFRS 16 amendments affect the application of IFRS 15, IFRS 15 does not apply to lease contracts. Accounting for a lease contract requires additional consideration of which components fall under revenue contracts and should be accounted for under IFRS 15.

Although lease and non-lease components should be separated and accounted for accordingly, under IFRS 16, paragraph 5, a practical expedient allows both components to be treated as a single combined lease if the lessee chooses this approach. Exceptions to this are embedded derivatives as characterised by IFRS 9 Financial instruments paragraph (4.3.3).

For non-lease components, to recognise revenue under IFRS 15 a five-step model is followed. An entity should first identify the contract with a customer and then recognize the performance obligations as set in the contract. The entity then determines the transaction price or estimates the amount of consideration when a variable amount is included. A transaction price is allocated to each distinct performance obligation, service or goods, based on a specific standalone selling price defined at the contract's initiation. Finally, revenue is recognised when a performance obligation is fulfilled, either at a point in time or over a certain time period. Usually, performance obligations satisfied over time are promises to transfer services and not promises to transfer goods. Revenue should be recognized over time only if the entity can reasonably assess its progress towards full fulfilment of the obligation.

When examining the impact of IFRS 15 on the shipping industry, several key considerations emerge. In order for a shipping company's revenue to reflect the transfer of promised services, the time frame in which this revenue is recognised should be from the cargo's loading operation to its discharge at the discharging port. This means that, compared with practices used under previous accounting standards, which recognised revenue in the time period between two discharge operations. Revenue is therefore recognised at higher rates for fewer days each year, leading to timing differences for voyages spanning more than one accounting period. The costs during a ballast voyage that would have been previously recognized as occurring will be deferred, because of IFRS 15, to match the revenue once it starts being recognized. (Barone, 2025)

Lastly, another peculiarity of the contracts encountered in sea transportation is demurrage. It is impossible to predict whether the laytime allowed under the

charterparty will be breached and the amount of liquidated damages that will accrue. In consequence, demurrage entails variable consideration and should be taken into consideration when calculating the transaction price if the chance of it occurring is deemed high. (Belesis, 2021)

2.3.8. Financial Instruments

Using derivatives for risk management or speculation is becoming increasingly common among shipping companies. The most common derivatives are Forward Freight Agreements (FFAs), Bunker Swaps, and Interest Rate Swaps (IRS). (Drakoulakos, 2020)

Forward Freight Agreements are financial derivatives on freight rates or time charter rates aiming to hedge freight rate risk. Participants in these swap contracts are usually ship-owners, charterers seeking to secure future revenue, or traders seeking to speculate. The reporting of closing prices and monthly settlement prices of FFAs is executed by The Baltic Exchange. (Kasimati and Veraros, 2018)

Similarly, swap contracts are used as a countermeasure against fluctuations in bunker prices. Shipping companies seek to employ these contracts because bunkering amounts for a big percentage of a vessel's operating costs. For bunker swaps other than the contract's delivery date, the swap contract price and bunker amount are also determined. For parties involved, one party pays a fixed price as calculated by multiplying the contract price by the bunker amount, and the second party pays a floating amount based on the hedged bunker amount multiplied by the bunker spot market price. Hence, after the settlement, the party paying the fixed price is able to purchase bunkers from the spot market at the fixed floating rate (Wang et al., 2018). Lastly, to manage interest rate risk on borrowing employing Interest Rate Swaps allows for a fixed rate exposure instead of a floating rate tied to a bigger liability exposure risk.

The IASB issued IFRS 9 with the intention to replace IAS 39, effective from January 1st, 2028. The new standard provides guidance on the classification and measurement of financial instruments and specific contracts for the sale and purchase of specific non-

financial assets. Furthermore, it aims to enable companies to improve their reporting using derivatives in their risk management strategy.

According to IFRS 9 all derivatives should be presented at fair value and changes in their value should be recorded in the profits and loss account. This requirement is not applicable in cases where hedge accounting is applied. Derivatives at fair value through profit or loss may be designated as hedging instruments used to offset the risk of the entity's hedged items with some exceptions. Hedged items are assets, liabilities, firm commitments or forecast transactions of high probability with external parties. Proper documentation of a hedging relationship consisting of eligible hedging instruments and hedging items is mandatory to be qualified for hedge accounting. In addition to the above the entity should include their risk management strategy and objective regarding the hedge.

Hedging relationships are categorized similarly to IAS 39 as:

- Fair value hedges
- Cash flow hedges
- Hedges of net investment in a foreign operation

The last category is not applicable to derivatives used commonly by shipping companies. For fair value hedges, changes in the hedged item's fair value that can be attributed to the risk being hedged lead to adjustment of the item's carrying value and are recognised in the profit and loss account. (Drakoulakos, 2020)

2.4 U. S General Accepted Accounting Standards (US GAAP)

The General Accepted Accounting Standards (GAAP or US GAAP) are the standards followed by the U.S Securities and Exchange Commission (SEC). Reporting to the SEC or state regulators by adopting US GAAP standards, is a requirement for any domestic companies with stocks or bonds publicly traded in the U.S markets. As appointed by the Financial Accounting Foundation (FAF), the Financial Accounting Standards Board (FASB) sets the accounting standards used in financial reporting by public companies.

Using as a guide the areas of importance as set in paragraph 2.3 of this study, it is concluded that the main applicable US GAAP standards for shipping accounting are the following:

ASC 360

ASC 835

ASC 842

ASC 840

ASC 805

ASC 810

ASC 820

2.4.1. Property, Plant and Equipment: ASC 360

Under US GAAP long lived asset's recognition, depreciation, impairment and disposal are addressed in ASC 360. Similar to IFRS, the initial recognition of PPE is at cost, measured as the total of expenditures to construct a vessel and bring it to a location that allows it to be operated for its intended use. Another similarity of the two standards regarding PPE is the depreciation of such assets over their useful lives.

Lastly, one key takeaway when looking into both standards is that under US GAAP while using a components approach is not prohibited, it also is not mandatory. Expenses such as a vessel's bottom or intermediate survey will be generally expensed as incurred and not depreciated over their useful lives. (PwC, 2025)

2.4.2. Capitalization of Interest: ASC 835-20

Vessels meet the qualifications set by ASC 835-20-15-5 for assets whose interest cost is part of the asset's acquisition historical cost and should be capitalized. Specifically, it is mentioned that assets produced as identifiable projects with the intent of being sold or leased in the future, such as vessels, are qualified for this category.

For the capitalization of costs included in a vessel's construction, under US GAAP ASC 835-20-10-2 and ASC 835-20-20, interest costs are eligible for capitalization. On the contrary, gains or losses arising from foreign exchange differences are treated differently.

The capitalization period based on ASC 835-20-25-3 commences once expenditures related to the construction have taken place, activities tied to the process have begun and interest cost is being incurred. If these conditions are deferred, with the exception of brief or necessary interruptions, or the construction is completed, capitalization is interrupted as stated in ASC 835-20-25-4 & 5. Capitalization of interest is also not interrupted in case of impairment below acquisition cost. (PwC, 2024)

Initial and subsequent measurement

Section 835-30 provides guidance for the amount of interest cost capitalized at first recognition. The amount of interest to be capitalized under 835-30-3 is determined by applying the calculated capitalization rate, based on the entity's outstanding borrowings to the average amount of accumulated expenditures for the vessel during the period. Capitalized interest cannot exceed the total interest incurred. The amount should express the interest cost incurred directly correlated to a vessel's construction that would have otherwise been avoidable if the order had not taken place. Accumulated expenditures are determined on a cash basis, with the exception of accruals bearing interest, solidifying the connection between incurred interest and the vessel's construction. After the initial recognition, the interest capitalized as part of the asset's historical cost is linked to its estimated useful life and amortized over the same period. (PwC, 2024)

2.4.3. Depreciation

It is worth mentioning that there is not a specific requirement under US GAAP to review useful lives or methods of depreciation annually. Such depreciation estimates are suggested to be reviewed periodically without prompt from impairment indicators. Moreover, a depreciable asset's residual value is not explicitly defined or measured.

Depreciation accounting states as described in 360-10-35-4 that the cost of an asset is distributed over its useful life and may include a residual value subtraction. This cost is expensed through profits or loss as it would also have been under IFRS.

2.4.4. Impairment of non-financial assets

Under US GAAP, impairment testing has a two-step approach, is performed at the asset group level, and is not required to be performed on an annual basis. Based on 360-10-35, first the future net undiscounted cash flows expected to arise from operating the vessel and its eventual disposal have to be estimated. Afterwards, the estimated amount has to be compared to the carrying amount of the asset. It is deemed that an asset is not recoverable if its carrying amount is higher than the discounted cash flows. In that case, its fair value must be measured and the determined impairment loss recognized.

For the determination of asset groupings, similarly to IFRS, impairment testing is performed at the lowest level at which cash inflows can be identified that are mostly independent from identifiable cash inflows of other assets or groups. The term "cash generating unit" is not present in the guidelines.

Finally, impairment losses under US GAAP are permanent and cannot be reversed regardless of circumstances. This contrasts with IFRS where reversal of impairment is permitted. (PwC, 2025)

2.4.5. Leasing

In 2016, FASB issued Accounting Lease Standard No.2016-12, Topic 842, Leases with implementation beginning in 2022. According to the new standard, the definition of which contracts constitute a lease or contain a lease is no different from the definition set by IFRS 16.

