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MASTER OF SCIENCE IN SHIPPING MANAGEMENT

MASTER THESIS

The effect of Shipping Firms' Life Cycle on Cost Behavior and Operating Performance

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PREAMBLE

This research study constitutes a master thesis, as part for the fulfillment of the academic obligations of the Master of Science Program "Shipping Management", in the Department of Maritime Studies, University of Piraeus.

The research object of the present study is the investigation of the relation between cost behavior and firm's operating performance, according to the life cycle stages of the shipping firms. The effect of shipping firms' life cycle on asymmetric cost behavior patterns and operating performance is a research topic that has not been investigated thoroughly in a methodical way. The present study aims to shed light to the aforementioned notions and relations that have not been researched in a systematic way in Greek literature.

At this part, I would like to express my gratitude for the people that I met, collaborated with and made a contribution to the fulfillment of this research study.

First and foremost, I would like to personally thank the supervisor of the master thesis, Dr. Vasileios-Christos Naoum, Assistant Professor in the Department of Maritime Studies, University of Piraeus, for his kind assistance and support during the designing and organization of the research process, as well as for the continuous guidance during the writing process of the master thesis. I would also like to express my gratitude to the Assistant Professor Dr. Dionysios Polemis and Associate Professor Dr. Ioannis Lagoudis for the participation in the three-member committee of the Master Thesis, the fruitful advice and the valuable time that they devoted for the successful completion of it.

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ABSTRACT

The current study investigates a) the asymmetric cost behavior of shipping firms, b) the cost behavior of shipping firms according to the life cycle stage c) the relation of cost behavior with operating performance, d) the relation of cost behavior with operating performance across the life cycle stages, e) the differences between the Shipping, Construction and Transportation firms in terms of asymmetric cost behavior. The data sample used for the analysis of this research consists of 32,888 observations of Shipping firms and parallel Shipping firms. Two additional data-samples for the Construction and Transportation firms are used for the purposes of the fifth research question. The analysis process is relied on a combination of three methods: a) the sticky cost methodology, introduced by Anderson et al. (2003), b) the life cycle methodology, presented by Dickinson (2011) and c) measurement of operating performance relied on the proxies Return on Equity and Return on Assets. The results of the study show that shipping firms in general do not exhibit asymmetric cost behavior, but a rather symmetrical cost pattern. However, the cost analysis conducted according to each life cycle stage, manifests that in case of SG&A cost, an anti-stickiness cost behavior pattern is present in Growth, Mature and Shake-out Phases. In case of operating expenses, in the Introduction Phase, stickiness cost behavior is exhibited, whereas in case of Growth and Mature Phases, an anti-stickiness pattern is apparent. No correlation of cost behavior of shipping firms with their operating performance is generally verified. Statistically significant results concerning the cost behavior of shipping firms and operating performance are found for several phases in case of SG&A cost and operating expenses. Significant differences are reported in case of Shipping and Transportation firms, where a comparison between them is made. The results of the research are discussed in combination with the findings of other studies of the Greek and international literature and propositions for future research are made.

Keywords: shipping firms, asymmetric cost behavior, sticky cost phenomenon, life cycle stages, operating performance

1ST CHAPTER

INTRODUCTION

Cost analysis and firm performance of shipping companies- according to the firm's life cycle stage- have aroused researchers' interest at an international level during the last two decades (Wang, Oguz, Jeong & Zhou, 2018; Jeong et al., 2018; Miah, Koh & Stone, 2017). Most of the research over the above-mentioned issue began during the early 2000s. The first main research that introduced the issue of interrelation of cost analysis and firm performance during the shipping firm's life cycle is that of Zisis and Naoum (2021).

Researchers have been trying to study this issue from a vast range of perspectives. The research is not limited to a certain country or continent, but it seems to be an object of systematic and meticulous research all around the globe. An indicative reference in countries, such as USA, countries of North, Central and South Europe, United Kingdom, China, Australia is not exhaustive (Kochen, 2022; Mondello et al., 2021; Ballas, Naoum & Vlismas, 2020; Balios, Eriotis, Naoum & Vasiliou, 2020; Chang & Ma, 2019; Ylhainen, 2016; Pervan & Pervan, 2012; He, Teruya & Shimizu, 2010 ; Moores & Yuen, 2001).

According to the definitions adopted by the international scientific community for the interpretation of the term sticky cost phenomenon or cost stickiness, a specific trend in cost behavior is usually observed when changes in volume of firm activity are reported (Anderson, Banker & Janakiraman, 2003). More specifically, sticky cost refers to the phenomenon of asymmetric cost response to changes in activity levels of the firm. Therefore, when a firm's activity level declines, costs decrease to a lesser extent than they increase when the activity level increases by an equivalent percentage (Anderson et al., 2003; Banker & Byzalov, 2014).

The reference to the term life cycle cost analysis of a firm is pertinent to the evaluation of the economic and financial performance of a firm over its entire economic life. There are four main stages in the life cycle of a firm: a) startup, b) growth, c) maturity, d) renewal or decline (Dickinson, 2011). Through life cycle cost analysis procedure, cost behavior is assessed over the aforementioned life cycle stages.

Firm performance refers to the ability of a firm to make use of the resources that it owns in order to achieve its financial objectives (Taouab & Issor, 2019). This measure of entrepreneurial performance depends not only on the firm itself, but also on the environment that it operates. Firm performance in the financial sector is also known as financial stability or financial health. There are various financial performance metrics available in order to evaluate the performance of the company, including quick ratio, current ratio, working capital, gross profit margin, net profit margin, equity multiplier, debt-to-equity ratio, return on equity, return on asset, total asset turnover, inventory turnover, and operating cash flow.

Considering the aforementioned definitions, the importance of this research topic is stressed, as most shipping companies are interested in gaining a better and deeper understanding of cost behavior over the life cycle stages of a firm and its appendant correlation with firm performance. Their increasing interest in this research topic is related to the managerial decisions needed to be made during the business activity of the firm.

Cost behavior in shipping industry exhibits different patterns across life cycle stages in comparison to other areas of business activity due to its special nature. Specific cost categories that are discussed in shipping pertain to variable and fixed costs. Variable costs in shipping industry usually include cargo-related expenses and navigation expenses that change in proportion to business activity. Examples of fixed costs in shipping industry include crew expenses, vessel expenses, depreciations, amortization expenses that are constant for a short-term period. (Gkonis & Psaraftis, 2010). Therefore, a thorough analysis of this issue is proven to be useful for shipowners and managers of shipping companies, as they can make more purposeful decisions based on cost behavior knowledge.

Therefore, the initial spark for the fulfillment of this master research thesis under the Master of Science Program “MSc. In Shipping Management”, was that those interested in science of managerial accounting are often concerned about cost behavior phenomena over the life cycle stages of a firm – such as sticky cost phenomenon- in order to predict the cost trends during the different phases of business activity. This piece of information is useful for managers of shipping companies, to take the appropriate course of action on time and to consequently boost firm performance. The correlation of cost behavior with firm’s performance in different life stages is also fruitful for financial analysts because they are able to estimate future firm’s earnings as well as predict future firm performance through the study of sticky cost patterns across life cycle stages. Therefore, they can evaluate future firm performance correctly and propose earnings' prediction models based on different sticky cost patterns across life cycle stages.

The choice of shipping sector for the realization of the current research thesis was not random, as the shipping industry has to confront numerous challenges, pertaining to cost behavior, not only during long-time, but also short-time periods. Cost behavior analysis on the current research topic is mainly concentrated on the long-time intervals and during the transition over the life cycle stages of a firm. The analysis is centralized in researching the asymmetric cost behavior trends in shipping industry and its repercussions on firm performance on financial terms.

The research approach of the current study is based on the methods and tools of previous studies that have been interested in this topic. The main approach in order to study the asymmetric cost behavior over the life cycle stages and its relation to shipping firms' performance is based on the definition of the life cycle stages, the examination of cost trends during the time intervals of life cycle stages and the interrelation with the financial performance of the shipping firms.

The remainder of the current study is organized as follows: On the first part, the theoretical background of the current study is presented.

More specifically, on the second chapter of the research thesis -entitled "Literature Review"- the main findings of previous studies, pertaining to the basic notions and variables of the study, are analyzed thoroughly. The second chapter consists of three subchapters. At the first point of each subchapter, the definitions of the notions of life cycle, cost behavior and firm performance are introduced. Then, the results of previous studies of international literature are reviewed in order to gain a deeper and more thorough understanding of the notions and correlations between them and other topics. The studies reported are concentrated on the main research topic, have been published in their majority during the last two decades and their focal point is the shipping industry. Research studies are not restricted only to the Greek literature, but also to the international literature, with important paper references from Europe, USA, China, India and the rest of the globe.

The third chapter entitled: "Aims and Hypotheses of the Research" presents the main objective and the motivation of the current research, as well as the goals that emerge from literature review that precedes this chapter. On the same chapter, the research hypotheses and queries are formulated and highlighted.

The second part of the research study is initialized with the fourth chapter named "Data and Methods", where the research methods followed are analyzed properly. There is a distinct report on the characteristics of the research sample, as well as the data collection procedure. Analytical details are also given on the statistical analysis methods used in order to extract the results of the current study.

