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Financing for a Sustainable Dry Bulk Shipping Industry: What Are the Potential Routes for Financial Innovation in Sustainability and Alternative Energy in the Dry Bulk Shipping Industry?

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Abstract: Environmental, regulatory, and economic exogenous disruptions force companies within the maritime shipping industry to become more sustainable. Financing for implementing the necessary changes is particularly challenging for these companies, considering their narrow margins. With the changes in the shipping industry being intrinsically capital-intensive, funding is a particular issue, as few institutional or individual investors can provide the capital required. This paper investigates the challenges of financing. Drawing from the theory of pecking order on debt and equity, it conceptualizes the relation between the modes of financing for the maritime shipping companies and the nature of the disruptions. Initially, we analyze the various IMO decarbonization regulations, GHG emissions, alternative fuels, and green energy. Moreover, the relationship between fleet operation and management and finance is explored. The paper provides a framework to illustrate from a financial perspective the plethora of challenges and disruptions that have troubled the industry. We then recommend more suitable funding routes for companies to gauge the proper mix of equity and debt levels, bonds, and leverage, based on the company's characteristics, such as size or ESG performance, as analyzed via the lens of corporate financing, along with the nature of the disruption, such as high inflation or geopolitical conflicts. In more detail, the paper focuses on key environmental, social, and governance (ESG) drivers both in the short-term and the long-term within the dry bulk shipping industry: impact investing and ESG factors are driving new investment opportunities and contributing to risk mitigation and long-term investment returns. The most pressing financial and economic questions of the time are wildly extended equity and bond valuations, inflation, and the conundrum most central banks face. Given these uncertainties, from an investment perspective for equity markets, the risk/return outlook for risk assets is skewed to the downside, making a cautious approach prudent for maritime shipping companies.

Keywords: maritime shipping; finance; dry bulk shipping; ESG; impact investing; sustainability; IMO; decarbonization; green energy; alternative energy; inflation; equity; debt; bonds; leverage

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1. Introduction

Given the global nature of shipping, its effect on the world economy, its history of regulation, and the recent wide-ranging environmental concerns (Balcombe et al. 2019), it is interesting to explore the various financing strategies maritime dry bulk shipping companies may adopt to tackle these problems. While shipping has held a reputation for being one of the "greenest" forms of transport of materials (Balcombe et al. 2019), following the introduction and anticipation of new regulations, the shipping industry is now under challenges (Romano and Yang 2022). According to various national statistics, sea transport facilitates more than 90% of trade on a global level, and the dry bulk shipping sector forms

approximately 40% of sea transport (Lin et al. 2019), which is significant when compared to a global fleet shares of 38% for tanker vessels and 22% for container vessels.

Due to the narrow margins for shipping companies, disruptions are forcing companies to react to these challenges by changing their vessels to be greener. As such, funding is a particular issue in this case, especially with the limited number of companies and individual investors acting as funding channels. This research investigates the various funding routes that could be used in the dry bulk shipping industry during the transition period to green energy and determines to what extent maritime companies can survive based on their profiles and access to finance.

The maritime shipping industry is not only highly competitive, with high barriers to entry given the significant capital and financing needed to purchase vessels, but in recent decades, it has grown to be one of the most heavily regulated industries worldwide (Romano and Yang 2022). With a plethora of new regulations and legislation constantly enforcing changes, many challenges have emerged in the shipping industry worldwide (Schinas and Bergmann 2021): such restrictions by the International Maritime Organization (IMO) and other international management bodies, and domestic, national decisions have led to technological advances and the development of machinery, such as the Ballast Water Treatment System (BWTS), the EGCS Scrubber system, and Alternative Marine Power (AMP), requiring significant capital both to install and maintain on bulk carrier motor vessels (M/V) (Balcombe et al. 2019).

Given IMO's 2023–2030 decarbonization regulation implementation (Balcombe et al. 2019), maritime companies constantly build dedicated Market Research and Development teams, evaluating all available technologies to reduce vessels' carbon footprint and enhance environmental progress as mandated by the IMO.