The lessee ought to apply a dual classification accounting model that distinguishes between finance leases and operating leases on the balance sheet. Short-term leases are not required to be presented on the balance sheet, but this does not extend to leases of low-value assets.

Finance leases under ASC 842-10-25 are characterized as sales-type leases or direct finance leases based on the concept of transfer of control. More specifically, sales-type leases are the arrangements that directly transfer control to the lessee and direct finance leases are the arrangements that transfer risk and rewards but not control. (Potharla, 2025)

Initial measurement

Both operating and finance leases are subject to the same initial recognition guidelines under US GAAP. At the lease's commencement the lease liability and right-of-use asset shall be measured. For initial recognition of the lease liability under 840-20-30, the lease liability is measured at the present value of the lease payments not yet paid, discounted at the lease rate. The discount rate is either implicit in the lease or determined using the incremental borrowing rate or risk-free discount rate for non-public companies.

The lease liability is measured at amortized cost under the effective interest method. The liability is subject to remeasurement if changes in the arrangement or payments occur. On the contrary, changes in an index on rate do not justify remeasurement unlike in IFRS. (PwC, 2023)

Amortization and Impairment for Leases

Under US GAAP amortization does not follow the guidelines for property, plant and equipment. Instead, the requirements as set by ASC 842-20-35 are used depending on whether the lease is characterized as an operational or finance lease.

For finance leases, other than the lease liability, a lessee shall measure after initial recognition the right-of-use asset at cost, deducting any accumulated amortization and impairment losses. The right-of-use asset is amortized on a straight-line basis and on

remeasurement the amortization is adjusted to the date it occurred. The period over which the right-of-use asset is amortized can be either of the below:

- From the commencement date to the end of the right-of-use asset's useful life
- From the commencement date to the end of the lease term
- From the commencement date to the end of the underlying asset's useful life if a purchase option is exercised

In operating leases after the initial recognition, the lease liability is measured as mentioned before at amortized cost under the effective interest method and the right-of-use asset is measured at the amount of the lease liability. Impairment losses of long-lived assets, even in the case of leases, is recognized in accordance with section 360-10-35. (KPMG LLP and KPMG IFRG Limited, 2025)

2.4.6. Business combinations

The financial reporting of business combinations under US GAAP is found in ASC 810. According to this standard, a fair-value based acquisition method is applied in which the fair value is determined at the acquisition date. If goodwill arises it is recognized as an asset. On the other hand, if a bargain purchase is measured, it is recognized as a gain in profit or loss.

In the event of a lease contract acquired in a business combination its recognition is separate from the recognition of goodwill upon acquisition. Regardless of whether the acquiree is the lessee or the lessor the classification of the lease is retained. Subsequently, for operating leases a separate intangible asset or liability may be recognized for the in-place lease value. For direct financing or sales-type leases, there is no separate recognition, only the recognition of the net investment's receivable, like in IFRS. (PwC, 2025)

Consolidation accounting

The main consolidation models are the variable interest entity (VIE) and voting interest entity (VOE) model. ASC 810 suggests that all reporting entities should assess whether

a legal entity should be consolidated under the VIE model before consolidating under VOE if the first model is not appropriate.

The VIE model usually applies to entities created for a limited objective. These entities may be securitization vehicles or asset-backed financing structures. According to this, a Single Purpose Company (SPC) meets the criteria of the VIE model. SPCs are legal entities whose only asset is the vessel and are commonly used by shipowners in debt financing to limit liability. (Kavussanos and Visvikis, 2018) Consolidation under the VIE model is also applied to operating companies and joint ventures affecting the shipping sector as mentioned in chapter 2.3. (PwC, 2025)

2.5 Differences between IFRS and US GAAP

In general, IASB standards are considered to follow a principles-based approach, compared with FASB's standards, which are evidently more rules-based. IASB's standards allow more room for interpretation compared to the more specified requirements of FASB. (Barth *et al.*, 2012)

A highly important topic is goodwill reporting because it can predict future cashflows. For investment purposes, assessment of future economic benefits is critical. However, goodwill accounting has been controversial due to the introduction of the impairment-only approach (IOA) by FASB in 2001 and the IASB in 2003. Both accounting boards have been reviewing their approach on business combinations and goodwill with FASB reintroducing amortization in 2020. While IASB is still opposing this idea, a discussion paper has been issued and the board is considering making annual testing for impairments not mandatory, unless impairments signs present themselves. (Schatt *et al.*, 2016) (Amel-Zadeh *et al.*, 2023)

Another area of differences worth mentioning is the concept of fair value for long-lived operational assets. The accuracy of reporting fair value plays a role in the valuation aspect of financial reporting, although its significance for PPE is suggested to be limited.

US GAAP seems to have a more restrictive approach to fair value measurements. Under IFRS property, plant and equipment is measured at fair value and investment property is either presented at fair value on the balance sheet or disclosed in the footnotes. On the contrary, for these assets reported in accordance with US GAAP guidelines it is

mandatory that they are measured at historical cost less accumulated depreciation and impairment. For firms more likely to use debt financing, such as shipping companies, fair value revaluation of PPE and IFRS is more prevalent. (Sellhorn and Stier, 2019)

Regarding PPE, while components depreciation in US GAAP, as mentioned before, is permitted, although not common, in IFRS it is considered a requirement. Differences in the depreciation figures imply differences in the company's bottom line and affect comparability.

IFRS and US GAAP also diverge in their treatment of borrowing costs. Despite a high level of convergence between IFRS standards and US GAAP in accounting for borrowing costs, determining the qualifying assets, eligible borrowing costs and the amount to be capitalized remains a substantial difference. Borrowing costs under IFRS guidance, suggest a broader interpretation than interest costs, and as a result, certain costs may be considered eligible for capitalization under IFRS that would not be eligible for capitalization under US GAAP. The shipping industry's reliance on debt financing and the assets' long construction period entail that accounting differences have material financial effects. (KPMG LLP and KPMG IFRG, 2025; Singh and Boissou, 2019)

The conversion to uniform standards is supported by many as necessary for the facilitation of capital flows across economies and the reduction of information processing costs halting investment efficiency. On the opposite end, those opposed to accounting standards' harmonization speculate that compliance costs will rise. (Nan and Tang, 2024). Although alignment could improve transparency and comparability for international shipping companies, in the present the differences illustrated above can affect the reported financial position and performance of these companies and need to be taken into consideration by the users of these statements.

3. Shipping markets

The shipping industry functions under a complex and uncertain economic environment, shaped by fluctuations in supply and demand, volatile freight rates and vessel prices. The increasing regulatory stringency, growing environmental considerations and various security and geopolitical uncertainties are among the factors shaping the intricacies of the landscape.

The companies participating in shipping, trade within the four most prevalent markets: the newbuilding market, the sale and purchase market, the demolition market, and the freight market. The freight market concerns the vessel's transportation services, while the other markets categorized above concern the vessel's ownership. The activities of the shipping markets are closely correlated, linked by the cash flows of shipping industry participants that drive market cycles. (Kavussanos and Visvikis, 2018; Stopford, 2009)

The shipping market cycles are mainly categorized in three types: seasonal cycles, short cycles and long cycles. Seasonal cycles reflect patterns within a one-year period, directly impacting freight rates that are generally dependent on seasonal patterns of demand (Stopford, 2009). Seasonal factors for example affect container shipping freight rates and the trade of agricultural products. (Yin and Shi, 2018)

Short term cycles, usually lasting for 7 years, are mostly affected by tonnage supply. In a short shipping cycle there are four stages that can be distinctly recognized. During the cycle's trough, there is a surplus of shipping capacity, with freight rates dropping to the operating cost of the least efficient ships and monetary pressure causing market distress. A more active demolition market, slow-steaming in existing ships or their lay-up steadily balance out the supply-demand equilibrium lead to recovery and gradual improvement of freight-rates. As conditions and confidence improve the market cycle reaches its peak, which may last for weeks or even years. During its peak, freight rates rise well above operating costs; laid up vessels, despite age, perform trips; slow-steaming gives its place to vessels running at full speed; and liquidity increases. These conditions urge banks to offer financing as newbuilding orders increase and so are second-hand vessel prices, which may even exceed newbuilding prices. As anticipated, oversupply of tonnage surely overtakes the sea transportation market, which in turn collapses and the freight rates once again sharply decline. (Stopford, 2009)

In addition to the shipping cycles mechanism described above, oversupply results from the time lag between a vessel's order and delivery, and from participants' convergent behaviour. There are also few obstacles to financing vessel acquisitions when traditional funding is unavailable, as aspiring shipowners can turn to private equity firms and export credit agencies. After a market collapse, a significant time may need

to elapse for global trade to increase to naturally cover the oversupply of tonnage. (Kavussanos and Visvikis, 2018)

Finally, long term cycles are more difficult to detect and typically they have a 30-year range. It is speculated that long shipping cycles are driven by significant technological or sociopolitical advancements (Stopford, 2009). These cycles hold little significance for investment decisions since they span beyond a vessel's useful economic life and loan repayment schedule. (Kavussanos and Visvikis, 2018)

This chapter provides an overview of the four shipping markets that determine the economic environment in which shipping companies operate. In addition, the chapter analyses the factors shaping the prices in each of these markets. Understanding these markets and their pricing dynamics offers insight into vessel valuations, investment decisions and strategic planning in shipping companies.