On the fifth chapter, entitled "Results", there is a meticulous presentation of the results of the present study.

The sixth chapter -labeled "Discussion"- comprises the interpretation of the main findings, as these have been extracted during the statistical analysis preceded. The conclusions of the present study arise in accordance with the research hypotheses and queries mentioned on the third chapter "Aims and Hypotheses of the Research".

On the last part of the current study, the literature references are reported in an analytical way.

2ND CHAPTER

LITERATURE REVIEW

Life Cycle Analysis, Cost Behavior and Firm's Operating Performance

This chapter outlines the theoretical background as well as the main results of research studies from the Greek and International literature pertaining to Life Cycle Stages, Cost Behavior and Firm's Operating Performance. More specifically, the research findings of previous studies referring to the aforementioned managerial accounting notions are analyzed, with special emphasis put on results concerning the shipping industry.

2.1. Life Cycle Analysis

Life Cycle Analysis is a practical methodology used by firms in order to assess the internal or external impacts correlated with the life cycle stages of a product, process or even the firm itself (Groot & Selto, 2013). Life Cycle Analysis is characterized by the life cycle stage analysis, where the different phases are presented in form of a life cycle model, to be implemented either in case of a product, process or firm. This segmentation assists in the in-detail analysis of the Product, Procedure or Firm Life Cycle. Life Cycle Analysis has been associated with other subject areas in literature, such as cost behavior, operating performance and efficiency of the firm (Ryu & Won, 2022; Abdelhay, Youssef & Awad, 2021; Wang, Oguz, Jeong & Zhou, 2018). On this subchapter, the analysis focuses mainly on business life cycle model and stages.

2.1.1 Business Life Cycle Model-Definition

The Business Life Cycle Model has been introduced in the international literature, as part of the firm's life cycle analysis (Dickinson, 2011). This model is a useful tool in studies pertaining to the long term course of the firm. It can be used in combination with other tools for the study of the whole business life cycle spectrum. It consists of the business life cycle stages, a typical segmentation made as a basis for the common understanding of the researchers. The main five stages of business life cycle model are a) Seed and Development, b) Startup, c) Growth, d) Maturity, e) Shake out, f) Renewal/Decline (Dickinson, 2011).

The analysis of the five stages of business life cycle model follows.

- **Seed and Development**

This initial stage of business life cycle activity is characterized by the main business idea, which is checked for its longterm viability and applicability (Dickinson, 2011).

- **Startup/Launch/Introduction**

At the Startup stage of business life cycle activity, the firm initializes the business activity by launching new products or services to the general public. During this introductory phase of business activity, sales are low, initial fixed and variable costs are high, so the revenue reported is low or even losses may be recorded. The firm should focus on marketing strategies in order to raise awareness of the possible customers about the comparative advantage and value proposition of the products or services offered (Dickinson, 2011).

- **Growth**

During the Growth stage of business life cycle activity, total sales increase at a rapid pace. When a business surpasses the breakeven point- where total sales exceed fixed costs- profits are reported. The production increases as a result of increasing demand for products or services and thus cost per unit diminishes (positive economies of scale). There is also an increasing tendency for positive cashflows during the growth phase, resulting from the collection of total revenues (Dickinson, 2011).

- **Maturity**

The maturity phase is characterized by the sales increase at a slower pace than that of the growth phase. The sales peak is achieved at this business life cycle stage. There is also a significant increase in costs, as total profit decreases in spite of the sales increase (Dickinson, 2011).

- **Shake-out**

The Shake-out stage is marked by the sales decrease. As a firm gets closer to shake-out phase, profit margins tend to be narrower than in previous phases, whereas cash flows tend to be more stabilized. Cash collected from customers tend to be higher in amount than the profit depicted in annual reports (Dickinson, 2011).

- **Renewal/Decline**

The last life cycle stage is distinguished by the dilemma of renewal or decline. The renewal involves the investing procedure in new technology and emerging markets with the intention of recovery of their initial growth. The decline is correlated with a gradual decrease in total sales, profit and cash flows. Companies which cannot adapt promptly to the business environment are consequently driven to market exit (Dickinson, 2011).

According to the literature (Zahorsky, 2022) there is another categorization of business life cycle stages:

- The Seed Stage.
- The Start-Up Stage.
- The Growth Stage.
- The Established Stage.
- The Expansion Stage.
- The Decline Stage.
- The Exit Stage.

A firm can go through all stages or only some of them during a life cycle. The transition criteria from one stage into another are researched in numerous studies of the current literature. The independent studies of Dickinson (2011), Zhipeng & Zhao (2006) and Jaafar and Halim (2016) aim to investigate and to present different methodologies in order to define the transition from one business life cycle stage into another.

Specifically, the methodology of Dickinson (2011) is based on the cash flow pattern proxy for the definition of stages in a life cycle. Cash flows in operating, investing and financial activities are indicative of profitability, growth and risk, factors of importance when identifying life cycle stages.

The methodology of Zhipeng & Zhao (2006) relies on the study of sample-time series properties, comparing the corporation's status at each point of its development

with its own historical status. The methodology of Jaafar and Halim (2016) proposes a refined firm life cycle model that is based on the combination of growth opportunities of the firm and assets used in order to identify the point of the life cycle that it is at the current time. Business life cycle in shipping companies is characterized by a slightly different stage categorization in terms of life cycle assessment of ships.
An indicative categorization of life cycle stages follows (Stopford, 2009).

- **Raw material extraction and steel fabrication**

This stage includes the extraction, collection or creation of raw material needed for the ship building process. The most common materials used for shipbuilding are steel and aluminium.

- **Ship building**

The ship building process involves a specific set of stages needed for a ship to be produced and be functional. This process consists of the design phase, the main shipbuilding and assembly phases in the shipyard and final sea trials and tests.

- **Ship Operation**

This stage involves the processes related to merchandise transportation from one place to another. These processes mainly entail the crew management, dry-docking procedure, operational maintenance and insurance claims preparation.

- **Maintenance**

This stage entails all the activities related to ship repair and maintenance, including alterations, conversions, installations, cleaning, painting, and general maintenance work. These activities are necessary for the preservation of functionality, sea- and cargoworthiness of the ship.

- **Scrapping**

The scrapping process is the last stage of a ship life cycle. It includes the disassembly or dismantling of the ship's parts for the extraction of raw materials in order to be used for scrap. This process is commonly referred to as ship recycling or ship cracking.

The shipping sector is also characterized by the shipping cycle, an economic cycle that aims to identify the changes in supply and demand, as well as their effect on freights and on shipping assets (Stopford, 2009).

The four stages of shipping sector are: (Stopford, 2009).

- **Trough**

The trough stage is characterized by low demand and excess supply. There is a ship surplus in the market and therefore freight rates are deemed to be low. Ships function in slow steaming and queue in ports. The least efficient ships are moved to lay-up and older ships are sold for scrap at the scrap price, with the following blooming of the demolition market (Stopford, 2009).

- **Recovery**

The recovery stage is characterized by the point where the freight rates supersede the operation costs of the vessel. There is confidence and optimism in the market about the possible future increase in freight rates (Stopford, 2009).

- **Peak**

The peak stage has as its typical characteristic the excitement about the future freight prices in market. Freight rates increase, there is also overtrading in shipping market, and as a result of it new-building orders increase (Stopford, 2009).

- **Collapse**

The collapse stage is characterized by the point where supply for vessels exceeds demand. This business cycle downturn is usually abrupt. Ships tend to reduce speed and freight rates decrease to an important level. The market can be reluctant to accept that the peak period is over (Stopford, 2009).

2.1.2 Life Cycle Stages in different countries

Several studies examine the life cycle stages of firms in different countries. Wahba and Elsayed (2014) contribute in the literature through the examination of the effect of life cycle stage of a firm on the relationship between board size and financial performance. An econometric analysis is used, where the sample is composed of 84 Egyptian listed firms over the period from 2005 to 2010. The findings of the study corroborate that the board size negatively affects financial performance during the initial stage of life cycle, but it positively affects financial performance during the expansion stage, maturity stage or revival stage.

One further step towards the investigation of firm life cycle impact on corporate investment efficiency is that of Ahmed et al. (2021). The sample includes 351 firms from Pakistan over the period 2005 to 2012. The analysis of the study shows that corporate investment efficiency tends to be higher at growth and mature stages, but lower at introduction and decline stages. Corporate investment efficiency reaches its highest point in the mature phase. Generally, corporate investment efficiency exhibits a U-shaped trend across different, consequent life cycle stages.

The investigation of financial liquidity of the firms is conducted on the research of Rehman, Ahmad, Hussain and Hassan (2021), who examine corporate cash holdings across the life cycle stages of a firm. The sample of the study consists of 2.994 China-listed firms. Findings support that firms tend to have the highest cash levels during growth stage and the lowest during decline stage. The investment needs in growth phase tend to make the firm to withhold more cash flows in order to avoid the external financing.

Other studies concentrate on the life cycle effects on small business finance. Ylhainen (2017) examines the life cycle profiles of small firms in Finland over use of credit and generally external finance. Results of the study stress the fact that most small firms are dependent on external forms of finance during the initial stages of life cycle and gradually financing costs decrease monotonically as firms pass into the mature phase of their business life cycle. The findings of the study confirm that as firm ages there is a tendency for less financial dependence from external sources of finance.

