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**THE ASYMMETRIC COST BEHAVIOR OF
OPERATING EXPENSES IN SHIPPING
COMPANIES**

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1. Abstract

This thesis examines the alternative theory of cost behavior known as sticky cost theory. Unlike the traditional theory, in which cost change is symmetric with volume change, this theory assumes that managerial decisions about the amount of resources used affect costs, resulting in asymmetric changes relative to sales. Empirical studies on this topic have demonstrated the applicability of this theory in the business world, while further research is an important endeavor to strengthen the foundation. Thus, the following study seeks to understand asymmetric cost behavior by examining the theoretical and empirical literature that exists on the subject, as well as the means from conducting an empirical analysis. More specifically, the first part of the paper presents the relevant literature from its first detailed appearance to the present day, with references to numerous research articles that have shaped the theory in its modern form. In the second part, an empirical investigation is conducted to examine this theory in shipping companies. This study provides a foundational exploration of a crucial issue with a comprehensive examination of both theoretical underpinnings and empirical evidence, with a specific focus on shipping companies during the period 2012-2022.

1.1 Introduction

In the business environment decision making is based on the information concerning the operation of economic units. Accounting developed as a scientific discipline because of the need that existed for monitoring the financial transactions of an entity and with the contemporary form of it deals with gathering, calculating, recording and transmission of financial information needed by the physical and legal persons interested in the financial units. Among the main sectors of Accounting are Financial Accounting and Administrative Accounting. Financial Accounting mostly concerns provision information for interested members outside the company while on the contrary Administrative Accounting provides information within a business (Meigs, R. F., Williams, J. R., Haka, S. F., & Bettner, M. S., 2014). Cost Accounting, in the context of which it could be said that the theory of asymmetric cost behavior studied in this paper is included work, it is possible to consider it as a "bridge" of Finance and Administrative Accounting. Specifically, Cost Accounting as a concept is mentioned in the techniques aimed at gathering, classifying, and recording and in the sharing of cost data to determine the cost of any element (project, process, and product). The Costing activities are four Cost Measurement meaning Gathering all the information required for him determining the cost of a particular product or activity (Eldenbug, L. G., Wolcott, S. K., & Chen, C., 2017). Cost Recording meaning Records the costs generated by the operation of a business, such as staff or third party fees, consumption of various stocks, etc. Cost Analysis, observation of the trend shown by the various costs that burden the activity of a business and Cost Report, Presenting costs in detailed internal reports.

Initially, focusing on cost can represent the monetary capital that has been invested for the acquisition of assets. The purpose of this investment is the achievement of the operating objectives of a business, such as monetization etc. Secondly, with regard to the exit, as a concept it seems to be a cost element consequent to the cost. More specifically, the exit refers to the part of the cost that is borne by the revenue of use. Constitutes essentially costs that have been consumed in the production process in order to turns into sales, which it accompanies. (Hilton, R. W., Maher, M. W., & Selto, F. H., 2019). Finally, the third meaning that requires clarification is the Expense. Expenditure is often used as a synonym for output but actually constitutes the procedure followed for the realization of the cost, i.e. the cost is a consequence of it. Companies in the context of Cost Accounting follow a Costing System. These systems are varied and mostly different important to

each other. Financial units adopt systems that meet their needs, with the choice mainly based on three factors: the size of the business, the type of production process and the number of different products produced. The Costing Systems can be divided into traditional and modern. Fundamental systems that worth mentioning are: Full or Absorption Costing, Variable Costing, Custom Production Costing, Costing Continuous Production and Activity Costing. (Drury, C., 2018). It is therefore easy to understand that cost is a key element importance for businesses and its systematic study by them can provide valuable information. Its effective understanding cost behavior mainly by the management of a business can improve the ability to effectively predict this and improve overall operation of the business, thus ensuring the long-term its well-being in the ever-changing business environment within it in which it operates and by which it is affected both directly and indirectly.

Understanding cost behavior is crucial for effective decision making and for the long term sustainability of organizations in the ever-evolving world of business and economics. The phenomenon of cost behavior is referring on how costs respond to fluctuations in production or sales, is of particular interest in the field of management accounting. Among the various facets of cost behavior, one that is confusing and often confounding is "asymmetric cost behavior." (Blocher, E., Stout, D., Juras, P., & Cokins, G., 2019). In this phenomenon, costs behave differently in response to changes in activity levels on the upside when activity increases and on the downside when activity decreases. An important determinant of revenue is cost affecting the cost structure and profitability of firms along different industries. Shipping Industry, at the crossroads of global commerce, playing a central role in facilitating the movement of goods and commodities across oceans and continents. Amid the dynamic and often turbulent seas of international trade, shipping companies might face multiple challenges, including volatile market conditions, changing regulations, and shifting consumer preferences. (Panayides and Song, 2015) A crucial aspect that often remains obscured in the maritime domain is the nuanced behavior of cost, a key determinant of profitability and competitive advantage. This thesis examines the complex phenomenon of "asymmetric cost behavior" in shipping companies, where costs exhibit different patterns in response to changes in shipping activity during both periods of growth and economic downturn. Asymmetric cost behavior within the shipping industry manifests in a unique and intricate manner. Unlike many other industries, shipping companies must deal with the intrinsic cyclicity of their business, which can result in demand spikes during global economic

expansions and sharp declines during economic recessions. Beyond the financial sheets, these cost patterns have a significant impact on key choices regarding pricing tactics, fleet management, risk assessment, and long-term viability.

This thesis serves as a compass to navigate the enigmatic waters of asymmetric cost behavior within shipping companies, striving to unravel its causes, consequences, and strategic significance. We aim to shed light on the mechanisms underlying these cost asymmetries and how they impact the financial health and operational strategies of shipping firms through an interdisciplinary approach that blends principles of maritime economics, cost accounting, and management theory. This thesis will provide a thorough knowledge of the financial complexities endemic to this vital business and offers a comprehensive understanding of the financial intricacies inherent to this essential industry. Additionally, it offers useful suggestions and insights to help shipping firms better manage their expenses, increasing their adaptability and competitiveness in a constantly changing global environment. I anticipate that the knowledge during this academic journey through the waters of asymmetric cost behavior in shipping companies will provide a comprehensive examination of this phenomenon in the Shipping sector. The study not only dissects the theoretical foundations but also incorporates real-world case study and empirical analysis to uncover practical insights for decision-makers. First, a historical review of scientific work and a thorough analysis of operating costs in shipping companies will be presented. In addition, an empirical model will be developed with a sample of 15 shipping companies for the period 2012 - 2022 and how it responds to the phenomenon of cost asymmetry. This research will contribute to the broader understanding of cost behavior, enrich the repertoire of tools available for decision-making in managerial decisions, and offer a valuable resource for organizations striving to optimize their cost structures in an increasingly dynamic business environment.

As we embark on this journey into the world of asymmetric cost behavior, it is our hope that this exploration will shed light to asymmetric cost behavior phenomenon in shipping companies.

1.2 Aims & Objectives

The shipping industry plays a central role in the global trade, and understanding the financial dynamics of shipping companies is essential for sustainable business operations. The focus of this thesis is to examine the asymmetric cost behavior of operating expenses (OPEX) in the context of shipping companies. As these companies go through different business cycles, it is crucial to understand how operating costs react to changes in economic conditions. The main objective of this thesis is to characterize and understand the asymmetric behavior of OPEX in shipping companies. (Haralambides, H. E., 2015). This includes examining how operating costs fluctuate in response to economic upturns and downturns, identifying patterns of asymmetry and assessing the underlying factors that influence these dynamics. Investigating the economic drivers that contribute to asymmetric cost behavior is an important goal. This includes examining the impact of factors such as fluctuations in fuel prices, changes in global demand for shipping services and macroeconomic indicators on the operating costs of shipping companies. The aim of this thesis is to assess industry-specific factors that contribute to the asymmetric cost behavior of OPEX. (Kavussanos, M. G., & Visvikis, I. D., 2006). Considering regulatory changes and competitive dynamics within shipping industry that may influence Operating Expenses in a non-linear manner. In addition, predictive model may be developed that can forecast the (Brooks, M. R., & Tsolakis, N., 2018) asymmetric cost behavior by leveraging statistical and econometric tools.

As far as the Objectives are concerned, the thesis will present a literature review on asymmetric cost behavior studies, asymmetric dynamics and a thorough research that affect the maritime industry. This thesis aim to a comprehensive understanding with respect to existing knowledge and to identify possible gaps for further research. First of all, gathering data from shipping companies and conducting a statistical analysis will be a crucial objective. This involves employing quantitative methods to scrutinize historical financial data, identifying patterns, and extracting meaningful insights into the asymmetric cost behavior o OPEX. The thesis will provide real-world examples of asymmetric cost behavior. Additionally, a comparative analysis will be conducted to highlight variations in cost dynamics across different companies and regions within the maritime industry (Kang, J., & Sorensen, E. H., 1999). By addressing the aims and objectives of this thesis my aspiration is to contribute with valuable insights to the maritime industry with respect to Cost Behavior.

2. Literature review

2.1 Cost Behavior Theory

The study of cost behavior focuses on how costs act and react to changes in activity and the effects that these changes have on this behavior. Cost behavior has been extensively researched and examined in economics since management choices depend on it. Traditional theory holds that cost behavior is symmetric and is expected to react symmetrically to changes in operational activities (Anderson, Banker et al., 1991). The phenomenon of sticky cost is particularly fascinating when analyzed across various cost categories with its unique characteristics and challenges. In this comprehensive analysis, we will shed light and explore the intricacies of sticky costs across different cost categories analyzing the implications for businesses that strive to navigate the complexities of a dynamic global economy.

2.1.1 Sticky Cost Theory across varied Cost Categories

It is crucial to understand that Costs may be divided into two primary groups: Fixed Costs (FC) and Variable Costs (VC). This system of categorizing expenses is based on variations in activity and solely considers the size of a shift rather than its direction.

Fixed costs are outlays for the business that don't alter no matter how active the firm is. Salaries, insurance, property taxes, interest charges, and depreciation are examples of fixed expenses. Fixed Costs are often sticky due to their resistance to immediate adjustment in response to changes in business activity. Factors that influencing stickiness are focused on regulatory constraints, long-term contracts and the need for consistency in operations. In Addition, Fixed Costs can vary significantly across countries. There are differences with respect to labor laws, tax structure, real estate markets and so forth.

On the contrary, Variable Costs are generally expected to fluctuate with changes in production. Raw materials prices and Utility expenses can exhibit stickiness. Contractual agreements with suppliers, regulatory constraints and commodity market dynamics are some factors that influencing and can contribute to the stickiness. The stickiness of variable costs can exhibit cross-country variations, as it may be influences by regional supply chain complexities, currency fluctuations that affect commodity prices and regulatory variation causing a significant impact to input costs.

The traditional theory of cost behavior is an economic theory that aims to explain how costs fluctuate in response to changes in production levels. This theory is frequently connected with fixed and variable costs and provides a fundamental foundation for cost analysis in a manufacturing or production scenario. This theory assumes that fixed and variable costs behave linearly within a meaningful production range. This indicates that the overall cost line on a graph is a straight line, but the variable cost per unit remains constant. This assumption simplifies cost analysis but may not represent all real-world events properly. Cost-Volume-Profit (CVP) Analysis is a key application of the traditional theory of cost behavior. It is concerned with determining the links between expenses, sales volume, and profitability. The study assists managers in decision making about price, sales volumes, and cost structure in order to attain targeted profit levels. According to the traditional theory, variations in production volume are the fundamental causes of cost fluctuations. Other factors that may impact costs, such as changes in technology, market conditions, or efficiency gains, are not taken into consideration. Traditional theory, although providing a fundamental foundation for understanding cost behavior, oversimplifies the intricacies of real-world corporate situations. Costs, in fact, can exhibit nonlinear behavior due to economies of scale, diseconomies of scale, step costs, and mixed costs with constant and variable components. The theory's unambiguous division of expenses into fixed and variable components aids decision-making. Managers may use cost structure analysis to make educated decisions about pricing, production levels, and resource allocation. Traditional cost behavior theory is critical in budgeting and planning procedures. Organizations may forecast future expenses based on expected output levels by knowing how costs behave. It's important to note that while the traditional theory of cost behavior provides a foundation for cost analysis, modern management accounting recognizes the limitations of this theory and has evolved to incorporate more sophisticated methods that better capture the complexities of cost behavior in contemporary business environments. During the past 20 years, a significant initiative has been made that centers on a different understanding of cost behavior. Many renowned scholars have disputed Sticky Cost or Asymmetric Cost Behavior.