3.1 Freight market

The freight market, due to the international shipping market's vulnerability to global socioeconomic events, has experienced massive fluctuations in the past decades. Economic and geopolitical instability influences shipping activity via several mechanisms, such as trade disruptions, increased insurance costs for high-risk routes, restructuring of trading routes and emerging trading policies and regulations. (Palaios *et al.*, 2025)

The shipping freight volatility is considered to be the fundamental source of commercial risk for market participants. Considering this, understanding the freight market's mechanisms and aligning a company's strategic planning with its fluctuations is crucial. (Su *et al.*, 2019)

3.1.1 Factors affecting the freight market

Dry bulk market

The main commodities transported by dry bulk carriers are coal, iron ore, grains and minor bulk like cement, fertilizers and sugar. The dry bulk shipping market, according

to Tvedt (2003) is greatly influenced by Asia as seen by the ability of prices expressed in Japanese yen to reflect fundamental changes in the dry bulk market for shipping services and shipbuilding. He also recognised the growing influence of China in the dry bulk trade, an observation that remains. Since 2008 China has imported more iron ore than all other importing countries combined, and in 2013, China was responsible for 40% of the global sea transportation of dry bulk commodities. Iron ore sources are relatively concentrated with the main exporters being Australia, Brazil, India and South Africa. Disruptions in supply chains caused by global geopolitical events as well as national policies, such as the three red lines policy affecting the Chinese real estate market, have increased freight rate volatility in dry bulk commodities. (Chu *et al.*, 2025; Huang *et al.*, 2020; Jiang *et al.* 2024; Kavussanos and Visvikis, 2018; Tvedt, 2003)

Beyond global geopolitical events and national policies many other macroeconomic determinants play a central role in shaping freight rate dynamics in the dry bulk shipping market. The state of the global economy, international trade volumes transported by sea, fuel costs, adjustments in the global fleet through new deliveries or increased scrapping activity contribute to the fluctuations observed in the freight market. (Alizadeh and Talley, 2011)

At the same time, vessel characteristics such as age, trading route and specific contractual agreements also determine freight rates. According to Kavussanos (1996), there is a higher volatility observed in the time charter market compared to the spot freight market, possibly due to the former expressing the participant's perception for the future. He also noticed that larger vessels are subject to larger fluctuations compared to smaller ones, since the latter are less limited in trading routes and commodities and are able to approach more ports without draft restrictions. (Kavussanos, 1996)

Complementing previous studies using a microeconomic approach, Alizadeh (2011) investigated some microeconomic determinants of freight rates and laycan periods in the dry bulk market. He concluded that freight rates are correlated to a vessel's size and laycan period. Moreover, freight rates and the laycan period were jointly determined and varied across different routes. Finally, the laycan period was perceived as variable that also expresses current market condition. (Alizadeh and Talley, 2011)

It is also noteworthy that there are observable seasonal effects relating to the dry bulk commodities transported by sea. According to Kavousannos and Alizadeh-M (2001)

dry bulk freight rates increase in the early spring and decline during June and July. In the same paper, it was noted that spot rates also increased during autumn for Panamax and Handymax vessels. Handysize vessels (around 30,000 dwt) mostly transport grain and minor-bulk commodities from Australia, North and South America to Europe and Japan, while Panamax vessels (around 65,000 dwt) mainly transport coal, grain and at times iron ore from Australia and North America to Western Europe and Japan. Therefore, their demand is affected by increased imports by Japanese companies during the end of the fiscal year, the harvesting season in the Southern hemisphere from February to March and strategic reduction of grain stocks in the Northern Hemisphere during March and April. The employment of Handysize and Panamax vessels in the transportation of grain during those months positively affect freight rates for Capesize vessels (around 120,000 dwt) that transport iron ore in the same routes but are limited to which ports they can approach due to their considerable draft. These seasonal patterns also emerge during the employment of Panamax vessels in October and November due to the increase of US grain exports and coal inventories accumulation in preparation for winter. (Kavussanos and Alizadeh-M, 2001)

Tanker market

Tankers are vessels carrying liquid products. The main cargoes transported in the tanker market are crude oil, heavy oil, refined petroleum products and chemicals. A market segment is also occupied by gas carriers such as LNG and LPG carriers. Various other sub-markets are also recognised based on the ship's capacity such as VLCC, Aframax etc. (Kavussanos and Visvikis, 2018)

In general, freight rates in the tanker market are determined by world economic dynamics, industrial production output, oil prices and supply of tonnage as constructed by vessel availability, shipbuilding activity and scrapping rates. (Alizadeh and Talley, 2011)

Macroeconomic variables such as the above, especially when they relate to energy commodities import and consumption have been considered to have seasonal elements. It has been observed that tanker freight rates decrease from January to April and increase in November and December in preparation for increased heating oil consumption during the winter months. (Kavussanos and Alizadeh-M, 2001) Other factors with a positive effect on tanker freight rates are increases in oil prices driving

an upsurge in demand for oil transportation by buyers seeking to secure oil supplies against potential future shortages. (Palaios *et.al*, 2025)

As pertaining to vessel characteristics, the volatility encountered in the hiring rates for larger vessels is heightened compared to smaller vessels, with findings however suggesting that conditional volatility in the VLCC sub-market is time-varying. Spot rates in comparison to time charter rates also showcase a higher degree of volatility and thus risk. (Kavussanos, 2003)

3.2 Shipbuilding market

The shipbuilding industry constructs and offers a highly specialized product that requires the appropriate technical and management expertise. Most shipyards are located in South Korea, China, Japan and Europe. While most shipyards can undertake both vessel construction and ship repair and maintenance activities, for the purpose of this thesis focus will be placed on yards undertaking new building constructions.

Despite Japanese shipyards dominating the landscape in the 70s and 80s due to high labour costs, in the present day, they have been mostly replaced by more competitive yards in China and South Korea. Chinese yards over the last decades have been rapidly expanding their capacity, broadening the project range they can undertake, improving their quality and still keeping a relatively low cost of labour. Despite China's increased shipbuilding output and orders across all vessel segments South Korea still produces the largest output of LNG carriers. (Georgiou, 2025)

The role of the government in financing the shipbuilding industry while in decline is still present in all previously mentioned countries. The main source of financing for China's shipbuilding industry, and the shipping industry in general, has been state-backed banking conglomerates. (Drobetz and Johns, 2018) Similarly, in the case of South Korea incentives have been introduced to strengthen the domestic shipbuilding industry by providing Refund Guarantees for future orders (Hellenic Shipping News, 2024). This approach is shared by Japan which aims to revive the industry by creating a public-private investment fund. (The Japan News, 2025; Tsai, 2010)

Shipbuilding facilities require substantial financial investments and the shipbuilding market is no stranger to the cyclical nature presented in other shipping markets. Shipyards

are major contributors to regional industry infrastructure and national security matters (due to naval vessel output) as well as sources of foreign currency income. Understanding the market dynamics and timing investments accordingly are therefore not only a tool for shipowners seeking to expand their fleet but also for shipbuilding economies aiming to expand their capacity and market share. (Koenig, 2016)

3.2.1 Factors affecting newbuilding prices

The prices of new vessels, in addition to market expectations, are influenced by shipyard capacity and costs related to vessel construction. To an extent they are also influenced by the prices of second-hand vessels.

Over the past decades, various approaches have been used to pinpoint the most significant factors and the mechanisms determining new vessel prices. Early work by Tinbergen (1931) and Koopmans (1939) uses a supply-and-demand approach based on the cobweb theorem. They suppose that the driving force behind the shipbuilding market cycle is the time lag between freight demand, newbuilding orders and actual delivery of the vessel, also taking into consideration occasional external shocks. Furthermore, Hawdon (1978) introduced the effect of shipbuilding-related costs, such as steel prices, alongside the significantly negative effects of overcapacity and current freight rates.

In 1985, Beenstock observed volatility in second-hand vessel prices relative to more stable newbuilding prices. His implication that newbuilding prices follow second hand prices has received criticism due to the speculative nature of the latter. The asset-pricing approach was once again presented by Beenstock and Vergottis (1989) who distinguished between newbuilding and second-hand vessel prices and argued that, in the case of newbuildings, prices should be aligned with market expectations at the time of delivery. (Beenstock, 1985)

A different approach to the above was followed by Jin in 1993, where further to the application of a supply and demand framework, specific types of highly variable costs related to shipbuilding were taken into account. Costs and capacity were regarded as variables of high significance in determining prices. (Haralambides *et al*, 2004)

In addition to the above findings, newbuilding prices appear to be inelastic with regard to demand according to Dikos (2004), which he partly attributes to financing constraints and risk exposure. Dikos uses a competitive equilibrium framework to explain the stability in prices, attributes their long-term to declining quality rather than technological innovation and encourages retail competition models for analysing the market (Dikos, 2004). While conceptually appealing, assumptions such as perfect competition may not fully reflect the reality of the shipbuilding industry. Moreover, comparisons with the retail industry oversimplify the capital- and labour-intensive industry of shipbuilding. Finally, technological advances and strategic decisions in the shipbuilding sector of the last few years could not have been taken into account at the time this study was written.