All those regulations and challenges mentioned earlier have sparked debates over the most efficient fuels to be used by vessels to minimize costs and ultimately maximize profits (Balcombe et al. 2019; Gilbert et al. 2018; International Transport Forum 2018). As explained, green energy has proven to be very disruptive in recent years, and in a world where the pace of change is so immense, shipping companies are called to explore alternative fuels, including LNG, Ammonia, HSFO, LSMGO, LFO, and even nuclear power. This is a particularly interesting evolution within the logistics industry, as some companies may be unable to cope with the costs of researching and developing, applying changes, and shifting their focus. Meanwhile, given their greater access to financing, other larger and perhaps more established ones may exploit this opportunity (Paul and Solli 2022). Hence, all the aforementioned concerns indicate why funding is important within the shipping industry.

This conceptual paper, therefore, seeks to ascertain: "What are the potential routes to finance innovation in sustainability and alternative energy in the dry bulk shipping industry?"

2. Green Energy and IMO Regulations

When investigating the environmental aspect of the ESG concept (as developed further in the paper) regarding shipping, the first and fundamental challenge is the environmental regulations that all shipowners must comply with. Firms operating within the shipping sector must follow developments (Sambracos and Maniati 2015), be ahead of other companies, and once there are solutions available, they should be able to implement them (Romano and Yang 2022). This can be seen in various ways, depending on the company's profile: for smaller-sized maritime firms that are not as established, consolidated, and in a sound financial position, this can be challenging. However, such challenges may also bring significant opportunities for extended control of costs and increased efficiency of their fleets and management strategies. In more detail, shipping companies in Greece consider environmental regulations to slow down vessel speeds while increasing scrapping and decreasing supply. Therefore, depending on firms' financial position and ability to foresee requirements and be ahead of rivals, such challenges can be turned into significant opportunities.

As mentioned previously, the maritime shipping industry is different from others—not only is it highly competitive with high barriers to entry (Alexandridis et al. 2020),

but in recent decades, it has grown to be one of the most heavily regulated industries (Balcombe et al. 2019), with the gradual proliferation and enforcement of new maritime laws. IMO's 2023–2030 decarbonization regulation implementation (Sigalas 2022; International Transport Forum 2018) has prompted maritime companies to build dedicated Research and Development teams to evaluate available technologies that assist in reducing vessels' carbon footprint and carefully decide on which size and fuel-type vessels to purchase. Based on the analysis of historical operational parameters, companies' vessel emissions profiles must become competitive within the upcoming Carbon Intensity Indicator (CII) framework (Psaraftis and Kontovas 2020), defined as "a measure of how efficiently a ship transports goods or passengers and is given in grams of CO_2 emitted per cargo-carrying capacity and nautical mile" (DNV 2022), which is expected to be adopted by the International Maritime Organization (Psaraftis and Kontovas 2020).

The IMO's Initial GHG Strategy, which will be in effect from 2023 to 2030, aims to significantly reduce greenhouse gas (GHG) emissions from international shipping. The strategy has a goal of reducing GHG emissions from shipping by at least 50% by 2050, compared to 2008 levels, with the ultimate goal of phasing out emissions entirely. To achieve these emissions reductions, the IMO has established GHG emissions reduction targets for different sectors within the maritime shipping industry, such as bulk carriers, tankers, and container ships. Companies operating in this industry will need to take steps to reduce their GHG emissions in order to meet these targets. This may involve implementing energy efficiency measures on their vessels, transitioning to lower-carbon fuels, or investing in emissions reduction technologies.

The scope of the IMO's decarbonization regulations is global, as they apply to all international shipping activities, and this means that all shipping companies operating internationally will be required to take steps to reduce their GHG emissions in order to meet the targets set by the regulations.

Previous efforts to address GHG emissions from shipping have largely focused on improving energy efficiency, but the IMO's Initial GHG Strategy represents a more comprehensive approach that aims to drive significant emissions reductions across the industry.

The significant impact of the IMO's decarbonization regulations on the maritime shipping industry is likely to be felt in a number of ways. Companies operating in the industry will need to invest in new technologies and equipment in order to reduce their GHG emissions (Caschili and Meda 2012), which may involve significant upfront costs. The regulations may also lead to changes in the types of fuels used by ships and changes in shipping routes and practices in order to maximize efficiency and reduce emissions. Overall, the IMO's decarbonization regulations are likely to have a significant and wide-ranging impact on the maritime shipping industry as it works to meet the emissions reduction targets set by the regulations.