2.1.1.1 Macro-Economic Factors and Cost Behavior

The dynamics of cost trends in the shipping industry are closely related to macroeconomic factors that have a significant impact on the financial situation. This section discusses the delicate relationship between macroeconomic conditions and fixed cost theory in different categories within the shipping sector. Gross domestic product (GDP) growth rates serve as a barometer of

economic health, and fluctuations in them directly impact the shipping industry's operating costs. During periods of significant economic expansion, shipping companies experience increased demand for their services, which can result in increased costs related to crew wages, fuel consumption, and maintenance. Conversely, an economic downturn may reduce demand and require cost-cutting measures to maintain financial profitability. Inflation as a persistent economic force further complicates cost behavior. Shipping companies are struggling with the impact of rising prices for fuel, materials and labor, which can lead to higher operating costs. Examining how these costs respond to inflationary pressures provides insight into the shipping industry's ability to adapt to macroeconomic changes. For shipping companies active in international trade, exchange rates play an important role in shaping cost behavior. Fluctuations in exchange rates can affect fuel costs, maintenance costs and port charges, which in turn can affect the financial performance of our shipping operations as a whole. Analyzing how companies cope with and mitigate the effects of currency fluctuations improves our understanding of the globalization of the shipping industry.

Government economic policies and regulatory frameworks also influence cost behavior in the shipping sector. Changes in tax policies, trade agreements and environmental regulations may result in additional costs or opportunities for cost reductions. Examining the interaction of economic policy changes and cost dynamics provides a complete picture of the external factors that influence shipping companies' operating costs. In conclusion, macroeconomic factors in different categories of shipping industry act as important factors in fixed cost theory. Understanding how GDP growth, inflation rates, exchange rates and economic policies affect cost behavior provides valuable insight into shipping companies' adaptability and resilience to prevailing economic fluctuations.

2.1.2 Sticky Cost Theory across Different Countries

It is essential, in order to comprehend the impact of sticky cost across borders, to delve into the nature and the origin. As already mentioned, Sticky Costs characterized by their resistance to change in fluctuations as far as production level or sales volumes are concerned. This resilience distinguishes them from variable costs, which adapt proportionally to changes in business activity. Sticky Costs remain relatively fixed over short periods, unlike variable costs that adjust to activity changes proportionally. The above implies that the cost remain stable despite the variations in

business operations. There are several factors that contribute to the cost stickiness and these factors can vary significantly across different countries.

First of all there are local regulations which play a crucial role in shaping cost structures. Environmental regulations, labor laws can create stickiness which is challenging to modify swiftly. The compliance with the environmental regulations may require investments in technology. Stickiness also is affected by cultural and labor market dynamics, affecting the ease with which companies may adapt to changing labor costs. Rigidity in labor laws, such as restrictions on layoffs or fixed-term contracts, can limit a company's ability to quickly adapt its workforce to changing economic conditions, adding to the challenge of changing costs in a timely manner. Cultural dynamics can have a significant impact on employee compensation structures and benefits. The influence of cultural norms on these elements can lead to resistance to cost-cutting measures, making it difficult for companies to implement changes without taking cultural sensitivities into account.

Labor market conditions, including the availability of skilled labor and the presence of unions, affect how quickly companies can respond to changes in labor costs. Understanding these dynamics is critical to anticipating labor cost challenges. Risks may also face companies that rely on suppliers from different countries with respect to trade disruptions or even natural disasters. Employee compensation and benefits may be influenced by cultural dynamics impacting the ability to implement cost-cutting measures. Last but not least, the complexity of global supply chains can contribute to the stickiness of costs. Suppliers' dependencies in different countries may expose many companies to risks related to trade disruptions, geopolitical events or even more to natural disasters. Challenges by sticky cost in a cross-country context can be various with respect to operational flexibility, limiting company's ability to quickly adapt to changes in market conditions or economic downturns. Challenges in profitability which becomes a complex task, making necessary a nuanced approach to cost management.

2.1.3 Sticky Cost Theory across Different Industries

Managing operating costs is an important aspect of financial decision making for companies in various industries. Among these industries, shipping companies present a unique scenario where cost behavior is often asymmetrical. This phenomenon refers to the differential response of costs to changes in activity levels, with costs rising faster during upturns and falling more slowly during

downturns. Understanding the reasons for asymmetric cost behavior in shipping companies is crucial for strategic planning, risk management and overall financial stability. Shipping companies are highly dependent on fuel, and the shipping industry has experienced significant fluctuations in fuel prices in the past. When fuel prices rise, operating costs skyrocket, which has a disproportionate impact on profit margins. However, in times of falling fuel prices, the cost reductions may not be as immediate or significant, resulting in an asymmetric response. The shipping industry is characterized by economies of scale, as larger ships and higher freight volumes can lead to cost savings. In times of economic upturn, shipping companies may need to expand their operations quickly to meet increased demand, leading to higher costs.

Conversely, during downturns, reducing operations to meet lower demand may not result in adequate cost reductions due to fixed costs and contractual obligations. Strict environmental regulations and safety standards in the shipping industry can contribute to asymmetric cost behavior. Regulatory compliance costs associated with introducing new technologies or meeting regulatory requirements can escalate quickly during periods of regulatory change, economic booms or increasing global trade activity. However, these costs can persist during downturns as compliance must be maintained, contributing to asymmetric behavior.

Recognizing and understanding the factors that contribute to asymmetric cost behavior allows shipping companies to implement more effective risk management strategies. This includes developing contingency plans, hedging against fuel price fluctuations and building up financial reserves to weather periods of economic uncertainty. In response to asymmetric cost behavior, shipping companies may need to adjust their strategic planning processes. The asymmetric cost behavior of operating costs in shipping companies is a complex phenomenon that is characterized by various industry-specific factors. By identifying and analyzing these factors, companies in the shipping industry can develop more robust strategies to overcome the challenges of asymmetric cost dynamics, ultimately contributing to their long-term sustainability and resilience in a dynamic global market.

2.1.3.1 Sticky Cost Theory across Different Industries

Supply chain integration is the promotion of cooperation and coordination between different entities within a supply chain. For the shipping industry, this includes interactions with suppliers, dealers, and other parties. The collaborative nature of integrated supply chains creates dynamics

where costs are shared, optimized, or collectively adjusted, challenging traditional notions of cost behavior. Efficient information flow is a hallmark of supply chain integration, allowing real-time visibility into various aspects of the supply chain. This increased visibility enables proactive decision-making and optimized operations. Examining how the integration of information flows affects cost behavior provides insight into the efficiencies and cost savings achieved through better coordination. An integrated supply chain can better manage risk and uncertainty. Whether it's disruptions in resource availability or unexpected market fluctuations, an integrated supply chain allows for faster adjustments and agile responses. Understanding how supply chain integration contributes to risk management and resilience reveals its impact on the shipping industry's ability to adapt and cost behavior.

The advent of technology and automation is playing a transformative role in supply chain integration. Automated systems such as Internet and advanced analytics improve visibility, decision-making, and operational efficiency. Analyzing the integration of technology into supply chain processes provides insight into how technological advances impact cost structures and behaviors in the shipping industry. Supply chain integration is an important element in cost behavior theory, especially across different industries. Collaborative cost structures, efficient information flows, risk management practices, and technological innovations related to supply chain integration are leading to significant changes in how integrated supply chains will impact the shipping industry's operating costs.

2.1.4 Sticky Cost Theory and Adjustment Costs

In the financial management intricate world exist two key concepts sticky costs and adjustments costs. Both categories play a significant role in shaping a company's ability to respond to economic changes. Sticky Costs does not adjust immediately to fluctuations in activity levels whereas adjustment costs, reflecting the expenses incurred when a company modifies its operations, present a complex interplay that significantly influences strategic decision-making. Adjustment Costs related to production processes modifying, contracts renegotiating even more with the implementation of new technologies.

There are some factors that contribute to Adjustment Costs. Employee Training and Turnover, Technological upgrades, contract renegotiation, financial strain and resistance to change. The interplay between Sticky costs and adjustment costs exhibit a challenge for businesses aiming to

navigate the complexities of the modern economic landscape. Strategic decision makers should carefully weigh the benefits of cost flexibility that aligns with the company's long term objectives. Adjustment costs encompass a range of factors that contribute to the complexity of organizational modifications. These expenses are complex and include everything from retraining staff to renegotiating contracts and introducing new technologies. Even though adjustment costs come with upfront costs, they frequently represent wise investments in the long-term viability and competitiveness of the company. A business can be well-positioned to prosper in changing market environments by making smart adjustments. One common component of adjustment costs is resistance to change, which emphasizes how crucial it is to manage the human element during organizational transitions. Good change management techniques can lessen hiccups and increase the possibility that changes will be made successfully. The intricate relationship between adjustment costs and sticky costs highlights how difficult financial management is. Companies can thrive in competitive and dynamic environments by adopting a strategic approach to cost management and striking the right balance. A thorough assessment of the organization's particular situation and a proactive approach to addressing the difficulties brought on by both kinds of costs are necessary for successful financial management.

2.1.4.1 Market Dynamics and Cost Behavior

Market trends play a key role in shaping operating cost trends within an industry, and the shipping industry is no exception. This section examines the complex relationship between market dynamics and adjustment costs associated with operating costs. Understanding how market forces influence cost behavior is critical for shipping companies seeking to meet the challenges of a dynamic business environment. Market demand and competition have a significant impact on operating cost fluctuations in the shipping industry. Fluctuations in the demand for shipping services, influenced by global trade patterns and economic conditions, can result in adjustments in various cost categories. Similarly, competitive pressures within an industry may cause companies to take cost-cutting measures or invest in efficiency improvements. The mismatch between supply and demand in the shipping market can cause operating costs to fluctuate. When demand exceeds supply, shipping companies may incur higher costs as they require additional resources such as crew and fuel.

Conversely, a situation of oversupply can lead to increased competition and affect price structures and operating costs. The shipping industry is subject to a variety of international and national regulations that can significantly impact operating costs. Changes in environmental standards, safety regulations or geopolitical factors may result in additional compliance costs. Analyzing how shipping companies adapt and absorb these regulatory changes provides insight into the dynamics of cost trends. Advances in technology such as automation and digitization can impact both initial investment costs and long-term operational efficiency. Examining how shipping companies are leveraging technological innovations in response to market trends can help understand changes in the industry's cost structure. In conclusion, market trends are an important factor in the asymmetric cost trends observed in operating costs in the shipping sector. This section focuses on the various ways in which market forces contribute to adjustment costs and provides a comprehensive understanding of the dynamic relationship between market dynamics and shipping companies' cost behavior.

2.1.4.2 Regulatory Environment and Adjustment Costs

The regulatory environment is an important factor in shaping the adjustment costs associated with operating costs in the shipping industry. This section addresses the complex relationship between regulatory frameworks and sticky cost theory and highlights how regulatory changes contribute to adjustment cost dynamics. The constantly evolving regulatory landscape has a significant impact on the adjustment costs incurred by shipping companies. Changes in international and national regulations regarding safety standards, environmental sustainability and operating practices may require costly adjustments. Complying with new or changing regulations often requires investments in technology, training, and procedural changes, increasing the overall cost of adaptation for the industry.