In conclusion, the factors considered relevant by the aforementioned authors are shipyard capacity, existing tonnage availability, and shipbuilding costs. The current freight rates, external shocks, and second-hand prices also seem to have an effect on newbuilding prices.

3.3 Sale and Purchase market

The sale and purchase market is of vital importance for the competitiveness in the shipping industry. It allows for the reallocation of capacity and in contrast to the newbuilding market allows for rapid changes in the ownership status of each vessel, fleet composition and provides shipowners with immediate access to the freight market. The lower cost of second-hand vessels also enables new investors to enter the industry with reduced risk. (Haralambides *et al.*, 2004) In some cases, purchasing a second hand ship in comparison to building one, can be proven more profitable. (Merikas *et al.*, 2008)

Developments in the second-hand market are important for shipowners and other types of investors pursuing an asset-play strategy, making the timing of buying and selling essential for profits. Lenders are also closely monitoring vessel prices because vessels serve as the main source of collateral for their loans. Declining asset values expose banks to greater credit risk reducing their recovery prospects. Fluctuations in the sale purchase market therefore have greater implications for asset backed financing in general by affecting lending capacity, loan to value ratios.

3.3.1 Factors affecting the prices of second-hand vessels

Second hand vessels in contrast to newbuildings are readily available, thus selling at a premium when the market is high, but usually lack in technological efficiency. At times where there is an oversupply of tonnage, old vessel prices tend to approach their scrap value

Beenstock argued in 1985 that vessel prices should not be analysed on the basis of supply and demand, since he considered this approach inappropriate in its simplicity for long lived capital assets. In his model, Beenstock applied portfolio theory and treated vessels like assets held as part of global wealth. In this model, second-hand prices depend on expected earnings and future resale value. Global fleet size, interest rates and world wealth in general are also factored in. According to Beenstock and Vergottis, who applied the above formula to other research papers written in the following years, the demand for second-hand vessels increases when the expected capital gain and operating income are high and decreases when investors find other ventures more attractive. The findings of the above method have been considered weak, and the implication that second-hand and new vessels are interchangeable has received its fair share of criticism. (Beenstock, 1985)

In the same time period, Strandenes' research described second-hand vessel prices as the present value of expected future earnings, taking into account the vessel's value, estimated trading days, and depreciation. He presumed that the sale and purchase and newbuilding market are linked and second-hand vessel prices depend on the conditions of other shipping markets. The assumption however that ships have an infinite economic life however is unfounded because as discussed in previous chapters ships have a measurable economic life. Kavussanos and Alizadeh have already reached different results by choosing a realistic depreciation factor and expressing expected earnings by using a weighted sum of the present and projected expected returns.

In the following years, studies by Kavussanos regarding the price volatility of different sized vessel in the dry-cargo and tanker sector revealed that price fluctuations depend on ship size. In his dry-bulk sector analysis, volatility was concluded to also be higher after periods of shocks to the industry with Capesize and Handysize vessels reacting stronger to it than Panamax vessels. Volatility in general however seems to be greater

the bigger a vessel is (Kavussanos, 1997). Similar results were reached by Glen and Martin (1998) at their respective body of work.

Based on the above, Haralambides presented a Theoretical Error Correction model. The variables chosen for estimating second hand vessel prices where the average time charter rates per day for a year, newbuilding prices, orderbook in relation to the total fleet and LIBOR. (Haralambides *et al.*, 2004)

His research concluded that the newbuilding prices and time charter rates are the most decisive factors in relation to prices. Notably, Suezmax prices are very sensitive to increases in newbuilding prices. This is attributed to the highly specialized trade of Suezmax carriers and their limited output even when demand is high. The latter can be explained by the lower revenue the shipyard receives for the construction of a Suezmax in comparison to other types of vessels, thus providing less docks for investors interested in constructing one. It seems therefore that turning to the sale and purchase market is the better alternative with sellers gaining bargaining power. Finally, interest rates seem to be more significant for dry-bulk carriers and there is a tendency for prices to drop in large and medium vessels as shipyards' orderbooks grow. The relevance of the above approach nowadays is relatively affected by the final discontinuation of LIBOR and thus other reference rates would be more appropriate for calculations. (Bachmair, 2026)

In 2022, Hyung and Naleen identified vessel-specific and economic factors influencing ship prices in the dry-bulk sector using ordinary least squares (OLS) regression. The study, consistent with previously published work, also determines that a ship's age affects its price on the sale and purchase market negatively, increasing with vessel size, while freight rates had a positive impact and similar trend regarding size. They also concluded that for bulk carriers over 40,000 DWT and tankers over 25,000 DWT, size was a negative factor in their resell value. Another observation was that vessels sold under time charter agreements had higher values than their counterparts across all vessel types.

Hyung and Naleen in addition to the previously mentioned economic factors observed a statistical significance among the country of build and type of main engine used. More specifically, ships build in China had the lowest resale value in comparison to European, Korean and Japanese-built vessels. In the tanker sector, the second-hand prices for

VLCCs built in Korea were significantly higher, while prices were also relatively high for small product, product, handysize, and container vessels. The main assumption is that buyer's perception regarding the country's shipbuilding quality is important and shapes the final price of second-hand vessels. (Nam et al., 2022)

Overall, among the above authors, it is accepted that ship age, freight rates, shipowners' expectations, vessel size, newbuilding prices, and whether the ship is under a time charter contract at the time of sale are critical. Along with characteristics like the country of build and the main engine type it can be concluded that these have the biggest role in shaping second-hand vessel prices.

3.4 Demolition market

The demolition market, also known as the recycling industry, is an essential component of the supply-and-demand dynamics in the shipping industry. In this market the ultimate buyers are the demolition yards who buy ships in their scrap value based on the vessel's lightweight tonnage. Shipowner's can sell to these yards through a specialized broker, although usually intermediaries purchase the ship for cash. (Kavussanos and Visvikis, 2018)

The annual volume of ships scrapped differs. In 2024 a total of 324 merchant ships, 4.6 million gross tonnes, was scrapped, a 30% fall from the 6.8 million gross tonnes scrapped in 2023. The volume observed in 2023 and 2024 is a sharp decline in gross tonnage, relative to 2012 with a total of 37.1 million gross tonnes scrapped or even 2016 for which 29.5 million gross tonnes were reported. These numbers serve as a statement to the markets pronounced fluctuation in scrapping activity. (Willmington,2025)

In addition to the annual vessel volume, their median age also varies. The replacement age is usually influenced by physical and economic factors, while some point to the concept of political obsolescence.

Physical obsolescence refers to the point at which a vessel is not worth salvaging by repairs due to extensive damages in its hull and machinery or natural erosion due to age. On the other hand, economic obsolescence presents itself when more efficient ships are introduced and operating older ones becomes uneconomic due to high operating costs

and lower freight rates. In some cases, retrofits to existing vessels are a feasible option and a vessel is demolished if there are no expected economic benefits from major modifications. Political obsolescence according to Buxton is referring to ships facing flag discrimination or those unable to comply with regulatory requirements impairing their trading activity.

The more competition a sector faces, the lower the median age will be. Passengers and service vessels for example have a higher median scrapping age both due to their activity in less competitive market segments and because they are more adaptable to different owner requirements or trading routes. Technological progress therefore affects intensely the more competitive sectors and determines the optimal life of a vessel. (Buxton, 1991)

Ship demolition is a viable source of cashflow to shipowners when freight rates are low and prices of second-hand vessels are close to demolition levels. Its activity is linked to the recessionary phase the market cycle and is a catalyst to reducing ship supply and thus leading to balance in supply and demand. Analysing the trends and prices of this market, along with recent regulatory developments allows for a more spherical understanding of the shipping industry and stakeholders' decisions. (Yin and Fan, 2018)

3.4.1. Factors affecting scrap prices

The scrap steel output from recycling accounts for a small percentage of global steel demand. A 98% of a vessel can be efficiently repurposed either by melted into new steel or rolled into long steel products and its machinery is usually resold in the second-hand market. Steel prices and the costs associated with scrapping are key drivers of demand.

Existing research has approached the subject of scrap prices formation applying various methodologies. In his statistical view of ship recycling, Mikelis (2007) found that freight rates affect demolition prices positively while also pointing to steel demand and local labour costs. (Yin and Fan, 2018)

Knapp (2008), prompted by discussions surrounding the issue of the environmental, occupational health and safety risks in the ship recycling industry applied econometric modelling to analyse the probability of a vessel being scrapped in Bangladesh, India,

Pakistan, China or Turkey. The study confirmed that an earnings increase deters scrapping of a vessel, while increase in scrap prices has a positive effect on scrapping. It was also concluded that the type, tonnage, flag of registration, detention history and ownership status of a vessel all influence the selection of a country for scrapping. This is a significant result as scrapping prices are dependent on labour costs which are affected by the location of the shipyard and local conditions. (Knapp *et al.*, 2008)

In addition to the above literature, Kagkarakis (2016) employed the VAR model methodology to investigate the demand for ship recycling. He assumed that the supply of vessels is fixed and argued that prices in the demolition industry are formed in relation to international steel-scrap metal prices. (Kagkarakis *et al.*, 2016)

Based on the above studies it is presumed that ship demolition prices are freight rates, international scrap-steel prices and labour costs. Understanding the evolution of recycling prices is essential for explaining fluctuations in scrapping activity and assessing fleet renewal decisions and timing.