Decarbonization is one of the major dilemmas. During the transitional period, shipowners will have to maintain their vessels in a condition that is acceptable on CII terms. Green energy has been proven to be very disruptive in recent years, so shipping companies are called to explore alternative fuels, including hydrogen, LNG, ammonia, HSFO, LSMGO, nuclear power, etc. (Balcombe et al. 2019). Until the new green fuels are delivered, there is not much more they can do.

With new regulations constantly enforcing changes, many questions have troubled the shipping industry worldwide (Howell and Bhattacharya 2015). Such restrictions by the International Maritime Organization, other management bodies, and countries have led to technological advances and the development of costly machinery. These regulations have often required the implementation of new technologies and equipment in order to reduce the environmental impact of shipping.

One example of a technology that has been developed in response to regulatory pressures is the Ballast Water Treatment System (BWTS). Ballast water is used to stabilize ships and maintain balance, but it can also contain harmful aquatic organisms that can be introduced into new environments when the ballast water is released. The BWTS is

designed to kill or remove these organisms from the ballast water, reducing the risk of invasive species being introduced into new ecosystems.

Another example is the Exhaust Gas Cleaning System (EGCS), also known as a scrubber. Shipping vessels can emit harmful substances, including sulfur oxides (SOx) and particulate matter (Lindstad et al. 2017), through their exhaust gases. The EGCS is designed to remove these substances from the exhaust gases, reducing their environmental impact.

Alternative Marine Power (AMP) is another technology that has been developed in response to regulatory pressures (Balcombe et al. 2019). AMP systems allow vessels to connect to a power source while they are docked rather than running their engines or using auxiliary generators. This can help to reduce air pollution and noise in port areas and can also be more cost-effective for shipping companies.

All these investments impose an additional financial burden for maritime shipping companies and should, therefore, be planned with the help of dedicated R&D teams and the formation of correct and feasible strategies.

3. Fleet Operation and Management in Relation to Finance

The dry bulk maritime industry is cyclical (Gavalas and Syriopoulos 2016). Building a fleet through timely and selective acquisitions of second-hand and new-building vessels (owned or operated under sale and lease-back arrangements) is critical to a successful business strategy (Star Bulk Carriers Corp 2021). Companies' fleets should be well-positioned to take advantage of economies of scale in commercial, technical, and procurement management.

In terms of commercial management, larger fleets may allow companies to negotiate better rates with clients due to the increased volume of shipping services they are able to provide. This can lead to increased profitability and competitiveness. In terms of technical management, larger fleets may allow companies to spread the costs of implementing new technologies and equipment, such as those required for compliance with regulatory requirements, over a larger number of vessels. This can help to make the adoption of these technologies more financially viable. In terms of procurement management, larger fleets may allow companies to leverage their purchasing power to negotiate better prices for goods and services, such as fuel and maintenance services. This can help to reduce operating costs and increase profitability. Overall, economies of scale can help companies with larger fleets to be more efficient and competitive in the maritime shipping industry.

The supply of dry bulk carriers is directly dependent on the delivery of new vessels (Gavalas and Syriopoulos 2016) and the scrapping of old vessels, and the demand for dry bulk shipping is often reliant on economic conditions and international trade (Balcombe et al. 2019; Jiang et al. 2018). This raises several questions about when it is appropriate to sell and purchase vessels so that the company does not purchase vessels at a higher price and ultimately harm its financial position. However, although companies' business strategies vary, the main focus is arranging voyage (long-term) and spot (short-term) charters for their ships, given the current market levels and political situation.

Owning a modern, diverse, high-quality fleet of dry bulk carrier vessels, reducing operating costs, improving safety, and providing the company with a competitive advantage in securing favorable time charters are all essential elements for achieving favorable outcomes (Lindstad et al. 2015; Lister et al. 2015; Poulsen et al. 2016). As a result, companies achieving the above can capitalize on rising market demand during a period of reduced fleet growth, customer preferences for their vessels and economies of scale while enabling them to capture the benefits of fuel cost savings through spot time charters or voyage charters.