Dealing with a complex regulatory environment involves legal and operational risks that impact coordination costs. Failure to comply with regulations can result in fines, lawsuits, and reputational damage. To mitigate these risks, shipping companies may incur additional costs related to legal advice, monitoring systems and internal controls. Understanding how the regulatory environment impacts legal and operational risk factors provides insight into cost trends within the industry. Beyond safety and environmental regulations, trade policies and tariffs play an important role in the coordination costs of shipping companies conducting international trade. Changes in trade

agreements, tariffs, and geopolitical tensions can disrupt established cost structures. Examining how companies are adapting to these changes in trade policy and the resulting adjustments to their cost structures provides valuable insight into the resilience and adaptability of the shipping industry. Proactively adapting to regulatory changes can lead to innovation in the shipping industry.

Companies that strategically integrate compliance into their operational frameworks may find opportunities to optimize processes and reduce adaptation costs over the long term. This section examines the intersection of innovation and compliance, highlighting how forward-thinking companies are leveraging regulatory changes to increase efficiency and minimize adaptation costs. In conclusion, the regulatory environment plays an important role in shaping the adjustment costs associated with operating costs in the shipping industry. Understand how regulatory dynamics contribute to overall adjustment costs within industries through detailed analysis of compliance costs, legal and operational risks, trade policy implications, and innovation potential.

2.2 Historical Research

The first study on the asymmetry in cost behavior that exists was published in 2003. The information presented is thought required for a comprehensive grasp of this theory since the literature is available from 2003 to 2010, which are years of theory development. The 'Sticky Cost' idea is based on scholarly studies from these years, with major nods to the works of Anderson et al. (2003). It is an important legacy in the asymmetric cost behavior theory. As they do extensive study in a wide variety of businesses in conjunction with these three primary categories of expenses, these writers can be regarded as the "fathers" of the idea. Specifically some researchers based on past references of Cooper & Kaplan et al. (1998) that the cost increases more in parallel with the increase of the activity volume than the opposite.

Based on Anderson et all (2003) if the size of cost increase is related to volume increase is greater than the magnitude of the decrease of the costs associated with an equivalent reduction in volume. The Researchers develop an empirical model of cost asymmetry that takes into account how SG&A expenses have changed throughout the course of the current period's sales movements. Data from thousands of firms over a 20-year period are included in the model. The basic premise

of whether SG&A expenses are sticky, those relating to aspects of asymmetric behavior, and those involving differences in the degree of stickiness are to be investigated based on the model Anderson et al. (2003).

Subramaniam and Weidenmier (2003) focus primarily on the relationship between unequal cost behavior and the industries in which the firms operate. The authors observe that while there is a noticeable cost asymmetry when considering businesses from various sectors (Anderson et al., 2003), the degree of asymmetry reduces when only taking into account businesses from a single industry (Noreen & Soderstrom, 1997). They base their investigation into the industries and the degree of activity of the firms in various and similar sectors on this observation. The findings of this study demonstrate that many costs do not show stickiness to minor changes in incomes.

'Managerial Optimism, Prior Period Sales Change, and Sticky Cost Behavior' is the title of a new article by Rajiv D. Banker on 2008. This research explores the managerial decision component that Anderson et al. (2003) proposed in their theory. Consider specifically that costs are "a manifestation of the deliberate decision-making of the executives" and that, as a result, these decisions influence costs. The optimism or pessimism of managers in resource management decisions is thoroughly investigated by Bankers, Rajiv D. Banker, on 2008. In the light of the significance of administrative decisions in the theory of asymmetric cost behavior. This role is in fact taken into consideration as a factor in asymmetric behavior in subsequent studies on the subject.

Ramji Balakrishnan and Thomas Gruca on 2008 concentrating on a company's running expenses, the writers investigate the possibility of stickiness. Although their study focuses on the healthcare industry, their findings may often be applied to studies for other areas of interest.

Dan Weiss on 2009 goal was to determine how cost asymmetries might impact analyst profit forecasting precision, the breadth of their coverage, and the market's reaction to earnings reports. The analysis the author conducts for this scientific project demonstrates that a firm with more asymmetry exhibits less accurate profit forecasts, while cost behavior affects analysts' coverage priorities and generally that behavior appears to influence investors in determining the value of a company.

However, Weiss' work is highlighted in this evaluation of the literature since it introduced the concept of "anti-stickiness" in a systematic manner and contributed to the development of theory. The paradigm emphasized by Anderson et al. (2003) was reversed, according to the author, who demonstrated that "under excess capacity, the response of costs to a decrease in the level of activity exceeds the response of costs to a similar increase in the level of activity. The notion of "anti-sticky" was developed as a result of this discovery, and it basically refers to a situation in which the cost rise associated with an increase in volume is less significant than the drop in costs associated with an analogous increase in volume.

Rajiv D. Banker et al. (2010) on the notion of asymmetric cost behavior was largely based on Anderson et al. work. Despite giving the 2003 paper a lot of weight, this research collects data from a wide range of theoretical and empirical sources up to 2010 employing a plethora of information from even earlier years and incorrect, as the authors show, detractors of the theory. Therefore, their publication may be regarded as a crucial resource for a more thorough comprehension of the theory, making it one of the most fundamental research papers of this new Cost Behavior theory.

More precisely, Banker et al. (2010) present the comprehensive theoretical underpinning of the theory of asymmetric cost behavior, acknowledging the existence beyond "sticky costs" and "anti-sticky costs" while taking into account the scientific work by Anderson et al. (2003) and Weiss (2009). Weiss (2009) defines "anti-stickiness" as the simple fact that prices rise less for rising sales than they fall for falling sales. As a result, the authors' full definition is as follows: Costs are considered "sticky" if they increase to a greater extent for a 1% increase in sales than for a 1% decrease in sales (Banker et al., 2010), and they are considered "anti-sticky" if they increase to a lesser extent for a 1% increase in sales than for a 1% decrease in sales (Weiss, 2009).

Even if "anti-stickiness" is acknowledged, academics believe that expenses often anticipated to be "sticky". Two primary factors seem to have led to this result. The long-term trend of sales of firms is generally good, which encourages executives to be upbeat. On the other hand, the adjustment costs for down resource adjustments are many times more than the corresponding to the above changes. Whether the shift is symmetrical in the up or down direction, their optimism will result in asymmetry. However, since we may infer that this sales trend data may be pertinent regardless of whether we are experiencing economic expansion or austerity, it's probable that in many

national economies today, it is no longer true. Despite the aforementioned factors, empirical evidence from 2010 supports the idea that costs vs average are "sticky," and experts incorporate this idea in the first hypothesis that take into account in their example. The writers of this article provide various elements that affect the variance of the grade's "stickiness" and "anti-stickiness" in addition to providing the definition in its entirety and the idea that expenses are, on average, "sticky" in their article. These are specified first of all to the size of the adjustment cost, to expectations for future sales and to possible representation issues. In order to examine economies at various stages, the authors employ the model developed by Anderson et al. (2003) based on these three characteristics. They study a wide range of enterprises globally. They specifically create a pattern that will be used to conduct an audit for the following four situations, which will ultimately confirm:

Later, I. Kama and D. Weiss will focus on the reasons why administrators alter resources, or the standards by which managers decide whether to recover fresh resources or release captives. The authors' research shows that when faced with incentives to avoid losses and cut profits, or to satisfy the profit projections of the financial analysts, administrative executives quickly adjust surplus resources downward when sales are falling, thereby decreasing the degree of "stickiness" of the cost. This result, however, may be stated to be true if there is no demand uncertainty and we investigate each time separately. This scientific study is among the first in the body of literature to examine incentives and how they relate to resource-level choices, but it is clear from its conclusions that more research is required into managers' motivations and how they contribute to the development of cost behavior that is asymmetric.

The study by Clara Xiaoling Chen on 2011, titled "The Agency Problem, Corporate Governance, and the Asymmetrical Behavior of Selling, General, and Administrative Costs" is an initial attempt to address this need for more research on the motivation of managers. The scientific study conducted by the authors added new knowledge to the literature on sticky costs by, among other things, addressing two key problems, which they characterize as: It mitigates strong corporate governance any positive link between agency issue and the asymmetry in SG&A costs. Is the asymmetry in SG&A costs positively associated with its problem agency, after adjusting for known economic driver factor of this asymmetry? As a result of their investigation, they

discovered that the agency problem and corporate governance both significantly affect the level of asymmetry.

In the Managerial Overconfidence and Cost Stickiness, an essay by Clara Xiaoling Chen on 2013 where in contrast to earlier but also later publications to be referenced, the authors concentrated on the psychology literature and emphasized how managers' excessive confidence causes an imbalance in their cost behavior.

In particular, they found that when examining a large number of businesses, managers who exhibited overconfidence underestimated future demand and were thus less willing to cut expenses when there was a decline in sales. This research effort's approach, which is a behavioral one, adds a new dimension to the idea of asymmetric cost behavior by explaining how "cost stickiness" is produced.

Rajiv D. Banker, Dmitri Byzalov, Mustafa Ciftci, and Raj Mashruwala on 2014 present a thorough empirical survey of the literature, taking into account all the factors that cause the asymmetry cost behavior as well as the theory of "anti-stickiness" introduced by Weiss (2009). The latter is made better, in the authors' opinion, because they not only acknowledge the existence of the "anti-stickiness" hypothesis, but also when to anticipate "anti-stickiness" in costs.

The two factors that impact managers' estimations of future demand, the order backlog and macroeconomic growth, as well as all the elements affecting asymmetric cost behavior that have been stated above were specifically confirmed by the authors using the models they utilized. They also demonstrated that "stickiness" or "anti-stickiness" expenses can take many various forms, such as operational costs, in addition to SG&A costs. Finally, they demonstrated that there is still a factor influencing stickiness and anti-stickiness in the cost behavior, specifically referring to past sales and how these influence executives' forecasts of future sales, including their optimism or pessimism and the potential for slack.

In 2015 George Venieris, Vasilios Christos Naoum, and Orestes Vlismas used the basic assumptions of the theory of asymmetric cost behavior to examine how intangible cost components affect the existence of "stickiness" in P&D costs. The authors outline their fundamental premise as follows: "Companies with high working capital exhibit a higher degree of asymmetry than firms with low business capital, which they largely prove. The authors state that "in a period of declining

sales, companies with high levels of intangibles, increase their slack of unused resources more than companies with low levels of intangibles. This is due in part to a high level of intangible investment, which increases its level adjustment costs and leads managers to form more optimistic expectations about whether future sales growth."

Simin Poursasan & Reza Hesarzadeh on 2016 examines which creation elements an imbalance in cost behavior apply to Tehran's stock market. This study is a helpful contribution and represents a distinct sort of research that hasn't been especially taken into account in the current literature review.

Hosomi Shoichiro and Nagasawa Shohei, on 2018 analyze the public sector of his enterprises and assume that there is behavior cost asymmetry. They come to the conclusion that the public sector has an "anti-stickiness cost". However, focusing specifically on a public sector company, "cost stickiness" was found in the water supply industry. The findings of this study are crucial, because they support earlier conclusions based on the Sticky Cost hypothesis in both of the preceding studies. The degree of "cost stickiness" and "anti-stickiness" varies from branch to branch in this particular situation, as noticed by the authors, adding to the idea of asymmetry of cost behavior and reiterating past theories at the time of writing.