4. Asset valuation

Vessel valuation is rooted in the broader framework of financial economics. The valuation of ships represents a complex example on the application of asset pricing principles in a capital intensive, volatile and cyclical global industry. The uncertainty and fluctuations of the shipping markets create a wide gap between market prices and fundamental asset values. Consequently, understanding the mechanisms of vessel valuation is critical for investment decision-making, debt financing and financial reporting. The effects of the 2008 financial and shipping crisis were a testament of the difficulties shipping professionals face in investment appraisal and capital budgeting and spiked the industry's interest around different valuation methods.

This chapter aims to highlight the importance of vessel valuation for the shipping industry, while at the same time presenting the challenge that characterize ship valuation and arise from the broader peculiarities of the sector. By analyzing the most widely applied methodologies, the objective is to understand both the parameters taken into consideration and the areas of application of each method. Lastly, the differences

between financial statement reporting under IFRS and US GAAP are explained in order to examine their implications for the main valuation methods.

4.1 Challenges in the valuation of ships

As outlined in Chapter 2 and Chapter 3, the shipping market is inherently volatile, with freight rates often fluctuating sharply and asset prices following their downward trend. Other long-lived assets, like real estate, present a sufficient level of predictability of returns that allows for market timing strategies to be implemented. (Mei and Liu, 1994) Although valuation of real estate is a complex process, prices are not subject to global demand fluctuations and rapidly evolving technical standards like ships. (Mohd *et al.*, 2020)

According to Kydland and Prescott (1982) cyclicalities are more pronounced when there is a major time lag between the planning and implementation of investment plans. The shipping industry presents a solid example of the above condition as new building delivery times range from 12 to 36 months, depending on the vessel type, its technical characteristics, and the global shipyard capacity at the time of its order. Between placing the order and the final vessel delivery supply and demand are subject to fluctuations that greatly impact the vessel's income generating capability and thus value at delivery. (Kavussanos and Visvikis, 2018)

Previously, vessel values were determined based on a recent comparable sale. Assuming perfect market conditions in which there is available credit and a plethora of willing buyers and sellers a vessel's price is equivalent to its value and stems from the voluntary transaction between an informed buyer and an informed seller. At times of crisis, credit availability for maritime investments is scarce. Additionally, the volatility and uncertainty in the industry raises questions regarding the equation of vessel prices and intrinsic value. In order for the price to be equivalent to the value it is also important that these transactions are not distress sales stemming from an owner's liquidity problems. Excessive optimism or pessimism in market participants, as frequently seen in the shipping cycles' highs and lows respectively, interferes with this equation. (Mayr, 2015)

After the 2008 market crash the importance of maritime investment appraisal and capital budgeting was highlighted. The predominantly used market-approach in the

valuation of vessels was also questioned. The overly pessimistic attitude of investors and underestimation of competition before the crisis led to purchasing a large number of vessels at high prices. Unavoidably, this led to a saturation of tonnage supply and market collapse. Pessimism and forced sales caused by liquidity issues resulted in an abrupt decline of vessel prices with no recent accomplished comparable sales for the market approach to be used. Debt financing criteria also became stricter and several vessels were auctioned. (Mayr, 2015). As a result of the above, ship valuation methods based on future cash flows gained more popularity inside the shipping industry. (Kavussanos and Visvikis, 2018)

4.2 The importance of ship valuation

Ship valuations are an essential instrument in the shipping industry and serve a wide range of financial, economic and legal purposes. Shipowners rely on vessel valuations for accounting, auditing and planning activities such as impairment testing and strategic financial decisions like fleet expansion or scrapping, issuing bonds or raising equity capital. Generally, investment and disinvestment decisions of both potential buyers and sellers are aided by valuation outcomes and shipbroking agencies also employ these outcomes when consulting their clients.

Vessel valuations are also of particular importance for financial institutions and shipowners relying on debt financing. Lenders aim to minimize their exposure to risk by ensuring that the borrower, in this case a shipowner, is secured against the risk of bankruptcy or seizure of his asset by other creditors and able to fulfil his obligations in a timely manner. On the other hand, the shipowner seeks to maximize his investment outcome while simultaneously giving his creditors the least amount of control over his operations. Currently, debt financing through traditional routes in shipping is hard to achieve, as it is a high risk and capital-intensive industry and financial institutions are facing liquidity constraints and heightened regulatory pressure.

In debt financing a vessel's purchase price and market value, as assessed by independent shipbrokers appointed or approved by the lender, are taken into consideration when determining the amount of the loan. In some cases, only the market value is considered for determining the maximum amount to be granted. Additionally, balloon instalments,

which are lump sum payments at the end of the loan terms, are dependent on the expected market value or even the scrap value of the vessel once the loan matures.

A lender's commitment to disburse a loan is subject to some conditions precedent such as fulfilling the minimum value/asset cover requirement and providing the agreed securities. Complying with the minimum value/asset cover requirement necessitates that the value of the security provided to the lender, usually the asset for which the loan was taken for, exceeds a predetermined amount relative to the outstanding balance throughout the loan's term.

In the case of non-performing loans there are several remedial measures that can be taken, such as forced refinancing, but once these methods are exhausted the lender could enforce its security by arresting and auctioning the mortgaged vessel. Although this is considered a measure of last resort and a plethora of principles have to be taken into account and meticulously applied, this remains an option for lenders and constitutes another example of the significance of vessel valuations in the financial outcome of managing non-performing shipping loans. (Kavussanos and Visvikis, 2018)

Beyond the significance of valuations in financial functions, vessel valuations hold significant relevance the legal domain of the maritime sector including insurance coverage and dispute proceedings. For example, a vessel's value is measured when assessing the total insurable value (TIV) of hull and machinery. (Knapp and Heij, 2017) Finally, Mergers & Acquisitions are prevalent in the shipping industry and their realization requires careful planning for outcome optimization. In shipping, synergies can be achieved through the acquisition of the target company's assets, avoiding the necessity for integrating their operational activities completely. This type of investment decision requires knowledge of the assets' value so as to make a fully informed decision regarding revenue prospects and investment risk (Kavussanos and Visvikis, 2018). Asset based valuation is largely used in shipping as vessels are revenue generating units with Net Asset Value (NAV) relying on the market value of the company's vessels highlighting the necessity of accurate valuation outcomes. (Kavussanos and Visvikis, 2018)

4.3 Ship valuation methods

As mentioned in the previous chapter, although a mark-to-market approach is still predominantly used the recent financial crisis, methods based on future cashflow speculation have gained traction. This section aims to describe the most common valuation methods which can be summarized as:

1. Market approach
2. Discounted Cash Flow (DCF) method
3. Replacement cost

The results stemming from the application of these methods are heavily influenced by market conditions. This is mostly attributed to the gap between a vessel's market value and inherent value. For instance, according to Adland (2006), when investigating the existence of asset bubbles during 2003-2005 in the Capesize dry bulk market she observed that second-hand vessel prices were undervalued during the time period probably due to the high risk of entering a time charter contract when the market is tight. The divide between a vessel's market value and inherent value is also in part based on the pessimistic or optimistic attitude of the parties engaging in the transaction. (Adland *et al.*, 2006) Based on Duru (2013), irrationality in the shipping business is observable and is due to the difficulty of delivering objective judgement in a speculative, capital intensive environment with high elasticity in demand. Duru concludes that stakeholders are characterized by a cognitive bias and poor assessment of collective behaviour. (Duru, 2013)

In general, during periods with low short-term volatility investors hold similar expectations and therefore these methods produce similar results compared to periods of uncertainty where it is more likely that these methods will generate different results. In the latter, the above valuation methods are to be treated more like complementary tools in providing different perspectives, rather than expecting a uniform estimate. (Mayr, 2015)

4.3.1. Market approach

This method is also referred to as “mark-to-market” or “last done approach” and uses recent comparable market prices. In these transactions the market price is the point of agreement between willing and informed buyers and sellers. (Mayr, 2015)

The application of this approach starts by pinpointing the vessel characteristics that allow comparability with other recent sales. Afterwards the buyer, usually through an experienced broker, collects a number of recent comparable sales as reference. To reach a single estimate, the mean or median of these prices is calculated.

In search of comparable sales, the most important criteria is a vessel’s type (Kavussanos and Visvikis, 2018). In chapter three the price dynamics in the second-hand market were analysed. It was concluded that ship age, freight rates, shipowners’ expectations, vessel size, newbuilding prices, the country of build, the main engine type and whether the ship is under a time charter contract at the time of sale are key in shaping prices. The date in which the transaction takes place and the geographical location of the vessel for sale are also very influential to the final price.