Vessels operating on time charters for a certain period of time provide more predictable cash flows and revenue streams (Star Bulk Carriers Corp 2021). Still, they can yield lower profit margins than vessels operating in the spot charter market during favorable market conditions. Ships operating in the spot charter market generate less predictable revenues but may enable the company to capture increased profit margins during improvements

in charter rates. However, the company would be exposed to the risk of declining vessel rates, which may have a materially adverse impact on its financial performance. Therefore, a company operating in the shipping industry must be in a position to devise appropriate business strategies to maximize its revenue streams correctly (Chen 2011).

Furthermore, as mentioned in previous sections, it is crucial for shipping companies to be actively engaged with R&D. Improvements in vessel efficiency and stricter environmental standards are set to increase the earnings differential between new and old vessels (DNB Markets Bank Markets 2021; Poulsen et al. 2016), consequently putting pressure on residual values (i.e., stranded assets). The record low order book (Kavussanos et al. 2014), coupled with upcoming environmental regulations that limit new vessel orders, also creates favorable long-term dynamics for this industry. Additionally, companies should improve their performance continuously, enhancing voyage planning and execution via weather routing, speed optimization, and hull performance monitoring.

Increasing focus on sustainable scrapping solutions could lead to lower scrap prices and potential costs associated with responsible vessel decommissioning. In addition, regulatory uncertainty limiting new orders, which could prolong the upcycle, and substantial regulatory uncertainty surrounding new environmental measures by IMO (Howell and Bhattacharya 2015) are also significant factors. Additionally, regulatory uncertainty regarding the implementation of new regulations and secondary implications for the market balance and costs could drive increased uncertainty in a highly volatile industry. However, the great potential and demand for improved efficiency in the world fleet leave opportunities for shipping companies willing to invest in new technology.

Meanwhile, requirements for vessel efficiency and ratings (RightShip GHG rating, etc.) among major charterers have and will continue to play an important role, increasing costs on higher-quality fuels and new propulsion systems. Therefore, from maritime shipping companies' perspective, keeping a well-maintained fleet, close dialogue with yards and class agencies to stay on top of the latest technology, and sound relationships with major clients allow for de-risked investment in new technology against long-term contracts and contribute positively to the company's financial position.

4. Sources of Finance

Currently, the shipping industry is consolidating in a world where the pace of change is so immense. This is economically positive for the sector because consolidation creates economies of scale and will allow players to raise freight rates due to decreased competition and rivalry, leading to greater self-control. Shipping companies are called to form various business models in order to benefit to the greatest degree from potential growth in the industry while also taking into careful consideration both the external environment of the industry, including the economic and political spectrum, and components of the business model canvas.

Consolidation for public companies is important because it makes it more enticing for institutional investors. In general, consolidation offers economies of scale on various levels to companies, gives better access to loans, and banks are more likely to lend to larger companies for the reasons outlined previously and considering that they have better human capital (Christodoulou 2015).

Shipping companies are almost exclusively financed by both equity and debt. Consequently, they have to investigate various sources of finance, including raising equity in public markets, issuing bonds, receiving bank loans, and giving collateral, to survive. Shipping is a business with little added value because, as can be seen by looking at historical charts throughout the years. It is also price sensitive, and consumers expect services of the highest standards, ultimately determining prices. It is a free market, using supply and demand, and consequently, it is difficult to have a valuation that is constantly above Net asset value (NAV) or vessel values in the case of shipping.

Furthermore, most of the financing comes from banks, and alternative financing can be expensive—which is not desirable because of the narrow margins and the small equity

returns of the industry, as analyzed above—and it is challenging to replace banking, which is currently the primary support of shipping. Capital markets are mostly closed to new entries and entirely for smaller companies. However, if existing players want to raise equity, they would have to do it at a discount to their NAV, diluting shareholders' financial positions within their respective companies. This section of the research paper shall briefly outline the various common sources of finance for maritime shipping companies purchasing dry bulk vessels, container ships, and tankers: debt and equity financing, bonds, and leverage.

4.1. Debt Financing

First and foremost, a significant source of capital is debt financing. Commercial banks are the most important providers of debt to finance the bulk shipping industry, usually offering loans of 2–10 years (Ioannidis 2020). Consequently, given that not all companies operating in this sector have the same accessibility to finance, whether through banks, financial institutions, organizations, individual investors, or the necessary connections in the industry, the gap between large and small shipping firms is widening. This is occurring partly due to historical reasons, including the high volatility of the sector (Ioannidis 2020; Moutzouris and Nomikos 2019) and the lack of trust in businesses that do not have long-standing quantitative and qualitative records. Companies may be required to provide collateral, such as the vessels themselves, in order to secure a loan.