Sticky Costs Behavior and Earnings Management by Alini da Silva on 2019. This paper sought to determine whether there was a correlation between the presence of cost behavior asymmetry and earnings management (EM). The definition of EM, which the authors claim refers to "a process that occurs when management makes certain modifications to the structure of financial statements or accounting functions for the purpose of changing information regarding the company's financial performance, which it does not constitute as accounting fraud as it is done within the statutory limits," is necessary in order for the results to be fully understood before they are presented.

Shipeng Han, Zabihollah, and Ling Tuo on 2019 connects the Management Earnings Forecast (MEF) and the notion of asymmetry cost behavior. In order to better comprehend the study that was conducted and the essay that follows, it is thought important to define the term MEF. According to the authors, the term MEF specifically refers to the additional information frequently supplied by businesses, providing more financial details than are legally needed. The authors explore the connection between the "stickiness" of a company's expenses and its readiness to go public, MEF, and show that there is a favorable correlation between the two. The management's

optimism, which not only fosters "stickiness" but also motivates management to disclose MEFs, as well as how adaptation costs and operational efficiency strengthen the link between asymmetric cost behavior and MEFs, should also be taken into account.

Mara Inés Stimolo and Marcela Porporato on 2020 examined how the causes causing cost asymmetry "operate" in developing nations. Argentina's evidence is presented. The Anderson et al. model, often known as the ABJ model, served as the authors' analysis's foundation, with Argentina serving as their reference nation. Their findings provided fresh empirical evidence to support her hypothesis of asymmetric cost behavior. Particularly, as the authors' research showed, expenses are generally "sticky" in Argentina. As the research on countries at various stages of development is not extensive, the presentation of this article is crucial for both its bibliography topic and the current bibliographic review. As a result, its conclusions are valuable for both economists conducting specialized research and for professionals applying this theory in their countries' businesses, particularly if those countries do not belong to the developed where there is unquestionably more evidence.

According to the book's title and authors Golden, Mark Kohlbeck, and Zabihollah Rezaee, the Sticky Cost theory and sustainability aspects like environmental, social, and corporate governance (ESG) are related. In order to determine if these sustainability investments might lead to an asymmetries in cost behavior, the authors examine the behavior of ESG investments.

Vasileios Zisis & Vasilios-Christos Naoum examined the behavior of costs in conjunction with the company life cycle in 2021. The current scientific work's material is highly novel because it is one of the first to delve deeper and give comprehensive findings for the various levels of "stickiness" demonstrated by businesses at various stages of their life cycles. The authors specifically discovered evidence of asymmetric behavior in expenses for all organizations through their investigation. However, it is important to note that while companies in the introduction and development stages exhibit "cost stickiness," companies in the maturity and decline stages demonstrate "cost anti-stickiness," which the authors claim supports the idea that "mature" companies prioritize functional efficiency, which naturally makes sense given the priorities of companies in the early stages of development. Abdulwahid Ahmed and Hashed Abdullah (2021) investigated whether the presence of asymmetric cost behavior has an impact on the profitability of firms. This research effort used a variety of methods to highlight the existence of a negative

correlation between "sticky costs" and driving profit, leading to the conclusion that the inability of companies to control their asymmetric cost behavior will result in lower profit for these over time. Additionally, the data showed a positive correlation between firm size and profit, thus it makes logical that the bigger a company is, the higher its profit would be. This article is included in the literature review not only for the significant findings that he makes, which unmistakably add to the body of knowledge on the topic, but also for the perspectives that open up new areas for investigation in the future, such as the combined approach of these data and their life cycle businesses.

Ahsan Habib & Mabel D Costa on 2022 looked at whether there is a connection between a company's operating expenses and sharp drops in share prices (stock price crashes). Their study is the first one of its kind in the literature, and the outcomes are evaluated throughout time. Three ideas are put forth by researchers based on their analysis of a wide variety of data from American corporations and the literature surrounding the stock market crash.

The asymmetric cost theory and the business strategies are attempted to be correlated by Apostolos Ballas, Vasilios-Christos Naoum, and Orestes Vlismas on 2022. The authors divided the businesses into the following categories based on Miles and Show's (1978) classification of businesses according to the pace of change of their product portfolios and functional markets a) Prospecting (i.e., businesses that are creative and experimental), b)Defending (companies emphasizing efficiency), c) Reacting (i.e., companies monitoring environmental cues), d) Analysis, which combines prospecting and defense.

3. Operating expenses in shipping industry

Operating Expenses form the backbone for shipping companies as far as the sustainability is concerned as they influence their daily operations and their financial health overall. Operating expenses in shipping industry refer to the costs incurred by shipping companies for operating reasons and for the maintenance of vessels and related infrastructure. These expenses are very important for the daily functioning of the shipping business and can significantly impact its profitability. The effective management of Operating Expenses is crucial in order to ensure operational efficiency and for the optimization of resources. Operating expenses include a variety of costs which can be distinguished based on vessel's type, fleet size, trading routes, and other factors. The basic categories of operating expenses in shipping include: Crew Costs, Fuel and Lubricants, Maintenance and Repairs, Insurance, Port and Canal Charges, Depreciation, Communication and Navigation, Catering and Provisions, Regulatory Compliance, Miscellaneous Expenses.

3.1 Crew Costs

Crew Costs are significant component and impact both morale and performance, highlighting the human factor in maritime success. These include crew wages, benefits, and other compensation for the crew members on board the vessel, such as officers, engineers, deckhands, and culinary staff. Crew costs in the shipping industry are a substantial component of operational expenses in the shipping industry. They include the costs of recruiting, hiring, compensating, and providing for the crew members that work on board a vessel. Factors such as the kind of vessel, its size, trading routes, the crew's nationality, and labor market circumstances can diversify crew costs. Here are some significant factors of shipping crew costs:

First of all is Crew Expenses. Shipping companies suffer costs for acquiring qualified crew members. This comprises employment postings, interviews, and screening candidates for roles like as officers, engineers, deckhands, and catering personnel. Wages and Salaries of Crew members are compensated for their work on board the ship. Different crew members have different duties and responsibilities, which might affect their salary. Officers and highly skilled specialties such as Superintendent Engineers, Service Engineer Technicians etc. are frequently paid a lot more. In Addition, Rank-Based Payments exist while crew members are often paid according to their ranks

or positions on the vessel. Officers, engineers, and senior crew members receive higher compensation and wages due to their increased responsibilities, expertise and onboard experience. There is also Contract Length. The contracts of the crew can vary. Some are short-term, lasting a few months, while others may span several months to a year or more. The length of the contract can impact crew costs, as longer contracts generally result in higher cumulative compensation. There is a variety of benefits and allowances for Crew Members. Due to the fact that crew is working in challenging conditions and many times in hazardous areas, bonuses such as overtime pay or holiday pay exist. Crew Welfare is also very important. Shipping companies are in charge of crew living conditions on board, which should be suitable for living including accommodations, meals, medical care & other services that contribute to crew's well-being (Zbigniew L., Piotr N., Dariusz P., 2019). Shipping companies should ensure that crew is well trained and qualified with required skills for respective positions onboard. These training costs are also part of crew expenses. In some shipping companies rotation system is implemented allowing crew members to be onboard for certain period and then to be repatriated. This system affect also crew costs as companies need to cover transportation and arise replacement crew expenses. The nationality of crew members can also influence crew costs. Crew from certain countries may demand higher wages and better working conditions, reflecting market conditions and labor laws in those regions. Many shipping companies operate under union agreements that dictate wages, working conditions, and benefits for crew members. These agreements can impact crew costs and ensure certain standards are met. Crew costs are a critical consideration for shipping companies when managing their operational budgets. Effective crew management, recruitment, training, and retention strategies play a crucial role in controlling these costs while ensuring a skilled and motivated crew to operate vessels safely and efficiently.

3.2. Fuel and Lubricants

The most significant category of operating expenses for shipping companies is Fuel. Costs of purchasing and using fuel to power the vessel's engines included in this category. Lubricants are also very important for the maintenance of the machinery and for smooth operations. Fuel and lubricants costs are crucial not only for accounting purposes but also for shipping companies' budget. Fuel enforces the engines that propel the ship, while lubricants secure the maintenance of the machinery's performance and longevity. Operation of vessel's engine and machinery is linked to operating expenses with multiple ways and directions (Simchi-Levi, D., Kaminsky, P., &

Simchi-Levi, E., 2008). Fuel Costs: Marine fuel also known as Bunker fuel is used to power the engines of vessels. It is a heavy-grade fuel oil in general that is less refined than others used for land-based transportation. The consumption of fuel depends on multiple factors, including vessel's size, the type of engine, speed, load, and trading route. Therefore bigger vessels and those traveling at higher speeds consume more fuel. Global oil prices influence and determine fuel prices of course with fluctuations based on factors such as geopolitical events, supply and demand, and generally economic conditions. Shipping company's operating expenses can be affected significantly by Fuel price volatility (Addel R., Li X., Zhilun J., 2023). The last decade International Maritime Organization (IMO) has applied stricter environmental regulations in order to reduce sulfur emissions. As a result more expensive fuels have been adopted and fuel costs have been significantly increased.

Lubricants Costs: Smooth operation can be ensured by lubricants which are essential for the reduction of friction in the ship's machinery and engines extending the life of the equipment. There are many different types of lubricants. Based on the component of the ship, different type of lubricant is used, including engines, gears, and hydraulic systems. Machinery's design would find the type of lubricant needed. The consumption of lubricants varies based on a variety of factors such as engine type and operating conditions. The Highest fuel efficiency can be obtained with high-quality lubricants, reducing operating cost long term.

Shipping companies apply a variety of measures and new techniques in order to optimize fuel consumption and improve efficiency. Route planning, speed optimization, engine tuning, and adopting new technologies are some examples. Advanced fuel management systems also have been applied along with monitoring tools so as to provide real-time data on fuel consumption. These measures enable crew members and operators to make decisions aiming the reduction of fuel consumption. Fuel hedging has been applied also by many shipping companies. Fuel prices have been locked at a certain level to mitigate the risk of price fluctuations. Reduction of fuel emissions and consumption can be attempted only by investing in new more fuel-efficient vessels or retrofitting existing vessels with eco-friendly technologies. Proper maintenance can ensure vessel's optimal performance, reducing the risk of excessive fuel consumption. Management and strategies to control fuel expenses are crucial for maintaining profitability and competitiveness in the industry.

3.3. Maintenance and Repairs

Regular maintenance and Occasional repairs are required in order to ensure seaworthiness and compliance with regulations. Costs for spare parts, equipment maintenance, and dry-docking included in this category. These costs are a significant part of operating expenses in the shipping industry. These costs are linked with the proper functioning, safety, and compliance of vessels. Regular maintenance and timely repairs are very important in order to keep vessels' operational condition so as to meet international safety and environmental standards. Maintenance can be divided into two categories: Scheduled maintenance & Unscheduled repairs.

Scheduled Maintenance is focused to identify any signs of wear or malfunction and includes regular inspections of a vessel's machinery and equipment. Potential issues can be prevented if regular inspections take place before major malfunctions be escalated. Planned maintenance schedules are followed by shipping companies for various components, including engines, generators, pumps, and navigation equipment. In this way and under scheduled maintenance the lifespan of equipment is expanded and the risk of unexpected breakdowns is significantly reduced.

Unscheduled Repairs category includes emergency repairs, unexpected breakdowns and malfunctions may occur at sea. Emergency repairs are applied for critical issues so as to ensure the safety of the vessel, crew, and cargo. Dry-Docking repairs involve taking the vessel out of the water for extensive inspections, repairs, and maintenance included also in this category and it is usually done every few years and include tasks like hull cleaning, painting, and overhauls. Dry-docking repairs take place using a shipyard facility and significant costs incurred. Docking fees, berth charges, and other related expenses included in these costs.

In addition there are costs linked with Inspections and Certifications. Maritime authorities in order to ensure compliance with safety, environmental, and operational standards, force shipping companies to regular inspections and certifications. These costs meeting these requirements are part of maintenance and repairs expenses.