2.1.3 Life Cycle Stages in different sectors

Life cycle stages of firms in different sectors of business activity are examined in a row of pertinent studies. Castro et al. (2015) aim to investigate into the impact of life cycle stages in capital structure of technological and non technological firms in different European countries. The findings of the study confirm the lower use of capital for technological based firms. The differences observed in different life cycle stages in terms of intangible assets and growth opportunities are explained through the information asymmetry factor. The findings are mainly attributable to high-tech firms.

Life cycle cost analysis can be used in order to evaluate energy saving equipment in manufacturing sector. Hajare and Elwakil (2020) examine the life cost analysis model in the residential building sector, as a way to assess energy efficient strategies. A simulation of energy efficient choices is applied for a family home apartment, in order to evaluate the economic payoff of these choices. Findings of the study support that new energy-consuming equipment contributes to energy saving to a greater extent, which is expected to pay-off during the life cycle of the building. Therefore, it is advisable to invest in new energy saving equipment at an initial stage of the building in order to be financially benefited through the life span.

Focusing on the manufacturing and building sector, Abdelhay, Youssef and Awad (2021) examine asymmetric cost behavior across the life cycle stages. For this purpose, a sample of 1577 observations of 99 Egypt listed companies actively engaged in the manufacturing sector is used. Results of the study show that the three cost categories, indicative of financial performance, costs of goods sold, selling, general and administrative costs and total costs are sticky to a great extent, with the behavior of total cost being stickier among the others. Across the organizational life cycle stages, a different cost behavior pattern is observed for each stage. In the introductory stage, COGS and TC exhibit anti-stickiness behavior, whereas stickiness behavior is observed for firms in the growth, mature, shake-out and decline stages. SGAs behavior is only sticky in the mature phase of life cycle.

2.1.4 Life Cycle Stages and the shipping sector

Life cycle analysis is a useful method for the financial as well as environmental assessment of a shipping company. Chatzinikolaou and Ventikos (2014) aim to shed light on the applicability of the principles of this method for the financial and environmental life cycle assessment of ocean going vessels. Findings support the idea that the method is proven to be well structured for the shipping sector, but it still is complex, if all parameters are taken into account. Last, but not least the assumptions taken and the uncertainties of the data used should be treated with caution for the avoidance of ambiguous results.

The life cycle model is also researched over its capability to assess costs and environmental impacts of different maritime vessel typologies. Favi et al. (2017) aim to propose a life cycle model for different vessel typologies, as a way of assessment of costs and environmental impacts. The model takes into account various aspects of vessel lifecycle, such as shipbuilding materials, manufacturing and assembly maintenance and operational activities. This model could apply to a vast range of marine vessel typologies.

Life cycle assessment and life cycle costing are set as essential methods for the evaluation of products, technologies and systems in companies (Miah, Koh & Stone, 2017). This hybrid methodology aims to combine the conventional life cycle costing with the environmental life cycle costing in order for the managerial decisions to be made by taking into account the aforementioned factors. These two methodologies could be combined in order to improve the environmental and financial sustainability of shipping companies.

Life cycle assessment and life cycle cost assessment are also suggested as valuable tools in decision -making cases for vessel propulsion systems in marine industry (Jeong et al., 2018). This lifecycle framework is proven useful, as decisions are made in sight of economic and environmental aspects. The use of these evaluation models facilitates the long-term overview of economic and environmental issues for ship designers and ship owners.

A second study (Wang, Oguz, Jeong & Zhou, 2018) corroborates the usefulness of life cycle and cost performance analysis on ship maintenance strategy. The study evaluates the cash, energy and emission flows of a hybrid ferry in order for the cost benefits to be assessed. Life cycle assessment is proven to be a reliable framework for reliable decision making in marine industry.

A comprehensive literature review is offered in the study of Mondello et al. (2021), as it aims to analyze previous articles of the literature with a view to highlighting the importance of life cycle costing and life cycle assessment in marine industry. This framework is suitable for an environmental and financial overview of shipping companies and generally for the assessment of shipping sector.

Business life cycle cost analysis framework has a lot of applications in terms of energy efficiency measurement. Bui, Perera and Emblemsvag (2021) make as well a proposal for the life cycle cost analysis framework to be used in case of emission reduction and energy efficiency purposes in the shipping sector. In sight of the climate crisis, ship owners are making efforts to reduce their environmental footprint and become greener by investing in innovative technology. These decisions should be held based upon the economic impact of such technology and the environmental benefit that it offers on a life cycle analysis framework.

The business model life cycle evaluation is also proposed by Böckin et al. (2022) as a new method for the measurement of environmental impacts of business models. This LCA methodology makes a connection between the economic performance of a business model, environmental impact and firm's product system. This methodology could be proven useful in the maritime sector.

Operational innovation has an important impact on firm value over the life cycle of the firm and mainly during growth, mature and decline stages. Ryu and Won (2022) concentrate on the relation between operational innovation and firm value across the life cycle of a firm. The findings of the study corroborate that firms aiming to firm value enhancement should focus on the performance of technical innovation during growth stage, whereas firms at the decline stage should focus on scale innovation. The sustainability and firm value is connected to a higher grade with technical innovation rather than scale innovation during all life cycle stages.

2.1.5 Life Cycle Stages in other subject areas

Life Cycle stages are studied in various academic studies and are related to a number of research variables, such as cost behavior, firm profitability, operating performance. Shahzad, Ahmad, Munir and Wang (2022) investigate into the managerial decisions concerning innovations during the firm life cycle. The sample consists of all A-shares listed on both Shenzhen and Shanghai Stock Exchanges from 2007 through 2016. Results of the study show that firms tend to invest more in input innovations during the start-up, growth and decline phase, whereas this tendency is not so apparent during the mature stage. The opposite pattern is observed for investment in output innovations, where the introduction and decline phase are characterized by less investment in output innovations, whereas the growth and mature stages are characterized by more investment in output innovations. The findings of the study corroborate that firms are risk takers for new innovations during introduction, growth and decline stages, whereas the opposite is applicable for the mature stage. The last finding implied that the higher the asset liquidity, the more obvious the tendency for managers to invest in innovation activities, aiming to convert input innovation into output innovation.

In corroboration of the previous findings, Shahzad, Lu and Fareed (2019) examine the risk taking behavior of firms' managers as well as the corporate performance across different life cycle stages. Risk taking behavior is more imminent during introduction and decline stages. The opposite pattern is observed during growth and decline stages. There is also a negative relation between risk behavior patterns in introduction and decline phase and corporate performance, whereas a positive relation between risk behavior patterns in growth and mature phase is observed.

The formality of management accounting systems from a life cycle perspective is analyzed in the academic study of Moores and Yuen (2001). The researchers use as a sample firm data from the clothing and footwear industry in Australia. The findings of the study manifest that management accounting systems tend to be more formalized in the growth life cycle stage rather than other life cycle stages, as a result of adaptation to the organizational characteristics of the specific phase.

Financial statement comparability seems to vary across life cycle stages and as the systems of accounting management mature. Biswas, Habib and Ranasinghe (2022) investigate into financial statement comparability between firms in the mature phase of life cycle and other firms in different phases of life cycle. The results of the study highlight that firms in the mature stage of their life cycle tend to produce financially comparable statements, in comparison to firms in other stages of business life cycle. This result is interpreted under the aspect that firms in the mature stage of business life cycle tend to have certain similarities, such as established organizational structures, skilled personnel and institutional internal controls.

Life cycle method can be also used in order to measure uncertainty and imperfect information for a firm. Firms tend to produce more accurate forecasts about firm profitability and less error in later stages of firm life cycle, as they mature and become more experienced. Entry level firms are usually led by imperfect information, which negatively affects managerial decisions and assets allocation. The results of the study stress the importance of the experience gained through the life cycle (Chen et al., 2020).

Focusing on the results of the aforementioned research, Khuong and Anh (2022) examine the relationship between organizational life cycle and financial reporting quality. The study is conducted on a sample of 408 Vietnamese companies over the period 2007-2017. The results of the study advocate that firms in the mature phase of life cycle tend to have higher quality financial statements in contrast with firms at initial stages of their business development.

Concerning the impact of corporate life cycle on accounting, finance and corporate governance, Habib and Hasan (2019) make a contribution by investigating the issue. The research on the determinants of corporate life cycles has demonstrated managerial ability and efficiency, flexibility and resource-base of the firm as the main factors of life cycle stage transition. The corporate life cycle also has a tremendous impact on financial reporting of the firm, decisions for corporate investment, financing and dividends options, managerial decisions and social and environmental responsibility.

Corporate social responsibility across the life cycle is also an issue of academic interest. Hasan and Habib (2017) examine the relationship between the corporate life cycle and corporate social responsibility. Corporate social responsibility tends to be more prevalent in terms of investment in CSR-activities in mature firms than firms in other stages of business life cycle. The factors that act as moderators of the aforementioned relationship are firm's size, profitability and slack resources.