Several of the major players within the dry bulk shipping industry present a debt-to-total-capitalization ratio of more than 50%, with most of the debt having been facilitated in recent years by financial institutions and commercial banks based in Asia (Duru 2013). As is analyzed below in more detail, the green factor also plays a major role in bank lending.

The performance of the maritime shipping company is of major importance when it comes to debt financing through the aforementioned channels. In more detail, taking into consideration that such investment channels seek to maximize their profits and return on investment (ROI) to satisfy their clients and enhance their investment portfolios, undergoing intense due diligence of the shipping company and determining to what extent it has reached the peak of its performance is necessary and ultimately becomes one of the deciding factors. Furthermore, the gearing ratio, calculated as the percentage of the debt of the total value of the vessels, and liquidity ratios of a company seeking financing from these channels, are also taken into account.

4.2. Equity Financing

Another major mode of financing is equity financing. The primary types of equity financing when it comes to shipping are public offerings, owner equity, and limited partnership (Stopford 2013). These three types seek various investments by offering a stake in the business(es) to individuals or financial institutions willing to take on additional, calculated risks and, if successful, shares of the profits (Stopford 2013; Stowel 2010).

Most major shipping firms finance part of their investments using an amalgam of equity from their retained profits and personal funds. This is generally the case for almost all shipping companies, bearing in mind that each adopts different strategies, and so the percentages and ratios for each firm may vary depending on the company's size, degree of risk, and the business environment (Stopford 2013).

Moreover, established companies may also opt to raise capital through public offerings in markets, i.e., NYSE, NASDAQ, etc.; and having a careful strategy, clear corporate structure, credible management record, and financial transparency help make public offerings successful. Nevertheless, it should be noted that raising equity to shipping companies through public offering has a varied history, as although there are some successful publicly-traded shipping companies, not all can perform well under these circumstances, and usually, the ones that do succeed are the major players in the industry that, combined with others, make for the majority of fleet market share. Hence, based on their efficiency and

ability to perform, businesses must be able to correctly judge and form appropriate models to maximize their revenue streams through equity finance.

Lastly, as will be developed further in the paper, environmental, social, and governance ("ESG") goals currently form an essential component of an investment strategy and fund allocation (Stowel 2010). When developing an investment strategy, incorporating a more diversified approach but also heavily considering and balancing the portfolio due to environmental, social, and corporate governance (ESG) factors and environmental impact are critical. Delivering ESG innovation alongside long-term value for clients and shareholders is one of the current concepts that dominates investors' portfolios and fund divisions. Additionally, impact investing and ESG factors drive new investment opportunities and contribute to risk mitigation and long-term investment returns.

4.3. Bonds

Shipping companies with good ratings can also raise money by issuing bonds. Nevertheless, the procedure takes a long time—months to develop the prospect and place the bonds in the market (Paul and Solli 2022). In more detail, rating companies such as Standard & Poor's and Moody's determine the credit rating of firms wishing to raise capital using bonds, and the percentage of interest follows the firm's credit rating (Christodoulou 2015). However, it should be noted that green bonds are expensive, and the market is closed (Stopford 2013). This financing route is used to a great extent by larger shipping companies listed in the stock market, and they typically facilitate purchasing additional vessels—either newbuildings or secondhand—ultimately allowing them to expand their fleets.

4.4. Leverage

Leverage is the use of borrowed capital to finance the purchase of assets, with the goal of increasing the potential return on investment. In the maritime shipping industry, leverage can be used in a number of ways:

- Leveraged buyouts: Companies in the shipping industry may use leverage to finance the acquisition of other companies or assets, such as vessels. This can involve borrowing money to fund the purchase, with the goal of generating a higher return on investment through the ownership of the assets.
- Debt financing: Companies may also use leverage by borrowing money to finance the purchase of vessels or other assets. This can allow them to acquire assets without having to come up with the full purchase price upfront and can potentially increase the return on investment if the assets appreciate in value over time.
- Charter financing: Companies may use leverage by entering into charter financing agreements, in which they agree to pay for the use of a vessel over a specific period of time. This can allow them to acquire the use of a vessel without having to come up with the full purchase price upfront and potentially generate a higher return on investment if the vessel is in high demand.