Last but not least are Upgrades and Retrofits. Shipping companies invest in new technologies adoption in order to improve efficiency and meet evolving environmental regulations. Installing scrubbers, ballast water treatment systems, or other environmental equipment are included in retrofitting vessels and can minimize future operating expenses.

3.4. Insurance

Shipping companies need various types of insurance coverage to minimize risks associated with the operation of vessels. Hull and machinery insurance, cargo insurance, protection and indemnity (P&I) insurance are only some examples. Insurance costs are a significant part of operating expenses in the shipping industry. Shipping companies purchase for insurance coverage in order to manage the risk associated with operating vessels and cargo transportation. These insurance policies provide financial secure against potential losses or damages that can arise during maritime operations. Hull and Machinery Insurance provides protection against damages to the vessel itself. Collisions, grounding are included to these damages. This type of insurance provides financial compensation for repair. Protection and Indemnity (P&I) Insurance covers liabilities that shipping companies may face for third-party claims related with pollution, property damage, bodily injury and other legal liabilities. This type of insurance is crucial in case of accidents involving the vessel. Cargo Insurance is refer to cargo being transported against various risks like theft, loss or damage during transportation. Many shipping companies offer cargo insurance to their clients as part of their services. Freight insurance covers cases where there is loss of freight revenue due to cargo damage. Shipping companies are being compensated for the revenue earned if the cargo had been delivered in good condition (Bertram, V., & Farmer, B. 2017). War risk insurance covers for case where damages or losses incurred resulting from war-related events, such as armed conflicts, acts of terrorism, piracy, and other hostile actions. Kidnap and Ransom (K&R) Insurance provides coverage for ransom payments and related expenses in case of piracy or other criminal actions. Environmental liability insurance covers costs related to pollution and environmental damage. Employer's Liability Insurance protects shipping companies against liabilities arising from injuries or illnesses suffered by crew members.

There is a variety of Factors that influence Insurance Costs. Vessel characteristics are crucial, the type and size of the vessel, age and value of the vessel may influence insurance premiums. The geographical areas, which the vessel may operates can impact insurance while some regions presenting higher risks than others. Every shipping company keep safety record where past incidents are included and claims history. In addition the type of cargo being transported and its value can influence cargo insurance costs. Implementing security measures to prevent piracy and other security threats in general can lead to reduced insurance costs. It is important to mention that compliance with international safety and environmental regulations can result in favorable

insurance terms. Insurance costs can be influenced by the overall state of the insurance market, including supply and demand dynamics.

3.5. Port and Canal Charges

These charges provide insurance coverage in case of using port facilities, pilotage services, and canal transits mainly in the Suez Canal or Panama Canal. Port and canal charges are costs that shipping companies face when their vessels enter and use ports or canals. These charges are defined by port authorities, canal operators, and relevant regulatory bodies for various services and facilities provided to the vessels during their time in these areas. Port and canal charges contribute to operating expenses of shipping companies and can vary based on factors such as the type of vessel, the port or canal being used, and the services required.

Port Charges are in general Berth or Quay Dues, these are charges related with the usage of the berth or quay facilities to dock the vessel. There is coverage for mooring and the space occupied by the vessel while loading, unloading, or waiting. There are also Pilotage Fees, these costs may occur when a local pilot is required for vessel's guidance into or out of the port. Pilots have knowledge of local waterways and navigational hazards. Towage charges are applicable when tugs assist in maneuvering the vessel in or out of the port or within the harbor. Anchorage charges may also be applied when a vessel is anchored in the port's waters before proceeding to the berth. Port dues are general charges for using the port facilities and services. These charges contribute to maintaining and operating the port infrastructure. Port Entry and Clearance Fees cover administrative procedures and regulatory clearances required for the vessel's entry and departure. Cranage Fees are used to load or unload cargo, cranage charge. Wharfage charges are associated with the use of the wharf or quay for loading, unloading and generally handling cargo. Demurrage charges may happen when a vessel exceeds the agreed-upon time for loading or unloading cargo at the port.

Canal Charges include Transit Fees, Tolls, Pilotage and Tug Assistance, Managing Port and Canal Charges, Efficient Operations, Route Planning, Regular Monitoring. Transit Fees occur when canal operators charge transit fees for vessels in order to pass through a canal (e.g. Suez Canal or the Panama Canal). Canal tolls are based on factors such as vessel size, type, and tonnage. That means that larger vessels generally pay higher tolls. Last but not least similar to ports, pilotage and tug services may be required to assist vessels through the canal.

Managing Port and Canal Charges

Effective Planning exists when shipping companies can optimize their schedule to minimize the waiting time so as to reduce berth or anchorage dues. In addition some charges may be negotiable, especially for frequent users or for long-term agreements. Streamlining loading, unloading, and administrative procedures can lead to reduced demurrage and other associated costs. Regular Monitoring and keeping track of charges and fees in regulations can help shipping companies effectively budget for these expenses. Port and canal charges are a crucial part of the shipping operating expenses.

3.6. Depreciation

Depreciation is considered to be an operating expense as it reflects the vessel's value over time. It's an accounting entry that represents the decrease in the vessel's value due its usage. Depreciation costs in shipping refer to the gradual decrease in the value of vessels and other assets over time, obsolescence, and other factors. Depreciation is a non-cash expense that reflects the accounting recognition of the reduction in the value of assets used in the shipping business. While depreciation itself does not involve a direct cash outflow, it is an important concept in financial reporting and taxation that impacts a company's financial statements and profitability.

Ships and other assets used in shipping, such as containers and equipment, have a finite useful life. As they are used, they experience reduction of their value. There are various methods used to calculate depreciation. The most common method includes straight-line depreciation and declining balance depreciation (Richard P., Wayne B., 2001). Straight-line depreciation spreads the cost over the useful life, while declining balance depreciation front-loads depreciation in the earlier years. The useful life of a vessel is an estimate of how long it will be economically viable to use the asset. It can be influenced by factors such as technological advancements, maintenance practices, and changes in regulations. The residual value is the estimated value of the asset at the end of its useful life.

Depreciation is recorded as an expense on the income statement while reducing the company's reported net income. This reduction in net income is a non-cash expense. The accumulated depreciation is subtracted from the original cost of the asset to determine its carrying value or book value on the balance sheet. Depreciation is added back to net income on the cash flow statement

because it's a non-cash expense. This adjustment helps reconcile net income with the actual cash flows generated by the business.

Depreciation can provide tax benefits by reducing a company's taxable income. Different tax jurisdictions have different rules for calculating depreciation. It has an impact on a company's financial ratios, such as return on assets and earnings before interest and taxes (EBIT). It's also a factor considered by investors, analysts, and lenders when evaluating a company's financial health and performance. Shipping companies count the impact of depreciation when making decisions about asset acquisitions, replacements, and disposal. Effective maintenance and timely upgrades can help extend the useful life of assets and reduce the impact of depreciation. It's important to note that while depreciation is an essential accounting concept, it doesn't necessarily reflect the actual market value of assets. Depreciation is a systematic allocation of costs for financial reporting purposes and is subject to accounting regulations and company policies.

3.7. Administrative Costs

These expenses include office costs, administrative salaries, legal fees, and other overhead expenses necessary for managing the shipping business. Administrative costs in the shipping industry refer to the expenses associated with the management, operation, and administration of a shipping company's business activities. A wide range of functions covered that support the overall operation of the company. These costs are essential for maintaining efficient business operations and ensuring compliance with regulations.

Personnel Costs include salaries and wages. Administrative staff, including management, human resources, and other support functions who receive salaries and wages for their roles. Employee benefits such as health insurance, retirement plans, and bonuses contribute to administrative costs. Rent and Lease expenses cover the cost of office space, warehouses, and other facilities used by the company for administrative purposes. Utilities and Maintenance Costs associated with electricity, water, heating, cooling, and maintaining office facilities are part of administrative expenses. Technology and Equipment expenses related to computer hardware, software, network infrastructure, and cybersecurity measures contribute to administrative costs as well. Costs associated with Communication Systems, phone systems, internet connectivity, and other communication tools are part of administrative expenses. Legal fees, consulting services, and compliance-related expenses contribute to administrative costs. Shipping companies need to

adhere to various international and local regulations. Costs associated with accounting, financial reporting, and external audits are part of administrative expenses. Expenses for office supplies, printing materials, and stationery contribute to administrative costs. Costs of consumables such as printer ink, paper, and other office-related materials are included in administrative expenses. Travel and Entertainment Expenses related to employee. (e.g. Travelling for meeting, conferences or any other business-related activity) may contribute to administrative costs. In addition costs associated with entertainment and corporate events are also a part of administrative expenses.

Training and Development include Employee Training. Costs of training programs, workshops, and professional development for staff contribute to administrative expenses.

Administrative costs include general overhead expenses that support the overall functioning of the company. Effective management of administrative costs is crucial for shipping companies not only to optimize their operations but also to improve efficiency, and maintain profitability. Balancing the allocation of resources between administrative functions and the core operational aspects of shipping is important for overall business success.

3.8. Communication and Navigation

Communication and Navigation costs associated with communication systems. Navigation equipment, and charts needed for safe and efficient navigation fall under this category. In the shipping industry are expenses associated with ensuring effective communication and safe navigation of vessels during their voyages. These costs cover various technologies, equipment, and services that enable vessels to communicate with shore-based operations not only other vessels but also maritime authorities, as well as to navigate safely.

Satellite Communication Services, Telecommunication Equipment, Crew Communication, and Emergency Communication are included in Communication Costs. Shipping companies rely on satellites to maintain contact with vessels at sea. These services provide voice communication, data transmission, and internet connectivity to ensure ongoing communication between onshore operations and vessels. In addition, vessels are equipped with communication systems such as satellite phones, radios, and email systems to facilitate communication with the shipping company's headquarters, port authorities, other vessels, and relevant stakeholders. Crew members need to have accessibility to communication facilities to stay connected with their families and

friends while at sea (Shanshan Fu, 2021). Shipping companies may provide onboard communication services for crew members. Emergency communication systems allow vessels to send distress signals and receive assistance during critical situations, such as accidents or adverse weather conditions.

Navigation Costs include the Navigation Equipment, Electronic Chart Systems, Automatic Identification System (AIS), Weather and Sea Condition Monitoring, Anti-Piracy Measures, Navigational Training, Navigation Equipment. Navigation systems such as GPS (Global Positioning System), radar, and electronic chart displays are essential for determining a vessel's position, monitoring its movement, and avoiding collisions with other vessels. Electronic chart systems provide up-to-date navigational charts and information, helping vessels avoid navigational hazards and comply with maritime regulations. Automatic Identification System (AIS) is a tracking system used to identify and locate vessels, exchange navigational information, and prevent collisions with other vessels and shore-based authorities. Many shipping companies invest in weather forecasting and sea condition monitoring systems to receive updates on weather patterns and sea conditions in real-time, helping captains make informed navigation decisions. Shipping companies may invest in security systems and services to enhance vessel safety and navigation in regions prone to piracy. Training programs and simulations help crew members navigate safely, reducing the risk of accidents and navigational errors. Effective communication and navigation are vital for the safety of vessels, crew members, and cargo. These should also be in compliance with maritime regulations. While communication and navigation costs are essential for smooth operations, they are investments that contribute to overall operational efficiency, risk mitigation, and the welfare of everyone involved in shipping operations.

3.9. Catering and Provisions

These expenses cover the cost of the food provided and provisions for the crew on board during their time at sea. In shipping industry refer to the expenses associated with food, beverages, and essential supplies to the crew members on board a vessel during its voyage. These costs are important for crew well-being, health, ensuring that they have access to nutritious meals and necessary supplies while at sea.