The financial means and resources of a firm vary across the lifespan. La Rocca, La Rocca and Cariola (2011) aim to analyze the diverse financing choices through the different stages of life cycle model. The results of the study show that firms intend to concentrate on particular financing options, as they progress into the stages of their life cycle. In the early stages of life cycle, debt is considered the suitable financing option. As the firms mature, there is a tendency to substitute debt for internal capital. This tendency seems to be valid for all sectors of financial activity. Thus, capital structure decisions are modified according to the life cycle stage of the firm at the time period concerned.

This aforementioned tendency is though not evident in the research of Mbanyele (2020), in which it is exhibited that firm debt increases during the later stages of life cycle in comparison to the firm debt during the earlier stages. This tendency suggests a non linear relationship between business life cycle stages and leverage. This tendency is partly explained by the lower cost of capital offered for the mature and growth companies. The state of firm ownership also plays an important role in debt management, as family owned companies and generally older companies tend to be based less on debt and private equity.

The following study is anchored to the financial means that firms tend to use over the life cycle. Kochen (2022) concentrates on the financing resources of firms over their life cycle in European countries. Firms at their initial life cycle stages are reported to have higher leverage, tend to pay higher interest rate spreads and accept equity from external capital sources than firms in later life cycle stages. Firms in middle- and higher income countries also report differences in the financing resources of their firms. Firms in middle income countries tend to borrow less from external sources of capital and pay higher interest spreads than firms in higher income countries and these differences are more pronounced for younger firms.

A fact corroborating the aforementioned results derives from the study of Nagar and Sen (2017), the findings of which indicate that the managerial decisions of Indian companies entail the use of classification shifting in various life cycle stages. Classification shifting is a method of manipulating earnings, in order not to report losses in official financial statements. This method tends to be used mostly in terms of decline phase, rather than other phases of life cycle, indicating dependency of the financial reporting accuracy on the stage of life cycle.

One further study that aims to explore the influence of green innovation on firm's value from the perspective of life cycle stages is that of Dai and Xue (2022). The sample includes Chinese A-listed companies. The results of the study show that green innovation has an impact on firm's value. More specifically, the impact of green innovation on firm performance is more pronounced during growth and decline stages rather than mature stages. This impact is mediated by the enhanced capability of sustainable development and reduced costs of debt financing during growth stage but by only reduced costs of debt financing during decline stage.

The effect of life cycle on the relationship between R&D expenditures and future performance, earnings uncertainty and sustainable growth is examined in the research of Yoo, Lee and Park (2019). The findings of the study show that in the introduction stage the expenses associated with R&D are negatively correlated with future performance, whereas the same type of expenses in the mature stage is positively correlated with future performance. Specifically, R&D expenses in the introductory stage are correlated with increased uncertainty and a negative effect on sustainable growth potential for the firm. R & D expenses in the mature stage are not correlated with any effects on sustainable growth potential.

The impact of life cycle and technology is crucial for the survival of the firm according to the study of Agarwal and Audretsch (2001). This study suggests that the survival of a firm is pertinent to different technological conditions and stages of industry life cycle. Small entry size firms are usually associated with decreased levels of long-term survival, whereas the exact different pattern is valid for larger entry size firms. In case of mature firms that are characterized by technological intensity, the successful entry in the market is influenced mostly by strategy and less by radical innovation.

2.2. Cost behavior

Cost Behavior is an essential term in accounting management, vital in decision making activities inside a firm. It refers to the fluctuations of costs and revenues with different levels of activity or production volume. Various kinds of costs react differently to changes in business activity (Drury, 2012). Cost behavior is assessed through the process of cost behavior analysis, a method used to evaluate cost behavior as business activity changes. In the following subchapters, an overview of cost behavior definition, basic cost categorization, research in different countries, sectors, various cost categories and correlations with other subject areas is provided.

2.2.1 Definitions

Cost behavior analysis is a term that refers to the method used by accounting managers of a firm in an attempt to correlate the fluctuations in firm's operating costs with changes in firm's levels of activity. The operational costs involved usually include direct labor, direct materials and overhead costs, related to the production of a product or the provision of a service. Central point of reference in this analysis is cost behavior, which stands as an indicator of cost change, when a change in business activity is reported. There are three main patterns in cost behavior analysis: a) variable cost b) fixed cost c) mixed cost d)semi-fixed or step-fixed costs (Drury, 2012).

Variable costs refer to costs that change in direct proportion with the change in levels of activity or production volume. Examples of variable costs in shipping industry include cargo-related expenses and navigation expenses that change in proportion to business activity. Fixed costs refer to costs that remain unaffected by changes in business activity for a specified period. Examples of fixed costs in shipping industry include crew expenses, vessel expenses, depreciations, amortization expenses that are constant for a short term period (Gkonis & Psaraftis, 2010).

Mixed costs refer to semi-variable costs that consist of fixed as well as variable items. Examples of mixed costs are rent, insurance, management fees, salaries, salaries plus bonuses and utilities. Semi-fixed or step-fixed costs refer to costs that remain fixed for a certain time period, but they can also change as a response to fluctuations in different activity levels. An example of this is a salary that includes both a fixed part and a variable part that fluctuates according to business activity (Drury, 2012).

2.2.2 Basic Cost Categorization

- **Direct-Indirect Costs**

Costs are classified as direct or indirect according to whether these costs can be assigned to a particular cost objective or not. Direct costs are usually connected to a specific product, service or process, whereas indirect costs cannot be directly related to a specific cost objective, but are rather general and administrative expenses, necessary for the maintaining and running of a business (Drury, 2012).

- **Product Costs-Period Costs**

Product costs refer to those correlated with the production process of a product or service offered by the firm. Period costs refer to costs that are not connected to the production process, but are rather costs incurred during the production period (Drury, 2012).

- **Direct Materials-Direct Labor-Manufacturing Overhead**

Direct Material refers to the cost of materials used in the production of finished products or the provision of service.

Direct labor refers to the wages and benefits of the employees that work in a company.
Manufacturing overhead refers to the sum of indirect costs that incur during the manufacturing of a product (Drury, 2012).

- **Prime Costs-Conversion Costs**

Prime Costs refer to direct material and direct labor, costs that are directly incurred to the production of a finished product or service provided. Conversion Costs refer to direct labor and manufacturing overhead, required converting raw material into finished goods (Drury, 2012).

- **Relevant-Irrelevant Costs**

Costs are categorized as relevant or irrelevant according to whether they are related to a certain managerial decision or not. Relevant costs change as a response to the managerial decision, whereas the irrelevant costs remain unaffected by this decision (Drury, 2012).

- **Avoidable –Unavoidable Costs**

Costs are distinguished as avoidable or unavoidable, depending on whether these costs can be saved or not in case a certain managerial decision is made. This categorization is similar to the relevant-irrelevant categories (Drury, 2012).

- **Sunk Costs**

Sunk costs refer to costs that have already been made, as a result of past decisions or actions. The costs created by decisions of the past are irrelevant with decisions for future actions (Drury, 2012).

- **Opportunity Costs**

Opportunity Costs refer to the sacrifice or loss that is made, when a managerial decision for a certain course of business action is taken, instead of an alternative course of action. (Drury, 2012).

- **Incremental –Marginal Costs**

Incremental or differential costs refer to the discrepancy between the costs of two possible alternative courses of action. Similar notion is that of marginal costs, that represent the additional cost of an extra unit of production (Drury, 2012).

2.2.3 Theories and Determinants of Cost Behavior

The assumption that is initially made in cost accounting as far as the traditional view of cost behavior is concerned, is that of a symmetrical pattern, where total sales and related costs rise and fall equivalently to each other (Flannery & Mohs, 2020). The seminal research of Anderson, Banker and Janakiraman (2003) introduces a different pattern of cost behavior that diverges from the traditional model of asymmetric cost behavior. This new model suggests that variable costs respond in an asymmetric way to changes in total sales due to a number of possible contributing factors, such as managerial decisions concerning cost management or delays in cost adjustment. Cost Stickiness is defined as the phenomenon where the costs tend to increase to a greater extent in response to increases in business activity than they decrease with equivalent decreases in business activity. Cost Anti-stickiness is defined as the phenomenon where the costs tend to decrease to a greater extent in response to decreases in business activity than they increase with equivalent increases in business activity.

Several studies try to shed light on the determinants of asymmetric cost behavior. The determinants of asymmetric cost behavior refer to a number of contributing factors, such as the managerial decisions over the release or retention of valuable asset resources, as sales volume changes, the expectations of the company's managers for future sales fluctuations, the relative volume of adjustment costs, the earnings' management and the importance of economic activity change.

Among the most significant factors that play a crucial role in asymmetric cost behavior are the managers' deliberate decisions for the retention or release of valuable resources after a sales volume decline. This influence is mostly observed in cost categories, such as: costs of goods sold (COGS), SG&A expenses and operating costs. (Anderson et al., 2003; Banker & Byzalov, 2014; Calleja et al., 2006; Venieris et al., 2015 ; Balakrishnan and Gruca, 2008; Kama and Weiss, 2013).

2.2.4 Cost Behavior in different countries

Cost behavior in different countries is analyzed in a number of related studies. Ballas, Naoum and Vlismas (2020) examine the effect of managerial strategy on the asymmetric cost behavior of selling, general and administrative expenses. A sample of US-listed companies is used in order to shed light on the relation between a firm's management strategy and cost asymmetry. Results show that firms are distinguished either as prospectors or defenders. Prospectors deal with SG&A cost stickiness as a result of their long term strategic orientation, whereas defenders deal with SG&A cost anti-stickiness, as a result of their short term strategic orientation. Therefore, cost asymmetric behavior is a result of managerial decisions concerning resource commitment and future or present prospect.