Alternative strategies often engage in leverage or, as mentioned above, gearing (ratio). Leverage within the shipping industry increases a company's sensitivity to market movements, as is evident via freight rates, and shipping firms that use leverage can be expected to be more volatile than other funds that do not use leverage (Alexandridis et al. 2020; Goldman Sachs 2019). Nevertheless, having high leverage levels in favorable market conditions may enhance return on equity (ROE) and profits (Alexandridis et al. 2020). As a result, shipping companies finance their fleets, including vessel acquisitions, with a mix of debt and equity, intending to maintain moderate leverage levels over time despite having the capacity to obtain additional financing. The dry bulk maritime industry is cyclical in nature, so building a fleet through timely and selective acquisitions of second-hand and newbuilding vessels—either owned or operated under sale and lease-back arrangements—is a critical aspect of a successful business strategy.

Overall, leverage can be a useful tool in the maritime shipping industry, as it can allow companies to acquire assets and generate higher returns on investments. However, it is

important for companies to carefully manage their leverage in order to avoid taking on too much debt, which can be risky if the value of their assets does not increase as expected.

5. Inflation

Inflation is undoubtedly one of the greatest concerns, and this paper was written when the U.S. entered a recessionary phase. Inflation will lead to higher interest rates, which will inevitably lead to recession. In the beginning, this will assist shipping because inflation increases the prices of both vessels and freight, but once the recession is reached, it becomes a major problem for shipping in general.

Exogenous macroeconomic shocks may influence the global supply chain networks, global trade, and commodity prices, which are seen to impact inflation directly. The most significant exogenous shocks—the coronavirus global pandemic and the respective port lockdowns (Gavalas et al. 2022); the recent Ukrainian conflict with Russia; the financial crisis of 2008, which led to maritime shipping companies' share prices facing significant pressure; and the plethora of environmental regulations set by the IMO and other management bodies—can be seen to have a significant impact, if not immediately, with a time-lag of a few quarters or years.

The current inflation in commodities faced as a result of the Ukrainian conflict can be seen similarly to the crisis of 2008, which had a significant impact on several levels. Firstly, maritime shipping companies which purchased vessels at high prices saw vessel values plummeting alongside freight rates and global demand.

Additionally, the vast majority of companies that were public at the time were faced with catastrophic falls in the respective stock prices, affecting not only their market capitalization but also creating great uncertainty within the financial sector -including individual investors, commercial banks, and funds- and, in practice, according to the investment strategies of major banks and asset management firms such as Morgan Stanley, Goldman Sachs, and JPMorgan, there is still a notion of instability and concerns when investing in maritime shipping companies of any kind, perhaps even due to the high volatility of the industry, as seen throughout the years.

Inflation can have a number of impacts on the shipping industry. Some of the ways in which inflation can affect the industry include:

- Increased operating costs: Inflation can lead to an increase in the cost of goods and services that shipping companies rely on, such as fuel, maintenance, and labor. This can lead to higher operating costs for shipping companies, which can eat into their profits.
- Changes in demand: Inflation can also affect demand for shipping services, as it can lead to changes in the prices of goods and services that are shipped. For example, if the cost of importing goods increases due to inflation, this may lead to a decrease in demand for shipping services.
- Interest rates: Inflation can also affect interest rates, which can have an impact on the cost of financing for shipping companies. If inflation is high, central banks may raise interest rates in order to curb inflation, which can increase the cost of borrowing for shipping companies.
- Currency exchange rates: Inflation can also affect currency exchange rates, which can have an impact on the cost of shipping goods internationally. If the value of a currency decreases due to inflation, it may become more expensive for shipping companies to import or export goods in that currency.

Hence, inflation can have a range of impacts on the shipping industry, and companies may need to adapt their business strategies in order to mitigate these effects. If companies face high inflation, banks are even more risk-averse to lending, which is, by definition, a challenge.