Catering Costs include food and meals, catering staff, menu planning, special occasions, provision costs, essential supplies, medical supplies, recreational supplies, safety equipment. Expenses

related to purchasing, storing, and preparing meals for the crew are also included in catering costs. Meals must be nutritious and balanced for the crew members. Many vessels have dedicated catering staff responsible for meal preparation, cooking, and serving. These crew members are trained to handle food safety and hygiene standards. Shipping companies may allocate additional funds for special occasions or holidays, ensuring that the crew can enjoy festive meals and maintain mental health.

Provisions costs cover a wide range of supplies that required for daily living on board, including toiletries, cleaning products and other personal items. Medical Supplies, first aid kits, medications, and medical supplies are part of provisions costs to ensure the crew's health and well-being. Providing recreational supplies such as books, games, and entertainment options helps keep crew members engaged and relaxed during their free time. Provisions costs can also include safety equipment and gear needed for emergencies and personal protective equipment (PPE) for specific tasks. Cost Saving can be contributed with proper planning of meals and provisions helps avoid food wastage and overstocking. Effective supply chain management ensures timely delivery of provisions and minimizes disruptions in the availability of essential items. Maintaining high food safety and hygiene standards is crucial in order to ensure the health of the crew members. Shipping companies request feedback from crew members to improve the quality of catering and provisions services. Budgeting is essential to allocate resources appropriately and avoid unexpected expenses. Providing quality meals and essential supplies that will contribute to the overall morale and satisfaction of the crew, which can truly have an impact at their performance and job satisfaction. Catering and provisions costs are not just operational expenses but also factors that contribute to the overall well-being and satisfaction of the crew on board. Ensuring that crew members have access not only to proper nutrition but also essential supplies in order to have comfortable living environment as it is crucial for a successful and efficient maritime operation. Shipping companies must comply with various international and local regulations, related with environmental standards and safety protocols. In this category are including expenses related to compliance and certification. Regulatory compliance expenses in the shipping industry refer to the costs associated with adhering to various regulations, laws, and standards set by national and international maritime authorities. These regulations cover a wide range of areas, including environmental protection, safety, security, labor standards, and more. Shipping companies are required to invest resources to ensure their operations are in compliance with these regulations.

There are various international environmental regulations that aim at minimizing the environmental impact of shipping activities. Standards for emissions, ballast water management, and disposal of waste set by the International Maritime Organization (IMO). Compliance with these regulations may require investing in technologies such as exhaust gas cleaning systems scrubbers to reduce emissions, and advanced ballast water treatment systems. Safety regulations should be followed to ensure the well-being of crew members, passengers, and the vessels themselves. Compliance may involve regular inspections, maintenance, and upgrades of safety equipment and systems, such as lifeboats, fire detection and suppression systems, navigation equipment, and more. Maritime security regulations are designed to prevent threats such as terrorism, piracy, and other criminal activities. These regulations may necessitate investing in security personnel, equipment like surveillance cameras and access control systems, as well as training programs to enhance security awareness among the crew.

Compliance with labor standards set by organizations like the International Labour Organization (ILO) ensuring fair treatment of seafarers, proper working conditions, and adherence to work and rest hour regulations. This can lead to increased labor costs due to additional staffing or changes in crew schedules. In shipping crossing international borders is a common state and in this way compliance with trade regulations is crucial. This can involve documentation, duties, tariffs, and adhering to specific customs procedures in each country visited. Port State Control where ships are subject to inspections in order to ensure compliance with safety, security and environmental regulations. Non-compliance can lead to fines, delays, or even detention of the vessel until issues are resolved.

Compliance often requires documentation and reporting to regulatory authorities. This can involve administrative work and potentially the implementation of digital systems to track and report various aspects of ship operations. As technology becomes more integrated into shipping operations, cybersecurity regulations may require investment in robust cyber security measures to protect sensitive data and prevent cyberattacks. In order to comply with evolving regulations, shipping companies may need retrofit vessels with advanced equipment or technologies. For instance, the installation of ballast water treatment systems to prevent the spread of invasive species.

Crew members need to be trained and certified to operate vessels and manage emergencies. Compliance might involve investing in training programs, simulators, and certifications for crew members. The expenses associated with regulatory compliance in shipping can vary significantly based on the size of the fleet, the routes taken, the age of vessels, and the nature of the cargo carried. Staying up to date with the evolving regulatory landscape and making necessary adjustments is an ongoing challenge for the shipping industry.

3.10. Miscellaneous Expenses

This category includes various expenses that essential for smooth operations. Miscellaneous expenses in the shipping industry encompass a wide range of costs that don't fall into the categories of direct operational expenses, regulatory compliance, or routine maintenance. These expenses vary depending on the type of shipping operation, the size of the fleet, the trading route, and the specific circumstances of each shipping company.

First of all there are Insurance Premiums. Shipping companies often need to invest in various types of insurance coverage. Hull and machinery insurance, protection and indemnity (P&I) insurance, cargo insurance are included in this category. These premiums can be significant and are essential for mitigating risks associated with maritime operations. Legal and Professional Fees are also considered as miscellaneous expenses. Shipping companies may need legal advice and representation for various matters such as contract negotiations, disputes, regulatory compliance, and international trade regulations. These legal and professional services can incur substantial costs. In addition, periodic surveys and inspections by classification societies, regulatory authorities, and other organizations are necessary to maintain compliance and ensure the safety and seaworthiness of vessels can incur significant costs.

Port Charges and Dues can vary widely depending on the port's location and services provided. When vessels dock at ports, they incur charges for services such as berthing, pilotage, towage, mooring, and waste disposal. Crew Welfare and Training to ensuring the well-being of crew members can involve expenses for crew welfare facilities, medical services, recreation, and training programs to enhance skills and certifications. Reliable communication and information technology systems are crucial for ship operations, and expenses can include satellite communication costs, internet connectivity, software licenses, and cybersecurity measures. Shipping companies often invest in marketing and business development efforts to attract clients,

negotiate contracts, and establish partnerships. Registering vessels under a particular flag state involves registration fees and ongoing annual fees. The choice of flag state can impact regulatory requirements and operating costs. Shipping involves international transactions in various currencies, leading to currency exchange costs and banking fees for wire transfers and other financial transactions.

Beyond routine maintenance, setting aside funds for major repairs or unexpected maintenance issues is important. These reserves can help cover unforeseen repair expenses that arise during the course of operations. Unforeseen events like natural disasters, accidents, or geopolitical disruptions can impact shipping operations. Setting aside funds for emergency situations is a prudent financial practice. Shipping companies may incur expenses for entertaining clients, partners, or stakeholders, especially during events like conferences, trade shows, and business meetings. Expenses related to managing the logistics and supply chain aspects of shipping operations, including transportation of goods to and from ports, warehousing, and distribution. Membership fees for industry associations, chambers of commerce, and trade organizations that provide networking opportunities, industry insights, and advocacy. Investing in market research, data analytics, and information services to stay informed about industry trends, market demand, and competitive dynamics.

These miscellaneous expenses vary greatly based on the specific operations and strategies of each shipping company. Effective financial management and budgeting are important to ensure that these costs are accounted for and do not negatively impact the company's overall financial health.

It's important to be noted that operating expenses can vary widely based on the type of vessel (container ships, oil tankers, bulk carriers, etc.), the age and condition of the vessel, the trading route, fuel prices, and economic factors. Effective management of operating expenses is crucial for shipping companies to maintain profitability and competitiveness in the industry.

3.11. Environmental Sustainability Costs

As global awareness of environmental issues increases, the shipping industry is under pressure to adopt sustainable practices and reduce its impact on the environment. This section discusses specific costs related to environmental sustainability in the area of operating costs for shipping companies. One of the main areas where the costs of environmental sustainability are being felt is

in the implementation of fuel efficiency measures. As regulators tighten emissions standards and public expectations for greener operations increase, shipping companies are investing in technologies and practices to optimize fuel consumption. These include introducing cleaner fuels, modifying ships to improve energy efficiency, and researching alternative propulsion systems. Environmental regulations regulating greenhouse gas emissions have prompted shipping companies to initiate programs to reduce their carbon footprint. These programs include developing and implementing strategies to limit emissions such as the use of slow steam operations, route optimization, and emission control techniques. While these measures contribute to sustainability goals, they also incur additional costs associated with equipment upgrades, monitoring systems, and compliance with strict emissions standards. Complying with international and regional environmental standards requires shipping companies to invest in technologies and practices that ensure compliance. This may include installing ballast water treatment systems, using environmentally friendly antifouling coatings, and implementing waste management protocols. The costs associated with these compliance measures complicate a shipping company's total cost of ownership. To stay ahead of evolving environmental regulations and industry expectations, shipping companies are engaging in research and development activities focused on sustainable practices. This includes investing in research into new technologies, materials and methods of operation that are consistent with environmental sustainability goals. While these initiatives provide long-term benefits to the industry, they also impose immediate costs on companies seeking to lead in sustainable transportation practices. The cost of environmental sustainability is a key component of a shipping company's operating costs. As the industry navigates a changing landscape characterized by environmental awareness and regulatory requirements, it is important that these costs are understood and managed to achieve a balance between economic viability and environmental responsibility.

4. Empirical Model

The analysis of an empirical model in a Master's thesis is of a great importance as it served as the cornerstone for contributing to meaningful conclusions and providing to the existing body of knowledge within a specific field of study robust results. A structured framework is provided through the Empirical model analysis for testing a hypothesis proposed in the thesis. Researchers can assess the validity of their assumptions and draw evidence-based conclusions, through statistical analysis thereby enhancing the robustness of their research results. Empirical models analyzing real-world data that enable the researcher to completely understand a data-driven complex approach. The empirical research make the more theoretical parts of a phenomenon to be observed and analyzed with a more practical way. This practical applicability of the theoretical constructs bridges the gap between real world cases / scenarios and academic theories which can lead to a better decision making process in a real world professional environment. The identification of patters and data relationships are facilitated through empirical models. The above is really important for uncovering complexities that might not be apparent through a framework more theoretical. New knowledge is being added and contribute significantly to the academic field through the empirical analysis. This empirical analysis gives the opportunity to researchers for research challenges in a way to advance the academic conversation using the existing literature by expand further with the support of empirical findings. Empirical models, in certain fields, provide evidence insights helping them making decision that may grounded in realities with empirical veil. The addition of an empirical model and analysis in a Master Thesis is crucial and strengthens the results of the hypothesis analysis. In this way, the Master Thesis and the empirical results can be demonstrated to academic and professional audiences giving insights and opportunities for future research. Unexpected results and uncovering knowledge gaps may also inspire for further exploration of the research area. In summary, the analysis of an empirical model in Master Dissertation is pivotal for transforming theoretical concepts into practical insights. It provides a solid foundation for evidence-based decision-making in professional world and may contribute to the academic discourse.

This empirical research is an academic journey through the waters of asymmetric cost behavior in Shipping Companies and will contribute to the broader understanding of cost behavior. It aim at deeper understanding of financial dynamics and management strategies. For the research to be

carried out, Fifteen Shipping companies listed in NYSE were selected as Sample. The time period frame of our research concerns the years 2012 to 2022. Operating Expenses, Revenues, Total Assets and Number of Employees are the variables under scrutiny used in order the phenomenon to be analyzed. By delving into these key indicators the most important relationship is the relationship between Operating Expenses and Revenues in which this research will be focused whereas Assets and Number of Employees are the Control Variables in order the model and the results to be more robust.