4.3.2. Discounted Cash Flows (DCF) approach

The discounted cash flow method is widely applied in academic research and has strong theoretical foundations. In this method, an asset's value is determined by estimating the present value of its expected future cash flows which are discounted at a rate that reflects the risk associated with them. (Damodaran, 2007)

The discounted cash flow method forms the foundation of most corporate valuation models due to its ability to evaluate both equity and the total value of the firm, including firms that do not distribute dividends. (Sutjipto *et al.*, 2020) In valuations, there are four methods that use a discounted cash flow method found in financial literature. These are the adjusted present value (APV), cash flows to equity (CFE), capital cash flows (CCF) and free cash flows to the firm (FCF). The outcome depends on the method selected as they differ substantially in cash flows considered, the discount rate applied and the tax shields relating to debt financing. (Oded and Michel, 2007)

In ship valuation the commonly applied method is that of the Free Cash Flows (FCF). Firm valuation models are also more appropriate compared to equity valuation models

because they analyse the asset's total cash generating potential while considering both debt and equity holders. The firm valuation model was proposed first by Miller and Modigliani (1958) and it establishes that the value of a firm is reflected in the present value of its operating cash flows after taxes. (Modigliani και Miller, 1958). Free cash flows can be understood as the cash available for distribution between shareholders and debt holders after accounting for reinvestment requirements and taxes and applying the Weighted Average Cost of Capital- WACC) as a discount rate. In order to account for tax benefits and the risk associated with debt financing the cost of capital includes the cost of debt after tax and by increased debt and equity cost as leverage increases (Kavussanos and Visvikis, 2018). It is important to note that in ship valuation tax benefits are not necessarily taken into account due to several tax regimes offering exemptions to profit arising from vessel operation as mentioned in chapter two of this thesis.

The Weighted Average Cost of Capital without taxes is calculated as :

$$WACC = r_E \times \frac{E}{V} + r_D \times \frac{D}{V} \quad (1)$$

Where:

rD : cost of debt

rE: cost of equity

D: market value of debt

E: market value of equity

V: the sum of the market value of debt and the market value of equity E+D

(Kavussanos and Visvikis, 2018)

The Long Term Asset Value method as introduced by Vereinigung Hamburger Schiffsmakler und Schiffsgentzen e.V. (VHSS) (German Shipbrokers Association) and endorsed by Pricewater Coopers (PwC) is based on the WACC as described above (KPMG,2020). According to the Hamburg Ship Valuation Standards the LTAV is

calculated by discounting the free cash flows (FCF_t) with the weighted average cost of capital (WACC) :

$$LTAV = \sum_{t=1}^T \frac{FCF_t}{(1+WACC)^t} = \sum_{t=1}^T \frac{(c_t - OPEX_t)}{(1+WACC)^t} + \frac{(RV_T)}{(1+WACC)^T} \quad (2)$$

Where:

C_t : Expected returns from charter contracts

OPEX_t : expected operational expense

RVT : the vessel's residual or scrap value

(Mayr, 2015)

Free cash flows are calculated by subtracting the expected operational expenses (OPEX_t) with the vessel's residual value added as a discounted cash flow at the end of the vessel's economic life. In determining future cash flows, predictions have to be made about the freight rates and subsequent vessels' income while also estimating the operating days per year. It is recommended that cash flows have to be measured in detail for a horizon of at least 3 years in the future as these cash flows are more easily determined compared to their later counterparts. Many vessels operate under a time charter agreement and in the case of charterers with established creditworthiness, it allows for more reliable forecasting of revenues. When there is no time charter agreement, valuations can be based on time charter rates or time charter equivalents as provided by shipbroking firms or research institutions to assess market expectations, also taking into consideration fleet capacity developments. Because of the pronounced volatility of the freight market, it may be necessary to consider the long-term historical average charter rates for a wider time period of a least 10 years. Measuring the average using the median instead of the mean is also a valid step to reduce the distortion caused by extreme values.

Other considerations when estimating the present value include inflation, a vessel's age and routine maintenance. A nominal discount rate is usually used by analysts to calculate the present value of future cash flows which accounts for the expected

inflation. To accurately calculate returns one should also take into account the reduced charter rates for aging vessels and possible unscheduled repairs due to technical failures. Unscheduled repairs are harder to predict compared to routine maintenance in the form of a ship's dry-docking period during which the vessel is off-hire for an average of 20 days if special surveys or extensive repairs are factored in. (Mayr, 2015)

The present value of the future cash flows heavily depends on the discount rate applied. Having established the used equation for the measurement of the weighted average cost of capital, the cost of equity, cost of debt and capital structure will further be analysed to ensure adequate understanding of its components.

To establish the cost of equity the Capital Asset Pricing Model (CAMP), a model applied for the analysis of investors' behaviour under risk, is commonly used (Vergara-Fernández *et al.*, 2023). With this framework, the return of an investment with no uncertainty is expressed by a risk-free interest rate parameter (r_f). As in practice there are no risk-free assets for a variety of reasons, especially in the case of the shipping industry, the risk-free interest rate is estimated by using yields on highly rated government bonds. Because interest rate depends on time to maturity, in valuations zero-coupon bonds matching the time frame of the projected cash flows are used by applying methods such as the Nelson-Siegel Svensson model to observed bond yields. For valuation purposes discrete annual interest rates are used for discounting.

The second element in calculating the cost of equity is measuring the risk premium required by owners for the investment risk incurred. To achieve this, an equity risk premium (ERP) is multiplied with the equity beta (β_E).

The beta coefficient represents systematic risk by expressing the sensitivity of an asset's value to movements in the market overall. (Mayr, 2015). If the beta coefficient is equivalent to one ($\beta=1$) then it is considered that the asset's returns move in line with market. For values above or below one, more or less risk is implied, respectively. In general, the beta coefficient is influenced by business risk, operating leverage, and financial leverage. The shipping industry is characterised by high volatility affecting cash flows and high operating and financial leverage, which cause shipping company stocks to exhibit high beta values, with relatively large fluctuations compared to other companies (Kavussanos and Visvikis, 2018). In vessel valuations, beta is estimated based on comparable publicly listed companies that present a similar business risk.

Betas are first unlevered to isolate the industry-specific risk and then adjusted again, assuming negligible debt risk, to reflect the expected capital structure of the vessel being valued. (Mayr, 2015)

Lastly, the cost of debt (r_D) reflects the interest rate required by lenders and typically includes a floating reference rate plus a credit spread expressing risk in regard to the borrower and the vessel. To estimate a stable cost of debt, commonly interest rate swaps are used for approximation.

4.3.3. The Replacement Cost method

Cost approaches in valuation are applied in many industries where due to lack of liquidity, a small sample of assets traded in open markets or a high degree of specialization the other approaches do not produce reliable enough results. A Depreciated Replacement Cost (DRC) method for instance is applied to public property appraisals especially when there is a lack of comparables due to special features in the property. (Fattinnanzi *et al.*, 2020). Better suited comparisons for the application of the Replacement Cost method in ship valuations would be offshore production lines, special purpose aircrafts and naval vessels.

For vessels that are constructed for a highly specialized trade the replacement cost method is the preferable appraisal approach. These vessels are heavily customized and meet very specific operational requirements that are not attractive to a large number of potential buyers, in contrast for example to Aframaxes. Some examples of specialized vessels are heavy lift ships, cable-laying vessels, livestock carriers etc.

Under the Replacement Cost approach, the ship's value is determined by referencing the current cost of constructing or acquiring an equivalent asset in the current market conditions. Careful consideration is required due to rapid technological advancements in the shipping industry, which would render old machinery outdated and would most likely make an exact replacement commercially unjustifiable. Additional expenditures that should also be taken into consideration when referencing the cost of constructing a new vessel are relocation expenses, classification society fees and statutory certification costs, insurance costs, bunker, stores and initial spares upon delivery, manning costs and financing costs during construction. (RICS, 2018). In general, in the Replacement

Cost method, the cost mainly represents an input-based measure of value rather than one based on market demand or similar transactions. (Karatzas, 2009)

4.4 Comparison of valuation methods

Each of the valuation methods described presents with distinctive advantages and limitations. To reliably assess a vessel's value, one is led to conclude that careful consideration is required in choosing the most appropriate approach.

The market approach is the most widely applied and practical of the three methods. Being based in prices derived from recent sales it provides a reflection of the current market conditions. Nevertheless, in extreme market conditions assets' market values are impacted by buyers' and sellers' attitudes and therefore do not accurately represent a vessel's intrinsic value and future income generating capabilities. Furthermore, a considerable amount of recent comparable transactions should be collected as a small sample severely impacts the results. While in good market conditions this is feasible, in a declining market the number of transactions falls substantially. Kavussanos (2018) also notes that when using the ordinary least squares (OLS) method, multicollinearity problems arise due to the high correlation among explanatory variables such as the correlation between age and capacity (Kavussanos and Visvikis, 2018). Finally, there are multiple variables considered in the selection of comparable transactions with many of them demanding a thorough understanding of a ship's technical and structural details in addition to commercial complexities. The speedy evolution of the shipping industry also necessitates that industry professionals remain consistently informed.

The income approach is the most widely examined in academic literature and is firmly grounded in economic theory. Incorporating fundamentals such as cost of equity, WACC and reinvestment rates is one of its core strengths. However, it is sensitive to assumptions about future cash flows and discount rates, which are difficult to forecast accurately. Evaluating vessel's expected revenue facilitates informed investment or disinvestment decisions. This method is also useful in determining the total value of a firm as it relies in the present value of expected cash flows rather than just the historic cost of its assets or the expected transaction price at the time of the valuation. The income approach is also the preferred method in the evaluation of debt covenants as it judges the borrowing company's capability to generate the necessary cash flows to meet

their debt obligations. The discounted cash flow methods however are characterized by a certain complexity. Predicting future cashflows is already a complex issued, more so in the case of the shipping industry where the freight markets volatility equals a heightened uncertainty.