6. Environmental, Social, and Governance (ESG) in Dry Bulk Shipping

Environmental, social, and governance (ESG) issues are essential to responsible investment and aim to enhance the relevant disclosure and performance. As such, within the

dry bulk shipping industry, companies aim to improve their annual ESG scores constantly, particularly when it comes to shipping companies that are public and constantly seek investment via commercial banks, financial institutions, and private investors by selling stocks in exchanges (mainly in NYSE and NASDAQ in the United States, or LSE in the United Kingdom) to thus increase shareholders in the company. At the time of writing in 2022, many potential shareholders strongly advocate that impact investing and ESG factors drive new investment opportunities and are contributors toward both risk mitigation and long-term investment returns.

6.1. Key ESG Drivers in the Long-Term within the Dry Bulk Shipping Industry

On the prerequisite that physical world trade will be sustained, shipping remains by far the most efficient means of transportation and should see continued growth, and the great potential and demand for improved efficiency in the world fleet leave opportunities for shipping companies willing to invest in new technology.

Certain rules and regulations could lead to transitional disruption with the potential to improve the market balance for shipping markedly—e.g., speed limits and environmentally-driven rerouting—and CO_2 footprint reporting on products could limit the attractiveness of globalized and specialized production lines. Furthermore, rapid technological development and stricter environmental standards pose the risk of stranded assets and two-tier markets.

Lastly, increasing the focus on sustainable scrapping solutions could lead to lower scrap prices and potential costs associated with responsible vessel decommissioning; and trends in near-shoring, recycling, and extending products' lifecycles could put pressure on shipping demand growth.

6.2. Key ESG Drivers in the Short-Term within the Dry Bulk Shipping Industry

In the short-term, regulatory disruption in the shipping industry with an increasing environmental focus may cause significant inefficiencies for trading vessels, limiting vessel supply and tightening markets. Meanwhile, regulatory uncertainty regarding the implementation of new regulations and secondary implications for the market balance and costs could drive increased uncertainty in such a highly volatile industry; and there is sustained tightness on the supply side due to limited new orders, as future ship technology remains uncertain.

Dry bulk shipping entails transporting coal, the worst performer ESG-wise, and iron ore for energy-intensive and polluting steel production, which screens poorly in the ESG framework. To uphold the Paris Agreement, coal must be the first fossil fuel to be scaled down. Coal represented 24% of dry bulk volumes in 2018, including coking coal for steel production, and cuts in trade volumes would be damaging.

7. Theoretical Framework—Proposition

The previous sections offer insight into the various funding routes that are most commonly used within the dry bulk shipping sector, and some of the many determinants that drive shipping firms and investors to form their respective strategies. To summarize, the main funding routes used are equity and debt financing and bond issuing; and core problems for the industry are the plethora of new environmental regulations, sustainability, ESG, and inflation. Given the different routes currently used, companies face the challenges above and are called to form strategies that overcome them, allowing them to maximize their retained profits.

The most pressing financial and economic questions of the time are wildly extended equity and bond valuations; inflation; and the conundrum now faced by central banks worldwide, most notably the Federal Reserve Bank of the United States. Given these uncertainties and the potential downside that could materialize with a Fed policy error, and from an investment perspective for equity markets, the risk/return outlook for risk assets is skewed to the downside, making a cautious approach extremely prudent.

As mentioned previously, high inflation is linked to debt financing, and ESG, in recent years, is directly linked to equity financing. Given the disruptions present, it could be said that companies with better ESG scores are more successful at pursuing equity financing. However, this means that companies with low ESG may be forced to raise capital via debt financing. The problem, however, is the high inflation rates, imposing additional trouble on banks for lending. Whether to take equity or debt also depends on the company's size, considering that equity financing incorporates a lot of risks; on the other hand, debt does not incorporate that much, as companies are not sharing the risk with their financing channel. Hence, ceteris paribus, equity financing is considered better within the maritime shipping industry. Still, companies need to work on their ESG, and if that is not possible, they have to use debt financing, and this has the issue of inflation.

Environmental, social, and governance (ESG) factors are increasingly being considered by investors and shipping companies as important indicators of a company's performance and potential for long-term success. ESG factors measure the impact of a company on the environment and society, and its governance practices.

In the maritime shipping industry, ESG factors can be particularly important, as the industry has a significant impact on the environment due to its greenhouse gas (GHG) emissions and other forms of pollution. Investors and shipping companies are, therefore, increasingly looking at ESG factors as a way to assess the sustainability of different companies and to make informed investment decisions.