The Statistical model:

$$\log(\text{Expenses}_t/\text{Expenses}_{t-1}) = a + b1 \log(\text{Revenues}_t/\text{Revenues}_{t-1}) + b2 \log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} + b3 \log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} * \log(\text{Assets}_t/\text{Revenues}_t) + b4 \log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} * \log(\text{Employees}_t/\text{Revenues}_t) + \varepsilon$$

- Dummy = 1 if $\text{Revenues}_t < \text{Revenues}_{t-1}$
- Dummy = 0 if $\text{Revenues}_t > \text{Revenues}_{t-1}$

The above mentioned equation is log-linear regression model which aim to explore the asymmetric cost behavior of operating expenses in shipping companies. The model incorporates independent variables including lagged and differenced values as well as a Dummy variable. First of all, $\log(\text{Expenses}_t/\text{Expenses}_{t-1})$ represents the logarithm of the ratio of current operating expenses to lagged operating expenses, serving as the dependent variable to be predicted. In addition, the Independent Variables are $\log(\text{Revenues}_t/\text{Revenues}_{t-1})$ which is the logarithm of the ratio of current revenues to lagged revenues, indicating the impact of changes in revenue of operating expenses. The Independent variable of $\log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy}$ implies an interaction between the logarithm of revenue ratio and a dummy variable. This incorporate an asymmetry factor based on whether the current revenue is less than the lagged revenue. An interaction term involving revenue, dummy, and the logarithm of the ratio of current assets to revenues, introducing a dynamic related to the asset structure present by the independent variable $\log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} * \log(\text{Assets}_t/\text{Revenues}_t)$. Last but not least, similar to the above mentioned term in the last independent variable $\log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} * \log(\text{Employees}_t/\text{Revenues}_t)$, revenue, dummy and the logarithm of the ratio of current employees to revenues imply a labor-related dimension.

There are the parameters a which is the intercept term and b_1, b_2, b_3, b_4 which are the coefficients representing the impact of respective independent variables on the dependent variable. Furthermore, when Dummy Variable is 1 if $Revenues_t$ is smaller than $Revenues_{t-1}$ that indicates a decrease in revenues whereas Dummy is 0 if $Revenues_t$ are greater than $Revenues_{t-1}$ that indicates an increase or no change in revenue. In summary there is the Error Term ϵ , which indicates the error or the unobserved factors that influence operating expenses that are not accounted for by the independent variables. This statistical model can capture how changes in revenues impact the dynamics of operating expenses in shipping companies in conjunction with the asymmetry induced by the Dummy variable. The addition of terms involving total assets and employee ratios adds further sophistication, considering the potential influence of these factors on cost behavior.

4.1 Descriptive Statistics

To comprehend and summarize data, descriptive statistics are used as a starting point. To produce a coherent picture, it entails organizing, visualizing, and summarizing unstructured data. Descriptive statistics' main objective is to give a succinct and understandable summary of the data's key characteristics. This enables us to spot patterns, trends, and traits within the data set without drawing any additional conclusions.

Key Aspects of Descriptive Statistics

- **Measures of Central Tendency:** Descriptive statistics include calculating the mean, median, and mode, which offer insights into the center of the data distribution.
- **Measures of Dispersion:** Variance, standard deviation, and range help us understand the spread or variability of the data.
- **Visualizations:** Creating graphs, histograms, bar charts, and pie charts visually represent the data's distribution and characteristics.

Mean

The “Mean” is the average of the data and can be identified by summing up all the numbers and then dividing them by the number of observations. It is calculated by adding up all data points and

dividing the sum by the number of observations. It is a measure that provides an average value for the dataset. Mean is sensitive to extreme values and it makes essential the understanding of distribution of data.

Median

It is the 50th percentile of the data and can be identified by ordering the data, splitting it into two equal parts, and then finding the number in the middle. It is the best way to find the center of the data. It is determined by arranging the data in ascending or descending order and identifying the middle value. In a number of observations, the median is the average of the two middle values. The median is less sensitive compared to the mean, making it robust measure of central tendency.

Standard Deviation

The most common measure of spread is the standard deviation. It measures how far the data deviates from the mean value. A low standard deviation indicates that data points are close to the mean while a high standard deviation suggests greater variability. It provides a quantitative measure of how much individual data points deviate from the mean.

Min

The Min as descriptive statistic indicates the smallest observed value in a dataset which indicates minimum point of the distribution for given variables. The minimum is useful for understanding the lower values that have a significant impact on the overall distribution.

Max

The Max as descriptive statistic signifies the largest observed value in a dataset, providing insight into the upper limit of the distribution for given variables. The maximum is crucial for the understanding of the upper range of the dataset. It helps in the identification of the most extreme values that may influence the overall distribution.

In summary, the above mentioned descriptive statistics provide valuable insights into different aspects of a dataset including central tendency, variability, and the range of observed values. All measures contribute to a comprehensive understanding of the distribution and characteristics of the data.

From Our Data Set the descriptive statistics are the following:

Table 1: Descriptive Statistics

Descriptive Statistics	Total Assets	Operating Expenses	Revenues	Number of Employees
Average	\$13,777,575.30	\$2,087,813.90	\$4,434,744.61	\$1,469.03
Median	\$1,787,122.00	\$112,736.00	\$331,976.00	\$1,070.00
St. Dev	\$47,620,814.72	\$8,306,994.46	\$19,046,552.21	\$1,619.64
Min	\$3,268.00	\$745.00	\$2,010.00	\$8.00
Max	\$328,590,425.00	\$76,054,030.00	\$189,630,465.00	\$6,200.00

Median

Based on the above table, Total Assets have \$1,787,122.00 median, Operating Expenses have \$112,736.00, Revenues have \$331,976.00 and Number of employees have \$1,070.00. The median is important descriptive statistic because it provides a robust measure of central tendency that is less sensitive to extreme values. Median is resistant to outliers. It represents the middle value of a dataset when it is sorted, making it a more stable indicator of central tendency in the presence of skewed or asymmetric distributions. The median accurately reflects the central position without being pulled towards the skewness. This makes it a better choice when describing the typical value in such scenarios. The median is really easy to understand and interpret. It represents the point in a dataset below which 50% of the values fall. This simplicity makes it a suitable measure for conveying central tendency to a broad audience.

Average

Furthermore, Average of Total Assets is \$13,777,575.30, for Operating Expenses is \$2,087,813.90, for Revenues is \$4,434,744.61 and for Number of employees is \$1,469.03. The average is typically represented by the mean and is an important descriptive statistic for several reasons. First of all, the mean provides a measure of central tendency, representing a typical or average value in a dataset. It is the balance point of the distribution and is easy to understand. By Calculating the mean simplifies complex data and makes it easier to communicate and compare different sets of information. The mean value has practical mathematical properties that make it

suitable for various statistical analyzes. It is often used in the formulation of statistical models and hypothesis tests. The mean value takes into account every data point in a data set. While this can be a disadvantage in the case of outliers, it also means that it is a comprehensive measure that reflects the overall pattern of the data. The mean can be calculated for data measured on interval and ratio scales and provides a meaningful average for numerical data. This makes it applicable to a wide range of quantitative variables. The mean is computationally efficient to calculate. The formula involves summing all values in a data set and dividing by the number of observations, which makes the calculation very simple. Many statistical methods, such as regression analysis and analysis of variance, are based on the mean value as a fundamental component. It serves as a basis for more complex analyzes and is often a prerequisite for advanced statistical methods. The mean value is intuitively understandable and easy to interpret. It gives a clear indication of the average value and is therefore accessible to a wide audience. While the mean has its advantages, it is important to note its limitations, particularly its sensitivity to outliers. In cases where extreme values may distort the average, other measures of central tendency, such as the median, are preferable. The choice between the mean and other measures depends on the characteristics of the data and the objectives of the analysis.

Standard Deviation

Standard Deviation quantifies the amount of variation in a set of values. In the context of above mentioned variables, the standard deviation, this statistical measure, provides insights with respect to the degree of variability. Regarding Total Assets, a standard deviation of \$47,620,814.72 means that the values in our dataset are dispersed around the mean value. A higher standard deviation implies a greater variability in total assets values of the entities. The standard deviation of Operating Expenses of \$8,306,994.46 implies the variability in Operating Expenses and suggests that across the dataset deviate more from the mean. For Revenues, a standard deviation of \$19,046,552.21 signifies the degree of dispersion in Revenues across the companies. A large Standard Deviation means that these values are more spread out from the mean and diversified performance levels for every shipping company. Last but not least, for the Number of Employees the standard deviation of \$1,619.64 indicates the amount of variability in workforce size. Diverse employment structures or operational models indicated through Higher Deviation. Standard Deviation is a really important descriptive statistic, as it provides the amount of variation and

dispersion in a dataset of values. Higher standard deviation implies greater variability whereas a lower standard deviation indicates that the values are closer to the mean. Standard Deviation in finance is often used as a measure of risk implying greater volatility. In addition, standard deviation calculates confidence intervals and make predictions about the population based on sample data. In summary, standard deviation is a fundamental tool in descriptive statistics that helps in the analysis and interpretation of datasets in various fields.

Minimum

The minimum values (Min) for our variables of Total Assets, Operating Expenses, Revenues, and Number of Employees provide insights into the lower bounds of these variables within the dataset. The minimum Total Assets value of \$3,268.00 implies the smallest amount of assets held by the entities in the dataset. This may indicate the presence of smaller businesses with limited capital investment. The minimum of Operating Expenses of \$745.00 indicate that there are entities that have relatively low operating expenses. In addition, it may indicate efficient cost management or perhaps businesses that operate on a smaller scale. The distribution of operating expenses in relation to revenues is essential to understand in order to assess the financial health and efficiency of the entities. The minimum of Revenue value of \$2,010.00 suggest the smallest reported income among the entities. This may imply the existence of smaller businesses or entities with limited sales or revenue generation. A minimum of \$8.00 for the Number of Employees suggests that there are entities in the dataset with a very small workforce. This might indicate the early stages of development micro-businesses or startups. In summary, the minimum values highlight the existence of entities with the lowest levels with respect to Total Assets, Operating Expenses, Revenues, and Number of Employees. It is important to understand the minimum values assessing the diversity within the dataset. Additionally, through this analysis of these values can be provided a comprehensive understanding of our variables' characteristics.

Maximum

The maximum (Max) values of variables in statistical analysis play an important role in providing insights into the upper bounds of the observed data. Total Assets Max of \$328,590,425.00 indicates the highest amount of assets held by the entities under consideration. This value provides a key measure of the upper limit of financial resources and potential capital invested in the analyzed context. Operating Expenses Max of \$76,054,030.00 reflects the peak level of expenditures

incurred by the entities. The Revenues Max of \$189,630,465.00 signifies the highest level of income generated by the entities. It may give insights in the overall financial performance of the entities. The Number of Employees Max of \$6,200.00 suggest the largest workforce size observed in the dataset. This specific Max value offers insights into the scale of employment and human resources management. The analysis of Max value of our variables is crucial for the understanding the overall scale of the dataset.

5. Regression Analysis

Regression Analysis has a pivotal role in a Master Thesis as it is a powerful and analytical tool which enables the researchers to analyze and explore the relationships between variables and derive meaningful insights. It can lead to qualitative observations and make precise, numerical assessments of how one variable influences another. Researchers can identify which variables have a significant impact on the dependent variable, through regression analysis. In addition, it provides a basis for making informed predictions. It provides measures, such as R-squared and adjusted R-squared, which assess how well the model fits the data. This evaluation is crucial for understanding the explanatory power of the model and ensuring its appropriateness for the research question. In cases where relationships between variables are intricate, the regression analysis can handle multiple predictors and interactions, allowing researchers to explore complex relationships within the data. In conclusion, regression analysis offers a systematic and rigorous approach to examining relationships between variables. The aim of this thesis is to assess through regression analysis if the chosen variables are statistically significant and in the prediction of the dependent variable up to which extent the changes of operating expenses are explained. Regression analysis is a statistical method for determining the structure of a relationship between two variables (simple linear regression) or three or more variables (multiple regression), its linearity. It is crucial in order to understand to which to which level these variables affect the dependent variable. Each coefficient will be studied based on shipping theory.