Lastly, the replacement cost approach is the preferred method for valuing vessels that are not frequently traded in open markets. There are notable limitations in accounting for the effects of the shipping market's condition and the asset's returns potential. The possible technical obsolescence of the equipment compared to its modern counterparts also means that several complicated parameters must be considered to accurately estimate the replacement cost. Overall, applying a single approach is not adequate to fully reflect a vessel's value. Industry practice usually involves the combined application of these methods to produce the most comprehensive and well-grounded result.

4.5 Differences between IFRS and US GAAP concerning valuation methods

The application of the market approach, income-based methods and the replacement cost method in vessel valuation is permitted by IFRS and US GAAP alike. There are however, substantial differences between these standards making their application differ.

An area of consideration is the difference between IFRS and US GAAP in components depreciation. While according to IAS 16, items of property, plant and equipment with high cost and different useful lives are depreciated separately, under ASC 360-10, a component approach is not necessary. Component accounting includes dry docking costs in which case the expenses for the survey and jobs performed are depreciated over the period until the next dry dock occurs. As a result, companies reporting under IFRS have vessels with higher depreciation in earlier years compared to companies reporting under US GAAP where these amounts may be depreciated over the vessel's useful life. Higher depreciation under IFRS in early years reduces carrying amount faster but in alignment with the vessel's intrinsic value. By distributing expenses evenly rather than front loading them, US GAAP produces a smoother decline but the carrying amount

does not reflect accurately the vessel's condition. In the replacement cost method, component accounting expresses more clearly the method's underlying mechanisms.

In accounting for borrowing costs, eligible borrowing costs and the amount to be capitalized remains a substantial difference between IFRS and US GAAP. Because borrowing costs under IFRS are interpreted more broadly, a larger amount may be considered eligible than under US GAAP. For capitalized costs the reported interest expense is lower in the earlier years, increasing reported net income and making free cash flows appear higher. Because early free cash flows are discounted less heavily their present value is higher compared to US GAAP and thus affects the LTAV.

Finally, impairment is essential for vessel valuations due to their high capital costs and price sensitivity to market changes. Both IFRS and US GAAP require assets to be tested for impairment if there are signs of impairment present. One of the major differences as previously mentioned is that IFRS requires annual impairment testing of long lived assets while US GAAP considers testing necessary only if impairment triggers are apparent. IFRS impairment testing consist of a one-step method based on the higher of discounted cash flows or fair value less cost to sell .US GAAP on the other hand approaches impairment testing with a two-step method by first checking undiscounted cash flows and then, if necessary, the vessel's carrying amount is compared to its fair value. Reversal of impairment is only allowed under IFRS. Because under IFRS impairment testing is performed in more frequent intervals and discounted cash flows are incorporated market conditions are reflected sooner. On the contrary, US GAAP valuations are less timely and because carrying values are compared directly to fair values greater impairment losses are reported.

Overall, while both frameworks allow for the same valuation methods to be applied, there are key differences between their approach in depreciation, impairment and capitalization costs. As a result, valuation metrics are affected and may lead to variations in reporting outcomes.

5. Case study

In the previous chapters the theoretical background for the main accounting standards used in shipping and their differences was established. Additionally, the main factors

affecting vessel prices were identified and the gap between a vessel's market price and intrinsic value was explained. By consulting mainly academic sources the fundamental methods used in vessel valuation were analyzed, compared to one another and examined within the different frameworks of IFRS and U.S GAAP.

Thereafter, a sample of 10 randomly selected publicly traded shipping companies was selected to provide actual data of the accounting standards and the vessel valuation methods used on an annual basis. The annual reports of each company were examined over a 3-year period spanning from 2022 to 2024. Finally, valuation method percentages were estimated according to fleet size, categorized in two groups, and accounting standards, also categorized in two groups.

5.1 Company profiles

The selected firms operate across different segments of the shipping industry and are the owners of dry bulk carriers, tankers, gas carriers, container ships or a mixed fleet. Presenting the company profiles of the selected sample will provide important information for the financial statement analysis.

Each company differs regarding its operational focus, fleet composition and accounting standards. These factors may affect the asset valuation methods applied in their financial reporting and brief description of each company will therefore be provided to establish the necessary foundations for the subsequent analysis.

Seanergy Maritime Holdings

Seanergy Maritime Holdings Corp. is a shipping company based in Greece engaging in dry bulk transportation by managing mainly Capesize vessels. Currently its fleet comprises of 17 Capesize and 2 Newcastlemax vessels while also owning a Capersize vessel under a bareboat charter agreement for the time being. The fleet's total carrying capacity is approximately 3,633,861 deadweight tons and the average is 14.6 years, with the oldest vessel constructed in 2010 and the youngest at 2013. The company's common stock is listed on the Nasdaq Capital Market.

The financial reporting process, accounting practices, compliance with regulations, and internal control systems are overviewed by the company's Audit Committee, composed of independent board members.

Star Bulk Management Inc.

Star Bulk Management Inc. is specialized in the transportation of dry bulk with a diversified fleet of 145 vessels that exceed 14 million deadweight tons in carrying capacity. The vessels' average age is 11.9 with size ranging from Newcastlemax vessels to Supramax vessels that may carry both major and minor bulk. The company's common shares are traded on the Nasdaq capital market and the company also owns a subsidiary based in Singapore, Star Bulk (Singapore) Pte. Ltd.

CMB.TECH

CMB.TECH owns a diversified fleet totaling 250 vessels with an average fleet age of 7.5 years (median age 6 years). The most significant divisions of CBM.TECH includes Bocimar for the transport of bulk commodities, Bochem, comprised of chemical tankers, Euronav for the transport and storage of crude oil, and Delphis which mainly consists of medium-size container carriers. The company is listed both on Euronext Brussels and NYSE.

Frontline Ltd.

Frontline originated from Frontline AB, originally established in 1985 and was listed on the Stockholm Stock Exchange until 1997. After Hemen Holding Limited became the majority shareholder, the company was listed on the Oslo Stock Exchange, and in 1998 it merged with London & Overseas Freighters, changing its name to Frontline Ltd.

During the following years Frontline Ltd. was listed on the New York Stock Exchange and spun off subsidiaries like Ship Finance Limited and Golden Ocean Group Limited. A landmark in the company's history was a major restructuring in 2012 and the creation of Frontline 2012 Ltd. which later proceeded with the acquisition of several assets. In

2015, the two companies merged, with Frontline 2012 Ltd. becoming a subsidiary of Frontline Ltd.

The company currently is the owner and operator of a large tanker fleet for the transportation of crude oil and refined products. The total fleet currently comprises of 74 vessels, with an average age of 7.6 years. Its common stock is listed on the NYSE and the Oslo Stock Exchange.

Diana Shipping Inc.

Diana Shipping Inc. owns a fleet of 36 dry bulk vessels with a carrying capacity of 4.1 million deadweight tons with a weighted average age of 12.28 years. For the management of the vessel's Diana Shipping Services S.A, a subsidiary of Diana Shipping Inc. is responsible as well as their joint venture with Wilhelmsen Ship Management named Diana Wilhelmsen Management Limited. The company has been listed on the NYSE for the past 20 years.

Capital Clean Energy Carriers

Capital Clean Energy Carriers is a NASDAQ listed shipping company focusing mainly on gas carriers. Its current fleet comprises of 14 vessels with expectations to expand its fleet size during 2026 and 2027. The fleet's average age is 1.8 years, making it one of the most modern fleets amongst US listed shipping companies.

TEN Ltd.

Tsakos Energy Navigation Ltd. is a NYSE listed company with a fleet of 63 vessels consisting mainly of crude, oil, products and LNG carriers. TEN's fleet average age is 7.5 years in a sector where the average is approximately 10 years.

Costamare Inc.

Costamare Inc. owns a fleet of 68 container ships and 38 bulkers for charter to third parties. The average age of the container sector of its fleet is 13.3 years and the average age of their bulkers sector is 13 years. The company's common stocks trade in the NYSE.

Globus Maritime Limited

Globus Maritime Limited is the owner of 9 dry bulk vessels with a total carrying capacity of 680,622 DWT. The average age of the fleet is 8.1 years and the median age is 10 years. The company's common shares trade on the NASDAQ capital market.