For shipping companies, strong ESG performance can be important for attracting investment, as investors may be more likely to invest in companies that are perceived as socially and environmentally responsible. Companies with strong ESG performance may also be more attractive to customers and stakeholders, which can lead to increased profitability and long-term success.

Overall, the concepts of profit maximization and sustainability are increasingly being integrated into investment strategies, and ESG factors are important indicators in this process for both investors and shipping companies in the maritime industry.

This, coupled with the increasing cautiousness by the IMO in the formation of plans for protecting the environment within the shipping industry, is important. Hence, the concept of ESG within the industry plays a deciding factor in companies' financial strategies and the various funding routes by which they will raise capital.

To tackle the issues at hand, and drawing from the theory of corporate financing with the pecking order on debt and equity and the nature of each mode, it is hypothesized that according to the responses of shipping companies to the various environmental challenges, the method will, in turn, develop the funding routes that they will take in forming their financial strategies and allocation the degrees of equity and debt. ESG is also a concept analyzed via the lens of corporate financing. To the best of our knowledge, no other paper has made direct reference to ESG and impact investments within the dry bulk shipping industry.

To summarize, the purpose of this paper was, therefore, to illustrate from a financial perspective the plethora of challenges and disruptions that have troubled the industry and the respective funding routes that prominent companies have taken as responses, with one of the conclusions being that, ceteris paribus, equity financing is more desirable than debt financing for larger companies.

8. Concluding Remarks

In the last three decades, we have witnessed several types of exogenous shocks and a great degree in uncertainty within the business world. These exogenous shocks, despite being infrequent, leave important scars in the economic arena. More precisely, some of the greatest exogenous shocks included: the COVID-19 global pandemic and the respective lockdowns that blocked trade for important shipping routes, mainly in Asia; the recent Ukrainian conflict with Russia; the financial crisis of 2008, which had a very negative effect on maritime shipping companies that were listed in the stock market and made use of both

equity and debt financing; and the plethora of environmental regulations determined by the IMO and other management bodies.

Given that shipping companies have narrow margins, environmental and geopolitical disruptions are forcing them to react to challenges by becoming more sustainability-focused and adopting diversified financial strategies. Hence, raising capital is a particular issue, especially with the relatively few companies and individual investors acting as funding channels.

To conclude, since maritime shipping companies have narrow margins, environmental and geopolitical disruptions are forcing them to react to challenges by becoming more sustainability-focused and adopting various financial strategies. Hence, considering the shipping industry's capital-intensive nature, funding is a particular issue, especially with the few institutional or individual investors that can provide the capital required. In the last three decades of business, markets have witnessed several types of exogenous shocks and a great degree of uncertainty. Despite being infrequent, these exogenous shocks leave important scars in the economic arena. To tackle the issues at hand, the paper conceptualized the relation between the mode of financing of the shipping companies and the nature of the disruptions by drawing from the theory of corporate financing with the pecking order on debt and equity and the nature of each mode. Furthermore, the topical concept of ESG was also examined via the lens of corporate financing.

Lastly, the paper recommends suitable funding routes for companies to gauge the proper amalgam of equity and debt levels based on their characteristics, such as size or ESG performance, and the nature of the disruption, such as high inflation or geopolitical conflicts. It is suggested that future studies analyze the aforementioned in an empirical framework to test the theories above, capture the fluctuations and volatility of the maritime shipping market regarding their ESG performance, and assess to what extent the statements in this paper have a valid frame of reference.

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Abbreviations

The following abbreviations are used in this manuscript:

AMP	Alternative Marine Power
BWTS	Ballast Water Treatment System
CII	Carbon Intensity Indicator
EGCS	Exhaust gas cleaning systems
ESG	Environmental, Social, Governance
HSFO	High Sulfur Fuel Oil
IMO	International Maritime Organisation
LFO	Light fuel oil
LNG	Liquefied Natural Gas
LSE	London Stock Exchange
LSMGO	Low Sulphur Marine Gas Oil
M/V	Motor Vessels

NASDAQ	National Association of Securities Dealers Automated Quotations
NYSE	New York Stock Exchange
ROE	Return on Equity

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