5.1 Summary Output

Summary output in the context of regression analysis provides a comprehensive overview of the statistical results and key parameters derived from the model. This summary is a crucial component

for researchers and analysts to interpret the relationships between variables. You can determine how well the calculated linear regression equation fits your data source by looking at the summary output.

The **Multiple R** is the Correlation Coefficient. It is a statistic used in regression analysis to quantify the strength and direction of the linear relationship between the independent variables and the dependent variable in a multiple regression model. In a multiple regression model, there are several independent variables that are used collectively to predict the variation in the dependent variable. It measures the strength of a linear relationship variables. The larger the absolute value, the stronger is the relationship.

1 means a strong positive relationship

-1 means a strong negative relationship

0 means no relationship at all

R Square is the Coefficient of Determination. It shows the goodness of fit and how many points fall on the regression line. R^2 is a key statistic in regression analysis that measures the proportion of the variance in the dependent variable that is explained by the independent variables in a regression model. It ranges from 0 to 1 and is expressed as a percentage when multiplied by 100.

Adjusted R Square is the modified version of R square that adjusts for predictors that are not significant to the regression model. It penalizes models that include unnecessary variables that do not contribute significantly to explaining the variance in the dependent variable.

Standard Error is another measure that shows the precision of your regression analysis. It is a statistical measure that quantifies the amount of variability or dispersion in a set of values. The Standard error is used to estimate the precision or reliability of a sample statistic.

5.2 ANOVA

Analysis of Variance is referred to as ANOVA. It provides details regarding the degrees of variability present in your regression model. It is a statistical method which is used to assess statistical significant differences between the means of three or more independent groups. ANOVA is a powerful tool for the understanding the variability and comparing means between groups. It is an asset in experimental research when the researchers aspire to determine if there are any significant differences among multiple groups. The fundamental concept behind Analysis of Variance is to examine the total variability into different components. First is the variability between groups and the variability within groups. The goal is the comparison of these two sources of variability in order to determine if the differences between group means are greater than what would be expected due to random chance.

- The degree of freedom (**Df**) connected to the sources of variance.
- **SS** stands for square sum. The better your model fits the data, the smaller the Residual SS in comparison to the Total SS.
- **MS** is the mean square.
- **F** is the null hypothesis's F statistic or F-test. It can be used to test the overall model significance very successfully.
- **Significance F** is the P-value of F.

The following table illustrate the results of the Regression Analysis.

Table 2: Regression Analysis

SUMMARY OUTPUT					
Regression Statistics					
Multiple R	0.662182481				
R Square	0.438485639				
Adjusted R Square	0.422995587				
Standard Error	0.372398157				
Observations	150				
ANOVA					
	df	SS	MS	F	Significance F

Regression				4	15.7028 164	3.925704101	28.3075652	2.21008E-17
Residual				145	20.1086 5613	0.138680387		
Total				149	35.8114 7254			
	Coefficients	Standard Error	T Stat	P Value	Lower 95%	Upper 95%	Lower 95.0 %	Upper 95.0%
Intercept	-0.057073084	0.041961491	- 1.360130 053	0.17589964 6	- 0.140008 274	0.025862105	-0.140008274	0.025862105
Log (Revenuet/ Revenuet-1)	0.814337478	0.107626666	7.566317 037	4.07165E- 12	0.601617 724	1.027057231	0.601617724	1.027057231
Log (Revenuet/ Revenuet- 1)*Dummy	0.955013033	0.360946972	2.645854 119	0.00904783 6	0.241615 938	1.668410127	0.241615938	1.668410127
Log (Revenuet/ Revenuet- 1)*Dummy *log(Assets t/Revenuest)	-0.575017393	0.096479596	- 5.959989 618	1.83246E- 08	- 0.765705 413	-0.384329372	-0.765705413	-0.384329372
Log (Revenuet/ Revenuet- 1)*Dummy *log(Empl o yeest/Reven uest)	0.102969202	0.051833186	1.986549 717	0.04885703 4	0.000523 005	0.205415399	0.000523005	0.205415399

Based on above results and our model:

$$\log(\text{Expenses}_t/\text{Expenses}_{t-1}) = a + b1 \log(\text{Revenues}_t/\text{Revenues}_{t-1}) + b2 \log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} + b3 \log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} * \log(\text{Assets}_t/\text{Revenues}_t) + b4 \log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} * \log(\text{Employees}_t/\text{Revenues}_t) + \varepsilon$$

- Dummy = 1 if $\text{Revenues}_t < \text{Revenues}_{t-1}$
- Dummy = 0 if $\text{Revenues}_t > \text{Revenues}_{t-1}$

In case of Stickiness our variable $b_2 < 0$ and statistical significant. If $b_2 > 0$ and statistical significant there is anti-stickiness.

5.3 Basic Analysis

Observing the above table representing the outcomes of the regression, the first thing that can be noticed is that there is Anti-stickiness, as variable $b_2 > 0$. In contrast to cost stickiness, the phenomenon of anti-stickiness of costs is defined in such a way that costs increase less when sales revenue increases, but costs decrease more when sales revenue decreases. It is crucial to mention that all regressions are statistically significant as their p-value is less than 0.05.

i) The coefficient of $\log(\text{Revenues}_t/\text{Revenues}_{t-1})$

The coefficient of $\log(\text{Revenues}_t/\text{Revenues}_{t-1}) = 0.81$. This coefficient represents the impact of a change in the natural logarithm of the ratio of current period revenues (Revenues_t) to the previous period revenues (Revenues_{t-1}) on operating expenses. It suggests that for a 1% increase in revenues from the previous period is associated with a 0.81% increase in operating expenses. This coefficient represents the basic relationship between revenue and operating expenses. In other words, as revenues increase, operating expenses tend to rise.

ii) The coefficient of $\log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy}$

The coefficient of $\log(\text{Revenues}_t/\text{Revenues}_{t-1}) * \text{Dummy} = 0.95$ introduces the variable Dummy, which appears to be an indicator variable. It represents the impact of a change in the product of the natural logarithm of the revenue ratio and the Dummy Variable on operating expenses. In this case, it's 0.95 which means that when the Dummy variable is activated, a 1% increase in the revenue ratio leads to a 0.95% increase in operating expenses.

iii) The coefficient $\log(\text{Revenues}_t/\text{Revenues}_{t-1}) \text{Dummy} \log(\text{Assets}_t/\text{Revenues}_t)$

In Addition, the coefficient $\log(\text{Revenues}_t/\text{Revenues}_{t-1}) \text{Dummy} \log(\text{Assets}_t/\text{Revenues}_t) = -0.57$ which means that when these three factors interact and the Dummy variable is activated, a 1% increase in the revenue ratio, combined with a change in the asset-to-revenue ratio, leads to a -0.57% change in operating expenses. This coefficient might indicate that, under certain conditions

represented by the Dummy variable, increases in both revenue and the asset-to-revenue ratio result in a decrease in operating expenses.

iv) The coefficient $\log(\text{Revenues}_t/\text{Revenues}_{t-1})\text{Dummy}\log(\text{Employees}_t/\text{Revenues}_t)$

Last but not least the coefficient $\log(\text{Revenues}_t/\text{Revenues}_{t-1})\text{Dummy}\log(\text{Employees}_t/\text{Revenues}_t) = 0.10$. This one involves the interaction of the revenue ratio, the Dummy variable, and the ratio of employees to revenue. It's 0.10, which means that when these three factors interact and the Dummy variable is activated, a 1% increase in the revenue ratio, combined with a change in the employee-to-revenue ratio, leads to a 0.10% change in operating expenses. This coefficient suggests that, under the conditions represented by the Dummy variable, an increase in both revenue and the employee-to-revenue ratio leads to a slight increase in operating expenses.

It is important to be mentioned that all regression coefficients are reported to be statistically significant as $p < 0.05$, implying that the observed relationships are unlikely due to random chance. Above mentioned results demonstrate a nuanced understanding of the model and its implications, particularly regarding the presence of anti-stickiness and the varying effects of different factors on operating expenses under different conditions.

6. Conclusion

Shipping industry is essential for the global trade and is facing myriad adversities that underscore the complexity of its operations. A constant challenge is the volatile fuel prices that impact operating costs (OPEX) and profitability. Strict environmental regulations demand substantial investments in cleaner technologies and all these add financial strain. In shipping industry exist frequent economic downturns affecting freight rates and cargo volumes. Substantial maintenance expenses are essential for aging fleets. In addition, the cyclical nature of the shipping market may lead to overcapacity driving down the rates and increasing the competition. Shipping companies

must adapt to this technological innovative environment and embrace these challenges in order to make operational efficiency (Talley, 2010). Despite all the adversities that occur, shipping industry remains indispensable to global commerce. This thesis emphasizing on the intricate dynamics of asymmetric cost behavior within the shipping sector. Through a comprehensive review of the relevant literature, empirical analysis and case studies, shed light on the multi-layered nature of cost asymmetry in this industry. The results underline the importance of recognizing and understanding the asymmetric responses of costs to various economic and operational factors (Banker, 1993). The asymmetric cost behavior observed in the shipping sector has a significant impact on decision makers, stakeholders and policy makers alike. Based on above mentioned empirical model and through regression analysis resulting cost anti-stickiness phenomenon which is defined as costs increase less when sales revenue increases, but costs decrease more when sales revenue decreases. Because of the asymmetry, performance optimization, risk mitigation, and cost management all need sophisticated approaches due to the increased complexity. Industry participants can improve their competitive advantage by strategically responding to changing market conditions by identifying and understanding asymmetric cost drivers. In addition, research has shown the importance of taking into account industry-specific characteristics such as fleet composition, market volatility and regulatory frameworks when analyzing cost behavior. Through a more realistic portrayal of the difficulties and opportunities faced by shipping companies, this nuanced approach helps to advance knowledge of the industry's economic dynamics (Banker, 2018). The transportation industry is constantly changing due to factors like environmental concerns, technological advancements, and shifts in global economic conditions. This thesis offers valuable insights that will help shape future research and industry practices. By acknowledging and addressing the asymmetry in cost behavior, stakeholders can develop resilient and adaptable strategies that contribute to the sustainability and success of the shipping industry in an ever-changing landscape. The regression analysis applied reveals intriguing insights into the dynamics between revenues and operating expenses, shedding light on the presence of anti-stickiness in the relationship. The key findings can be summarized as follows:

First of all, the positive coefficient $b_2 > 0$ is associated with the interaction term between the logarithm of the revenue ratio and the dummy variable indicates the presence of anti-stickiness. This phenomenon indicates that operating expenses are increased less when sales revenue is on the rise but are decreased more significantly when sales revenue experiences a decline. In addition,

the coefficient of (0.81). This coefficient reflects the fundamental relationship between revenue and operating expenses, indicating a positive correlation. The coefficient of (0.95) emphasizes that expenses tend to rise more significantly during periods of declining revenue. Notably, the negative coefficient (-0.57) associated with the interaction of revenue, the Dummy variable, and the asset-to-revenue ratio suggests that, under specific conditions, increases in revenue and the asset-to-revenue ratio can lead to a decrease in operating expenses. Conversely, the positive coefficient (0.10) for the interaction involving revenue, the Dummy variable, and the employee to revenue ratio indicates that, under the conditions represented by the Dummy variable, an increase in both revenue and the employee to revenue ratio results in a slight increase in operating expenses. In summary, all regression coefficients exhibit statistical significance ($p < 0.05$), indicating that the observed relationships are unlikely to be attributed to random chance. The results in general suggest a nuanced relationship between revenues and operating expenses, characterized by anti-stickiness. The model provides valuable insights into how expenses respond differentially to changes in revenue, offering a comprehensive understanding of the asymmetric cost behavior in the context of anti-stickiness.

7. References

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