Pyxis Tankers:

Pyxis tankers is a NASDAQ listed mixed fleet shipping company currently consisting of six mid-size tankers and bulkers. The average age of their MR2 product tankers fleet is 11.2 years while their dry bulk fleet has an average age of 10 years

5.2 Financial statements

From a sample consisting of the ten companies described in “5.1 Company Profiles”, their annual reports from 2022-2024 were analyzed to determine the valuation methods used in practice. The valuation methods mentioned in each company's financial statements can be summarized as follows:

Table 5. 1: Applied vessel valuation methods per company

Company	Valuation method(s) used in 2024	Valuation method(s) used in 2023	Valuation method(s) used in 2022
Seanergy Maritime Holdings	Market approach unspecified third-party valuation methods	Market approach unspecified third-party valuation methods	Market approach unspecified third-party valuation methods
Star Bulk Management Inc.	Market approach and unspecified third-party valuation methods	Market approach and unspecified third-party valuation methods	Market approach and unspecified third-party valuation methods
CMB.TECH	Market approach (Level 1)	Market approach (Level 1)	Market approach (Level 1)

Frontline Ltd.	Market approach (Level 1)	Market approach (Level 1)	Market approach (Level 1)
Diana Shipping Inc.	Market approach for acquisitions and unspecified third-party valuation methods for existing vessels	Market approach for acquisitions and unspecified third-party valuation methods for existing vessels	Market approach for acquisitions and unspecified third-party valuation methods for existing vessels
Capital Clean Energy Carriers	Market approach	Market approach	Market approach
TEN Ltd.	Discounted Cash Flows and unspecified third-party valuation methods	Discounted Cash Flows and unspecified third-party valuation methods	Market approach
Costamare Inc.	Market approach and Discounted Cash Flows	Market approach and Discounted Cash Flows	Market approach and Discounted Cash Flows
Globus Maritime Limited	Unspecified third-party valuation methods	Unspecified third-party valuation methods	Unspecified third-party valuation methods
Pyxis Tankers	Market approach and unspecified third-party valuation methods	Market approach and unspecified third-party valuation methods	Market approach and unspecified third-party valuation methods

Based on the companies' fleet sizes they will be grouped depending on whether they exceed a vessel count of 50 ships. Then the percentage reporting the application of only the market approach, the percentage using mixed methods and the percentage clearly stating the use of a discounted cash flows model will be measured. Despite not being certain of the approaches used by third-party valuations, these have been regarded as a

mixed method due to the possibility of methods other than a market approach being present in their estimates.

The group consisting of companies with over 50 vessels (Group A) has the following characteristics:

Table 5. 2 : Group A

Company	Vessels	Valuation Method	DCF stated
CBM.TECH	>50	Market	No
Frontline	>50	Market	No
TEN	>50	Mixed	Yes
Costamare	>50	Mixed	Yes
Starbulk	>50	Mixed	No

The group consisting of companies with under 50 vessels (Group B) has the following characteristics:

Table 5. 3: Group B

Company	Vessels	Valuation Method	DCF stated
Seanergy	<50	Mixed	No
Diana	<50	Mixed	No
Capital	<50	Market	No
Costamare	<50	Mixed	Yes
Pyxis	<50	Mixed	No

According to the above findings in Group A:

- 40% of the companies used only a Market approach to calculate their vessels' fair value.
- 60% of the companies used a mixed method to calculate their vessels' fair value.
- 40% of the companies mentioned the use of a Discounted Cash Flows method in measuring their vessels' fair value.

On the other hand, in Group B:

- 20% of the companies used only a Market approach to calculate their vessels' fair value.
- 80% of the companies used a mixed method to calculate their vessels' fair value.
- 20% of the companies mentioned the use of a Discounted Cash Flows method in calculating their vessels' fair value.

The same process will be followed for the grouping of the above companies to companies preparing their financial statements in accordance with U.S. generally accepted accounting principles (Group C) and companies preparing their financial statements in accordance with International Financial Reporting Standards (Group D).

Table 5. 4: Group C

Company	Accounting Standards	Valuation model	DCF stated
CBM.TECH	IFRS	Market	No
Frontline	IFRS	Market	No
CBM.TECH	IFRS	Market	No

Table 5. 5: Group D

Company	Accounting standards	Valuation Method	DCF stated
Seanergy	US GAAP	Mixed	No
Diana	US GAAP	Mixed	No
Capital	US GAAP	Market	No
Costamare	US GAAP	Mixed	Yes
Pyxis	US GAAP	Mixed	No
TEN	US GAAP	Mixed	Yes
Costamare	US GAAP	Mixed	Yes
Starbulk	US GAAP	Mixed	No

According to the above findings in **Group C**:

- 100% of the companies used only a Market approach to calculate their vessels' fair value

On the contrary in Group D:

- 12.5% of the companies used only a Market approach to calculate their vessels' fair value
- 87.5% of the companies used a mixed method to calculate their vessels' fair value.
- 37.5% of the companies mentioned the use of a Discounted Cash Flows method in measuring their vessels' fair value.

5.3 Discussion

It was observed that a big portion of the companies consulted third parties for the fair value measurement of their vessels. There is no standard way in which third-party shipbrokers estimate vessel values, although some sources, as seen in chapter 4, consider that shipbroking companies benefit and use discounted cash flows methods. It has been established that different valuation methods yield different results, the gap between them widens during poor market conditions. It has also been established that, depending on the accounting standards under which a company files its financial statements, the inputs used in valuation methods are affected. The lack of transparency regarding the actual valuation methods used could be misleading for the users of these types of financial statements.

Based on the data used, companies with a fleet exceeding 50 vessels are more likely to use a market-only approach, although this could be based on the accounting standards used and not necessarily the number of vessels the company holds. As seen in the groups based on the accounting standards used by each company, companies reporting under IFRS used only a market approach for the fair value measurement of their vessels. This percentage was lower for companies reporting under US GAAP, where 12.5% of them used only a market approach and 87.5% of them used a mixed method to calculate their vessels' fair value. Noteworthy was the small number of companies clearly mentioning the use of a discounted cash flow approach in their valuation techniques.

The criteria used to determine the groups were selected without testing their statistical significance. It is encouraged that any later study on this matter includes a bigger sample and calculates the chi-square and p-value of the respective dataset.

The most significant observation regarding the above findings is probably the percentage of publicly listed companies opting to report under US GAAP. In this randomly selected dataset 80% of the shipping companies used US GAAP instead of IFRS. There are many reasons behind this choice, some of which have been analysed in Chapter 2 of this thesis.

6. Conclusions

In this thesis, the features and accounting framework of shipping companies was established and explained. Because the shipping industry's shareholders and participants are located across the globe the non-convergence of the accounting standards used in financial reporting affect transparency and comparability. Therefore, the International Financial Reporting Standards (IFRS) and the General Accepted Accounting Standards (GAAP or US GAAP) were thoroughly examined with focus on the standards holding the most influence over the shipping sector. From this comparison, it was concluded that a major difference between the two standards is goodwill reporting and the implications for impairment testing frequency. Additionally, fair value measurement under IFRS was deemed to be more appropriate for industries reliant in debt-financing. Other distinguishing factors between the two accounting standards is the treatment of components, depreciation and borrowing costs. Under IFRS, components depreciation is mandatory, compared to US GAAP's treatment, where although permissible it is not obligatory. Borrowing costs under IFRS present a broader interpretation compared to US GAAP. These requirements affect key accounting standards and should be taken into consideration by the users of these statements.

To further understand the market dynamics that influence ship values the freight, shipbuilding, sale and purchase, and demolition markets were examined. Emphasis was placed on the main factors affecting freight rates, newbuilding prices, second hand vessel prices and scrap prices. There was a reported correlation between newbuilding and second-hand vessel prices, and both seem to be dependent on freight rate levels. Newbuilding prices based on the available studies can also be attributed to shipyard specific parameters like capacity and shipbuilding cost while external shocks and the existing tonnage capacity are also significant. Factors affecting second-hand vessel

prices on the other hand, other than the ones already mentioned, were a vessel's age, size country of built, engine type, whether the vessel was under an existing time charter contract, as well as shipowner's expectations.

This paper also presented the importance of ship valuation for financial institutes, insurance coverage, mergers and acquisitions and shipowners' decision making. The three most popular methods of ship valuation were examined, that is the market approach, Long Term Asset Value (LTAV) approach as a category of the discounted cash flows (DCF) method and the replacement cost method and compared to one another. The market approach was characterized as the most common method that reflects the reality between most sale and purchase transactions between two willing buyers while the discounted cash flows approach was found to be the most researched method with solid foundation in economic theory. Based on the sources used, the replacement cost method was the preferred method for highly specialized vessels with no comparable sales. The consensus view was that during periods of low volatility the results of each method are comparable and similar while during periods of moderate to extreme fluctuations the difference between the results becomes apparent. This leads us to the conclusion that a mixed approach where multiple methods are used is the most trustworthy application. Also, another aspect of the differences between IFRS and US GAAP is that the difference between estimation of depreciation, impairment and capitalization costs affect valuation metrics and lead to variations in reporting outcomes.

Lastly, by examining the financial reports of 10 randomly selected publicly listed shipping companies some observations were made. There was a notable preference for the use of US GAAP in comparison to IFRS, the valuation estimates received by third party shipbrokers were vaguely described and a small number of companies explicitly stated the use of a discounted cash flows model.

6.1 Proposals for further research

Based on the observations during the completion of this thesis there are some proposals for further research to be done.

The implications of the recently issued standard "IFRS 16: Leases" for the shipping industry are important as they may influence management decisions and charterer's

behaviour. It is therefore encouraged to examine the effects of the replacement of IAS 17 for companies reporting under IFRS.

The regulatory framework aiming to tackle emissions from the maritime activity has brought into the spotlight many energy efficiency improvement technologies for ships. The effect and comparison of these modifications to the vessels' value would be a fruitful topic to cover as not enough data was available at the time this thesis was written.

It is also recommended that the financial statements of a bigger sample are examined due to this sample's limitations for the extraction of significant enough results. The lack of transparency regarding the methodology used by third party shipbrokers points to the need of further research into the preferred valuation methods of shipbroking companies.

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