The determinants of sticky cost behavior are investigated by the study of Restuti et al. (2022). Managerial ability is correlated with sticky cost behavior by using panel regression analysis on a sample of 19.612 listed firm-year observations in ASEAN countries from 2013 to 2019. The results of the study show that companies that are led by less able managers that cannot manage resources efficiently and promptly are under risk of sticky cost behavior. This is partly a repercussion of the fact that less able managers tend to retain resources rather than adjust costs efficiently in case of volume decrease. Last, but not least the impact of environmental uncertainty on cost stickiness is stronger in firms with less effective managerial strategy.

In an attempt to enlighten various aspects of sticky cost phenomenon, Balios, Eriotis, Naoum and Vasiliou (2020) aim to explore the effect of earnings management on cost stickiness by using a sample of various firms in G-7 countries (France, Germany, Italy, Japan, Canada, the UK and the USA). The results of this study corroborate the fact that earnings management is a considerable determinant of asymmetric cost behavior. In fact, the intensity of cost asymmetry is higher for countries, the firms of which do not exhibit intense earnings' management. Cost stickiness is a global phenomenon, as cost asymmetry is prevalent in most countries and the degree of its intensity varies according to managerial decisions concerning earnings' manipulation. Countries that do not exhibit intense managerial earnings' manipulation tend to show lower levels of cost asymmetry.

The impact of cost stickiness on profitability is examined in the study of Huong (2018). The research measures cost stickiness on a sample of Vietnamese companies over the period from 2011 to 2015 in order to answer the research question of whether the cost stickiness is a determinant factor of profitability. Results of the study show that selling, general and administration costs are sticky to a great extent and to a higher point than US and Brazil. Further analysis shows that sticky cost behavior of selling and administrative costs is a determinant factor of earnings per share forecast.

Focusing on cost behavior in firms of various business sectors, He, Teruya & Shimizu (2010) corroborate the effect of sticky cost phenomenon in selling, general and administrative expenses in Japanese companies. The study makes use of a sample of Japanese industrial companies over the period 1975 to 2000 from the PACAP database. Findings of the study show that SG&A expenses in Japanese companies manifest a similar pattern of sticky cost behavior as the US listed companies. The stickiness of these costs is not so well adjusted, as firm performance changes. Cost stickiness is not restricted to a specific sector, but it is extended to manufacturing, merchandising and service firms, supporting the generalization of the phenomenon.

One further research that intends to shed light on cost stickiness in Croatian beverage industry is that of Pervan and Pervan (2012). For this purpose, a thorough analysis of Croatian firms actively engaged in the food and beverage industry is conducted from the time period 2003 to 2010. Results of the study confirm the asymmetric pattern of cost behavior, as the material costs and costs of employees exhibit cost stickiness as sales volume increases or decreases. This behavior pattern is interpreted by the deliberate managerial decisions concerning resources as a response to sales volume change.

The relationship between intangible assets of a company and asymmetric cost behavior of SGAs expenses is analyzed in the study of Venieris, Naoum and Vlismas (2015). For this reason, a sample of US listed firms is utilized. Findings of the study support that firms with high organization capital tend to exhibit sticky cost behavior, whereas firms with low organization capital tend to exhibit anti-sticky cost behavior. This finding indicates that managerial decisions concerning the development of intangible assets could have a profound effect on sticky cost behavior.

Concerning the asymmetric cost behavior of Greek listed firms, Tzillas (2019) investigates the sticky cost patterns of them. The sample includes 190 Greek listed companies over the period 2008 to 2018. The results of the study show that Greek listed firms dealt with the phenomenon of cost stickiness during the adversities of the financial crisis over the period 2008-2018 and that sticky cost phenomenon tends to decrease during longer time intervals.

Concentrating on cost behavior in different life stages, Zisis and Naoum (2021) investigate the sticky cost phenomenon across the firm's life cycle. The sample includes data from US listed companies covering the period from 1997 to 2017. The main findings of the study support the fact that during the early stages of life cycle – namely in the introduction and growth stage, SGAs costs show cost stickiness, whereas during the later stages of life cycle-in the mature and decline phase- cost anti-stickiness patterns are reported. During the shake-out phase, a rather symmetric behavior is implied. This study suggests that cost stickiness is a characteristic cost behavior pattern of firms in earlier stages of their life cycle, whereas cost anti-stickiness is reported during later stages of life cycle.

The relationship of cost stickiness at firm level with the strictness of the country-level employment protection legislation provisions is examined in Banker, Byzalov and Chen (2013). A sample of firms in 19 OECD countries during 1990- 2008 is used. The findings of the study support that the degree of cost stickiness at firm level fluctuates along with the strictness of each country's EPL provisions. Higher levels of strictness are correlated with higher degrees of cost stickiness for adjustment costs. This finding corroborates the fact that cost stickiness is the result of managerial decisions concerning resource commitment in case of dealing with adjustment costs.

The effect of financial restriction on sticky costs is scrutinized in the study of Degenhart et al. (2021). For this research aim, a sample 834 observations of Brazilian companies is used. Findings of the study indicate that both companies with and without financial restrictions exhibit an asymmetric cost behavior pattern. Yet, financially constrained firms manifest better adjustment in terms of company's total costs and decreases in total revenue. There are more decreases in adjustment costs for these companies, but also difficulties in obtaining valuable resources when the economy returns, due to the low level of investments.

The relation between asymmetric cost behavior and corporate risk is examined in the research of Zhang (2021). The sample consists of A-listed Chinese companies from 2009 to 2019. Findings of the study confirm that cost stickiness as well as cost anti-stickiness significantly increase corporate risk. The moderating factor of management shareholding plays a role in aggravating the effect of cost anti-stickiness. Thus, these findings come in accordance with the hypothesis that cost stickiness plays an important role in diminishing the efficiency of resource allocation and the accuracy of earnings management, increasing corporate risk.

2.2.5 Cost Behavior in different sectors

Research on cost behavior in different sectors of business activity investigates the magnitude of sales activity as a prime determinant of sticky cost behavior. There are different behavior patterns for different sectors of economic activities. Firms in sectors that tend to have higher levels of tangible assets and inventories, such as the manufacturing sector, tend to exhibit -to higher extent- patterns of sticky cost behavior, whereas sectors with lower levels of tangible assets and higher competition, such as the merchandising sector, tend to exhibit less patterns of sticky cost behavior. Financial and service sectors exhibit some patterns of sticky cost behavior, with the determinants of interest expense, employee and inventory intensity leading the behavior of cost for each sector respectively (Weidenmier & Subramaniam, 2003).

The sticky behavior of costs in healthcare industry is assessed in the study of Balakrishnan & Gruca (2008). Cost stickiness is detected mostly for operating costs, but related only to the hospital’s core activity, the healthcare of patients. The asymmetric cost pattern is not evident in supporting activities. Therefore, the closer the activities of a department to the hospital’s core activity, the stickier are the costs allocated to this department. This finding is in order with the statement that the costs fluctuate and adjust differently to changes in sales activity, according to the department that are attributed to. The uniqueness of this study is that it concentrates on intra-firm variations in cost stickiness.

The contributing factors of sticky cost behavior in air transportation industry in United States are researched in the study of Cannon (2011). The sample includes observations from nine airline companies across 16 years (1992 to 2007). Results of the study show that sticky costs arise as a result of managerial decisions in terms of resource handling with different levels of economic activity. This finding is in accordance with the findings of later studies.

One further research that aims to shed light on adjustment costs and their impact on cost stickiness is that of Eltivia et al. (2019). The sample comprises of 24 consumer goods companies listed on the Indonesian Stock Exchange over the period 2014-2015. Findings of the study show that cost stickiness exists in consumer goods companies and the degree of its intensity depends on the managerial actions towards resource commitment or release. The adjustment costs have partially got an effect on the aforementioned relationship.

Gavalas and Syriopoulos (2019) aim to investigate into the sticky cost phenomenon in the shipping industry. For this purpose, a sample of 126 US listed shipping companies categorized as tankers, containers and shipping bulk companies over the period 2006-2016 is used. Results of the study corroborate the initial estimations of the study that the presence of stickiness is apparent in case of total labor costs and vessel operating costs for all types of shipping companies.

The asymmetric cost behavior in case of shipping companies is further examined in the study of Naoum, Ntounis & Vlismas (2020). The sample of the study consists of 1.151 firm- year observations deriving from US shipping companies over the period 2000-2018. The results of the study support that the managerial behavior pattern is different with the fluctuations of revenues. In fact, managers tend to make adjustments for resources faster when revenues decrease, than they do when revenues increase, a contributing factor to cost stickiness. What is more, the intensity of cost anti-stickiness is correlated negatively with the level of financial and operating leverage. Last, but not least -according to the research- the economic crisis is not a contributing factor to cost asymmetry behavior.

The research on asymmetric cost behavior is also apparent in distribution industry. A recent study (Cha & Choi, 2020) shows that cost asymmetry is noticed in the distribution industry. Specifically, there is a trend for cost stickiness when there is a decrease in sales volume. The sample consists of 28.695 firm-year observations from 2002 to 2019 for the KOSPI and KOSDAQ stock markets. In comparison with other sectors, a greater rigidity in cost adjustment is observed in distribution industry, resulting from difficulties in making flexible managerial decisions according to the fluctuations of cost.

A further research on asymmetric cost in various industries (Pimentel, Modenesi, Ribeiro & Pires-Alves, 2020) shows that there is a heterogeneity in cost pass-through among the 21 industrial activities of the study. The research focuses mainly on 21 industrial activities in Brazil using various industrial costs with either positive or negative changes. The results of the study indicate that most activities show a positive asymmetric price transmission.

2.2.6 Cost Behavior of different Cost Categories

Cost behavior of different cost categories is investigated in a number of related studies. Weidenmier and Subramaniam (2003) aim to explore the behavior patterns of different costs for various fluctuations of sales activity. SGAs and CGS costs exhibit sticky cost behavior in case the revenue changes by a percentage of more than 10, whereas for smaller activity changes a linear behavior pattern is implied.

The different cost categories are examined over their tendency to exhibit sticky cost behavior. Anderson and Lanen (2007) focus on the cost stickiness of SGAs as well as other cost categories, such as advertising costs, labor costs, R&D costs, PP&E costs. These cost categories that are more subject to managerial discretion do not show systematic patterns of stickiness on this research, so there is still weak evidence in order to characterize the aforementioned cost categories as sticky. Sticky cost phenomenon is more evident in a 27-year sample, implying a long-term period appearance of this cost behavior pattern. Cost changes in the short-term period are likely to exhibit sticky, anti-sticky or even linear behavior patterns as a response to sales changes.

The asymmetric behavior of selling, general and administrative expenses in correlation with the agency problem and corporate governance are examined in the study of Chen, Lu and Sougiannis (2011). The sample includes data over the period 1996-2005 for firms in the S&P 1500 index. Results of the study show that SG&A cost asymmetry is positively associated with the agency problem, with corporate governance as a mitigating factor. There is also a positive correlation between cost asymmetry and managerial incentives for empire building companies due to the agency problem. This positive correlation is exacerbated under weak corporate governance. What is more, the agency problem shifts SG&A cost stickiness from its optimal level.

One further research that aims to examine asymmetric cost behavior is that of Ibrahim and Ezat (2017). The study uses a sample of Egyptian listed companies over the period 2004 to 2011. The results of the study show that Egyptian listed firms tend to exhibit sticky cost behavior and especially in case of SG&As, CGS, TC. The corporate governance code seems to have a significant effect on asymmetric cost behavior of SG&As, as the sticky cost behavior before the application of code changes to anti-sticky after the application of code. The code also has an important impact on the sticky cost behavior of CGS and TC.

The contributing factors to asymmetric cost behavior are further examined in the following study. Golden, Mashruwala and Pevzner (2020) set as primary objective to explore the issue of asymmetric cost behavior under the aspect of labor adjustment costs in a sample of US listed firms. The results of the study show that labor adjustment costs are a determinant factor in cost asymmetric behavior among firms. In fact, labor costs have a more obvious effect on cost asymmetry when unemployment rates are low. Furthermore, skilled labor is usually connected to higher labor adjustment costs than unskilled labor and thus with greater levels of cost asymmetry. Therefore, cost asymmetry is also associated with specific costs of operational performance and with the particularities of the labor community of each firm.

A research issue that is investigated by Zhong et al. (2020) is the relationship between business strategy and cost asymmetry under different ownership. The sample consists of firm data from Chinese listed companies over the period 2002 to 2015. The results of the study indicate that companies with different business strategies show different patterns of cost behavior, with a differentiation strategy entailing higher cost stickiness than a low cost strategy. The managerial expectations about the market definitely affect the patterns of sticky cost behavior. Optimistic perspective about future sales increase cost stickiness, whereas pessimistic perspective decreases cost stickiness. In case of the optimistic perspective, a differentiation strategy tends to exhibit greater cost stickiness than a low-cost strategy. The opposite pattern is observed in case of pessimistic perspective.

One further research that investigates into the relationship between cost stickiness and firm value is that of Yang, Khuang and Li (2020). The sample includes Chinese A-listed companies. The findings of the study show that cost stickiness tends to reduce firm value in the short term period, but to increase it in the long term period. The main factors that affect the relationship between the aforementioned variables are adjustment cost management, optimistic management expectations about sales, which have a positive effect and agent costs that have a negative effect. An abrupt and rapid change in adjustment costs tends to decrease firm’s value in the short term period, whereas the phenomenon of cost stickiness in moderation tends to increase firm's value in the long-term period.

Strategic cost management in manufacturing companies is examined as a method for dealing with asymmetric cost behavior and increasing corporate sustainability (Rounaghi, Jarrar & Dana, 2021). The findings of the study reveal that strategic cost management plays a determinant role in creating competitive advantage for the firm, as it entails the dissemination of useful cost price information, necessary for the managerial decisions. Accurate cost pricing results in competitive advantage and increased profitability for manufacturing companies at an international level.

2.2.7 Cost Behavior in other research areas

Cost behavior is studied in a wide research area. Wiersma (2010) sheds light into the impact of the reward structure of a firm on cost stickiness. A sample of 2569 firms is used in this research. Results show that the higher the percentage of bonuses in the reward packages of the firm, the lower the stickiness of costs. This result is interpreted under the aspect of deliberate managerial discretion, where managers have a motive to decrease the firm's resource level immediately after the decrease in sales, as they receive a higher level of bonuses.

Other studies concentrate on the predictability of firm's earnings based on sticky cost behavior. Weiss (2010) aims to examine the effect of asymmetric cost behavior on analysts' earnings forecast. The findings of the study show that firms that indicate sticky cost behavior have less accurate predictions from analysts about earnings' fluctuations rather than firms with less patterns of sticky cost behavior. Results of the study also show that cost stickiness plays a determinant role in the formation of analysts' opinion about the firm's value as well as coverage priorities. It is concluded that market's response to earnings' forecast is mediated by sticky cost phenomenon.

A number of authors (Spyckova & Myskova, 2015) investigate into cost optimization, by making use of useful tools, such as activity based costing, target costing and life cycle costing. All these techniques are part of Strategic Management Accounting that can help improve the efficiency of costs or investments and can support economic valuation and investment decision making in the long-term period.

The relationship among managerial style, cost asymmetry and shareholder value is examined in the research of Lopatta, Kaspereit and Gastone (2020). The results of the study show that cost asymmetry includes a negative effect to the firm and shareholders, the CEO- related excess SG&A cost asymmetry. Furthermore, CEOs' contribution to SG&A cost asymmetry is connected with decreased shareholder value.

The analysis of the relationship between corporate financialization and sticky cost behavior is conducted in the study of Zhu et al. (2021). The sample consists of Chinese listed companies over the period 2009-2017. The results of the study indicate that there exists a negative relationship between corporate financialization and sticky cost behavior. This negative influence of corporate financialization on asymmetric cost behavior is mediated by the factors of high quality of internal control, strong compensation incentive and low levels of agency problem that weaken the aforementioned negative relationship.

2.3. Operating Performance

Operating performance of a firm is a key term in accounting management. A business pursues to measure and evaluate its operating performance, as an indication of the efficiency of the company's assets management. In the following subchapters, the definitions of notions correlated with operating performance, the dimensions of operating performance, the research in different countries and sectors, as well as the correlations with other subject areas are discussed.

2.3.1 Definitions

Operating performance is defined as the measurement and evaluation of operating results connected to the assets utilized for the achievement of those results. Operating performance is an indicator of the efficiency of company's management of economic resources (Slack, Brandon-Jones & Johnston, 2013). The operational efficiency of a firm is depicted in Balance Sheet Report. Operating performance is also measured by a number of indices.

Proxies of Operating Performance

The most representative proxies of operating performance are referred below: (Al-Matari, Al-Swidi & Fadzil, 2015)

- **Fixed Assets Turnover Ratio**

The Fixed Assets Turnover Ratio is an index indicative of the efficiency of a firm to generate sales revenue from its fixed asset resources. A higher ratio implies that firm managers are using the fixed assets more effectively in order to produce revenue.
The formula of Fixed Assets Turnover Ratio is: **Fixed Asset Turnover = Net Sales / Average Fixed Assets**

- **Sales or Revenue per Employee**

The Sales or Revenue per Employee is an index that stands as key performance indicator. It concerns the portion of sales or revenue that is attributed to each employee of a company. This index is beneficial for companies that rely mainly on employees' behavior for the generation of revenues.
The formula of Sales or Revenue per Employee: **Sales-per-Employee ratio = Annual Sales / Total Employees.**

- **Operating Cycle**

An operating cycle refers to the days that are necessary for a business in order to receive inventory, sell the inventory to possible customers, and collect cash from the selling of inventory.

- **Cash Conversion Cycle**

The cash conversion cycle is a metric that measures the time period needed for the conversion of the investments into inventory or other resources into cash flows from sales revenue.

- **Account Receivable Turnover Ratio**

The Account Receivable Turnover Ratio is an index indicative of the ability of a company to collect debt and extend credit. The higher the ratio, the better the ability of a company to manage debt and credit. The formula of Account Receivable Turnover Ratio is **Net Credit Sales / Average Accounts Receivable.**

- **Accounts Payable Turnover Ratio**

The Accounts Payable Turnover Ratio is an index that measures the average number of times a company pays its creditors over the accounting period. A higher turnover ratio is considered to be more favorable for a company, indicative of short-term liquidity. The formula of Account Payable Turnover Ratio is: **Total Purchases made from Suppliers or Cost of Sales / Average Accounts Payable Amount.**

- **Inventory Turnover Ratio**

Inventory Turnover Ratio is an index that estimates the efficiency of the company to use its inventory. It shows how many times the company has sold and replaced inventory during an accounting period. The formula of Inventory Turnover Ratio is**: Cost of goods sold * 2 / (Beginning inventory + Final inventory).**

- **Return on equity**

Return on equity is an index that estimates the efficiency of the firm to generate profits. As a measure of financial performance, it shows the profitability of the firm in terms of generating income from its equity financing. The formula of Return on equity is: **Return on Equity = Net Income/Average Total Equity**

- **Return on assets**

Return on Assets is an index that estimates the profitability of the firm in relation to its total assets. Financial analysts and corporate management use this index to determine the efficiency of a company in generating a profit using its assets. The formula of Return on assets is: **Return on Assets= Net Income/ Average Total Assets.**

2.3.2 Dimensions of Operating Performance

The operating performance of a firm can be thoroughly analyzed by the 4Vs- the four dimensions of operating performance. The 4 dimensions of operations are: Volume, Variety, Variation and Visibility. A deeper analysis of the 4Vs model follows (Slack, Brandon-Jones & Johnston, 2013).

The first dimension of the model is Volume that indicates the quantity of products or services produced and provided by a business. This dimension separates the companies into two categories: a) high-volume, b) low-volume. High-volume companies are those that have got a high volume production and invest in technological equipment and facilities needed for the high volume production. High volume production is characterized by the process repeatability and positive economies of scale. Low-volume companies are those that have got a low volume production and thus do not invest in technological equipment to a great extent. These companies depend on the customization and uniqueness of the product or service provided.

The second dimension of the model is Variety that refers to the range of different product or services that this firm produces and provides to possible customers. This dimension distinguishes the companies into two categories: a) high- variety, b) low-variety. A business that is categorized as high-variety is characterized by higher unit cost, more complex production processes and supply chains, whereas a low-variety business usually has more simple production processes and supply chains, less flexibility and a tendency to specialization or customization to a certain product or a certain range of products.

The third dimension of the model is Variation that makes a reference to the fluctuations and the general predictability of demand that a business deals with. A business with high variation usually needs to be flexible in order to deal with the changes in demand, are good at anticipating various changes in demand and therefore have got the quantity of inventory available if needed. A business with low variation in demand does not need to be concerned to a great extent about the uncertainty and fluctuations of demand in the market.

The fourth dimension of the model is Visibility that refers to the visibility of the customer to the business and its processes and vice versa. Businesses of high visibility focus more on customer satisfaction and thus will be more client-oriented, whereas low visibility businesses concentrate on their processes in privacy and are judged for the outcome based on other criteria, such as cost, quality of provided product or service.

Another model that allows an organization to measure and evaluate the operating performance is the one cited by Slack et al. (2011). This model describes five basic operations performance objectives: a) quality, b) speed, c) dependability, d) flexibility and e) cost. Quality refers to the product or service quality that can be measured through the criteria of performance, reliability and durability. Speed makes reference to the time interval between the beginning and the end of a process. Dependability is a performance objective that refers to the fact that products are delivered or the services are provided when they are needed or promised. Flexibility is another measure of operations' performance and refers to being able to adjust processes in order to keep up with changes, either in products/services, mix of products/services, volume or delivery. Last, but not least cost is another operations' performance objective that is affected by the 4Vs dimensions.

2.3.3 Operating Performance in Different Countries and Sectors

Operating performance is analyzed in literature in terms of different countries and sectors. One study that aims to analyze the operating performance of firms' through the life cycle stages is that of Yazdanfar and Öhman (2014). This study aims to examine the implementation of the life cycle model of firm performance among Swedish small- and medium- sized enterprises. Results of the study show that there is a life cycle performance pattern along with a six-stage life cycle model that it is applicable in SMEs in order for growth and profitability to be foreseen. SMEs in their early stages of life cycle tend to show better performance in growth and profitability rather than SMEs in their further stages of life cycle. What is more, larger in size SMEs show better performance than smaller in size SMEs.

Synthesizing the different views of the academic literature, Chang and Ma (2019) investigate into the impact of financial flexibility, managerial efficiency and life cycle stage on firm performance. The sample comprises of Chinese listed firms. The findings of the study corroborate that financially flexible firms in China tend to exhibit satisfying firm performance. However, managerial efficiency gradually decreases to a great extent as the firm transits into the mature life cycle stage, indicating the need for further research on the impact of life cycle stages on financial flexibility and managerial efficiency.

One further study examines the correlation between cost asymmetry and earnings management. The sample consists of 160 Brazilian companies over the period 2008 to 2017. The findings of the study show that firm profitability is affected by sticky cost phenomenon and earnings management. Cost asymmetric behavior patterns can also explain accruals and earnings management patterns (da Silva, da Silva Zonatto, Dal Magro & Klann, 2019).

Earnings' transparency in correlation with sticky cost behavior is also an interesting topic of research. Oh and Park (2021) concentrate on the relationship between cost stickiness and earnings' transparency. The sample consists of Korean listed firms over the period 2007 to 2011. The findings of the study corroborate that a negative relationship exists between cost stickiness and earnings' transparency. This relationship is mediated by corporate sustainable management, mitigating the effect of cost stickiness on earnings transparency. Corporate sustainable management acts as a mechanism that prevents the managerial behavior with opportunistic motives.

Another study that investigates into the relationship between firm life cycle and earnings' management is that of Khuong et al. (2022). The sample includes 622 Vietnamese listed companies over the period 2010-2019. The results of the study manifest that earnings management differs across the life cycle stages. The findings indicate a U-shaped curve, the discretional accruals being mainly observed in the introduction and decline stages, whereas less noticed in other life cycle stages. The role of state ownership is a determining factor in the relationship between firm life cycle stages and earnings management.

A thorough examination of the relationship between intellectual capital's efficiency and Chinese firms' financial performance based on business life cycle is conducted on the research of Xu, Haris and Liu (2022). The study uses a sample of Chinese manufacturing listed firms over the period 2014 to 2018. Results of the study show that the effect of intellectual capital on financial performance of the firm differs across life cycle stages. At the introductory stage, human capital, structural capital and innovation capital have a significant positive impact on financial performance. At the growth and mature stages, intellectual capital leads the most important role in determining financial performance. Human capital and structural capital play an important role in revival stage, whereas human capital positively affects financial performance of a firm of a decline stage.

2.3.4 Operating performance in other research areas

Operating performance is studied in various research areas and is correlated with a number of research variables, such as growth, profitability, financial flexibility and ownership patterns. Irvine, Park and Yildzhan (2014) aim to shed light on the issues of customer-base concentration, profitability and distress across the corporate life cycle. Customer-based concentration is connected to operational efficiencies for firms with increased profitability. However, firms at their initial life cycle stages are impaired by customer-based concentration in terms of firm profitability. These discrepancies are explained by a life cycle model where the relation between customer-based concentration and profitability is time varying. In fact, there are larger fixed costs and greater operating leverage in the earlier stages of a firm that can be proven beneficial in the long run.

The accuracy of growth and profitability forecasting models through the life cycle stages is analyzed in the research of Vorst and Yohn (2017). The sample includes 60.536 observations of firms over the period 1998 to 2005. The results of the study show that profitability is lower in introductory and decline stage and maximizes in mature stage. Variations in different companies in terms of growth and profitability are highest in introduction and growth stages. Life cycle models are proven to be more accurate than industry-specific or economy-wide models in predicting future growth and profitability of the firms.

Firm performance and financial flexibility are reported to be correlated according to the following study. Chang & Ma (2019) recognize that exceptional firm performance is partially determined by financial flexibility. As the firm goes through mature stage, managerial efficiency in achieving good firm performance gradually declines, although levels of financial flexibility remain unaffected. The sample concerns Chinese listed firms that are examined for their financial flexibility as well as the managerial ability of managers through life cycle stages. A modified financial flexibility index for the needs of Chinese listed firms is proposed.

One further study that aims to examine the influence of ownership patterns on firm performance through life cycle stages is that of Sridharan and Joshi (2018). The study uses a sample of S&P BSE 500 companies in the Indian market over the period of 9 years. Findings of the study support that firm performance maximizes in different ownership patterns through the life cycles of a firm. Mix-family held firms show better performance in growth and mature stages than other types of ownership, whereas foreign held firms show better performance in mature and revival stages than other categories of firm ownership. As far as operational performance is concerned, government-held firms show better performance than other ownership types in the mature period. This study could be proven useful for firms aiming to optimize their operational performance through a different reorganization of ownership type.

3RD CHAPTER

AIMS AND HYPOTHESES OF THE RESEARCH

According to the literature review, business life cycle analysis, cost behavior and firm's operational performance are issues of utmost importance in management accounting that have been intriguing researchers all around the globe.

Previous studies (Anderson et al., 2003; Banker & Byzalov, 2014; Calleja et al., 2006; Venieris et al., 2015) have stressed that asymmetric cost behavior is a common cost behavioral pattern for different kinds of costs in most sectors of economic activity. Asymmetric cost behavior is correlated with issues of managerial interest, such as the operating performance of a firm, dividends' policy, earnings' management, leverage, as well as other aspects that pertain to firm management decisions. Asymmetric cost behavior is connected with the levels of business activity of a firm and fluctuates according to the life cycle stage of a firm or other factors (ex. sales volume).

This current research study aims to shed light on the relationship between sticky cost phenomenon and operating performance across the different life cycle stages of shipping companies. Focal point of this research is the shipping sector in Greece and at an international level. This research investigates into the asymmetric cost behavior patterns in shipping sector across life cycle stages and in comparison with other sectors. Another issue of study concerns the asymmetric behavior patterns in different kinds of costs. The level of cost asymmetry across the different life cycle stages is also under scrutiny. Last, but not least the relationship between sticky cost behavior and operating performance of shipping companies is examined.

The following research inquiries are formulated:

- What is the asymmetric behavior pattern for different kinds of expenses in shipping firms?
- Is the level of asymmetry different for different life cycle stages of shipping firms?
- Is the relationship between Sticky Cost Behavior and Operating Performance for shipping firms positive or negative?

- What is the relationship between Sticky Cost Behavior and Operating Performance for shipping firms for different life cycle stages?
- Is asymmetric cost behavior expected to a greater extent in shipping sector than in other sectors, for example Construction or Transportation?

According to the literature review, firms belonging to business sectors that tend to have high levels of tangible assets and inventories demonstrate high levels of sticky cost behavior (Weidenmier & Subramaniam, 2003). This tendency is interpreted under the research finding that sticky cost patterns emerge as a result of managerial decisions concerning resource handling in different levels of business activity (Cannon, 2011). Shipping firms usually tend to have high levels of assets and inventories in terms of economic value, as this is illustrated in Balance Sheets. Managers and owners of shipping firms tend to make adjustments for the available resources with different levels of business activity. Therefore, the special nature of assets and inventories of shipping firms in combination with the managerial decisions concerning resource handling are contributing factors to the appearance of sticky cost patterns in shipping.

Summarizing the above analysis, we introduce the first hypothesis:
H_1. Shipping firms exhibit asymmetric cost behavior.

Furthermore, we speculate that the level of cost asymmetry fluctuates across the different life cycle stages in shipping firms. This hypothesis is relied upon the research finding that sectors equivalent to shipping in terms of assets and inventories value, such as the manufacturing sector, tend to exhibit fluctuating levels of cost asymmetry across different life cycle stages and with different levels of business activity. Across the different life cycle stages, a different cost behavior pattern is observed for each stage. In the introductory stage, COGS and TC exhibit anti-stickiness behavior, whereas stickiness behavior patterns are observed for firms in the growth, mature, shake-out and decline stages. SGAs behavior is only sticky in the mature phase of life cycle (Abdelhay, Youssef and Awad, 2021). An analogous pattern is assumed for shipping firms across the different life cycle stages.

Summarizing the above analysis, it is speculated that:

H_2. In shipping firms, the level of cost asymmetry fluctuates across the different life cycle stages

Evidence of the literature review show that firms' operating performance and generally firms' profitability are affected by sticky cost phenomenon and earnings' management (da Silva, da Silva Zonatto, Dal Magro & Klann, 2019). Financial flexibility plays a determinant role in firm profitability, with financially flexible firms demonstrating a robust and satisfying firm performance (Chang & Ma, 2019). Therefore, firms that are less flexible in terms of cost handling and resource management, tend to exhibit a less rewarding firm performance. Thus, there is a negative relationship between sticky cost patterns and operating performance. An analogous pattern is hypothesized for shipping firms.

Summarizing the above analysis, we introduce the following hypothesis:

H3. In shipping firms cost stickiness is negatively associated with operating performance

Taking into account the above analysis, we speculate that:

H4. In shipping firms, cost stickiness is differently associated with operating performance across life cycle stages

Current literature supports that firms that are characterized by a higher intensity of assets and employees among others, tend to exhibit sticky cost behavior to a higher extent (Anderson et al., 2003). This result is due to the tremendous difficulty that these firms face when there is a need to downsize human and material resources in periods of reduced production. Construction, Shipping and generally Transportation firms both tend to possess a considerable amount of assets in terms of economic value as well as valuable human resources - necessary to sustain the functionality of the firm- and therefore not being able to cut down easily, even in periods of reduced production.

Based on the above analysis, we assume that:

H5. Construction and Transportation firms tend to exhibit sticky cost behavior to the same degree as Shipping and parallel Shipping companies

The originality of this research lies on the fact that very few studies in the international literature have focused on the relationship between asymmetric cost behavior and operational performance of a firm across life cycle stages. Even fewer studies tend to elaborate on the same academic topic in shipping sector. In Greek literature, there is no relevant study to combine all the aspects of the aforementioned issue, but a certain issue is rather examined as isolated- with a specific academic view-whether it entails life cycle analysis, asymmetric cost behavior or operating performance of a firm. Therefore, this study constitutes a valuable asset for the assessment of asymmetric cost behavior as well as the most recent trends of the shipping sector in managerial accounting.

The contribution and practical utility of this research study are associated with the use of its results for the better understanding of the notion of asymmetric cost behavior and its relationship with the operating performance of a shipping firm across life cycle stages. Further analysis is conducted for different kinds of costs and sectors for the comparability of the extracted results. The ulterior motive is to provide a useful study for academic researchers wishing to elaborate more on this intriguing issue of managerial accounting in shipping and for managers aiming to enhance the operating and general performance of the shipping firm through better decision making and handling of asymmetric cost behavior in different life cycle stages.

4TH CHAPTER

DATA AND METHODS

4.1 Data Sample

The Data Sample consists of chronological panel data (Observations= 32.888) from Greek and foreign based shipping and parallel shipping companies over the period 1992-2022. Foreign countries included in the sample are the USA, Greece, France, Spain, Portugal, Canada, Russia, China, India, Indonesia, Argentina, Australia, Austria, Portugal, Italy, Germany, United Kingdom, Peru, Cayman Islands, Taiwan, Panama, Hong Kong, Singapore, Bahamas, Monaco and Jamaica. The companies used for the analysis bear the following Standard Classification Codes, indicative of their main economic activity: 6331, 4412, 3443, 3669, 2851, 3561, 3663, 3412, 4731, 5093, 1389, 5172, 4700, 4400, 4923, 5550, 3790, 3812, 3730, 4955, 6411, 6351 and 1311. The sample is extracted from the Database Computstat and refers to 981 variables, most of which pertain to accounting and financial measures of Balance Sheet, Income Statement, Statement of Cash flows and Statement of owners' equity of the companies included. Gross national product (growth percentage) was not initially included as a variable in the sample. Data for GNP for the period 1992-2022 were extracted from OECD website as well as World Bank website and were added according to the location of the company's headquarters, leading to a sum of 982 variables. For the purposes of the fifth research query, two additional samples of Construction (Observations = 1611) and Transportation firms (Observations = 3000) are used, which refer to 982 variables.

4.2 Methodology

On this subchapter, the methodology followed for the purposes of the research is analyzed in a thorough way. The analysis process is based on a combination of three methods: a) the sticky cost methodology endorsed by Anderson et al. (2003) and reviewed by Banker and Byzalov (2014), b) life cycle methodology introduced by Dickinson (2011) and c) measurement of operating performance relied on the proxies Return on Equity and Return on Assets.

4.2.1 Sticky Cost Methodology

The sticky cost methodology, presented by the seminal research of Anderson et al. (2003), inaugurates an empirical model of SG&A behavior that assesses the SG&A response to various changes in sales revenue and distinguishes between periods that revenue increases and revenue decreases. The initial model (equation 1) has the following mathematical formula:

$\log \frac{SG\&A_{i,1}}{SG\&A_{i,\ t-1}} = \beta_{0+}\ \ \beta_1 * \log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} + \beta_2 *$ Decrease_Dummy$_{i,t}$* $\log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \varepsilon_{\iota,t}$	Eq.(1)

This model provides the basis for the measurement and assessment of SG&A stickiness. The interaction variable, Decrease Dummy, takes the value of 1 when sales revenue decreases between periods t − 1 and t, and 0 otherwise.

A slightly alternated model is used by the current study with the following formula:

$log \frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \ \beta_{0+}\ \ \beta_1 * log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} + \beta_2 *$ Decrease_Dummy$_{i,t}$* $\log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 *$ Decrease_Dummy$_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} *$ *Successive Decrease i, t* $+ \ \beta_4 *$ *Decrease_Dummy*$_{i,t}$* $\log \frac{Revenue_{i,t}}{Revenue_{i,t-1}}$ **Growth*$_{i,t}$ $+\beta_5 *$ *Decrease_Dummy*$_{i,t}$* $log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * \ log \frac{Assets_{i,t}}{Revenue_{i,t}}$ $+\beta_6 *$ *Decrease_Dummy*$_{i,t}$* $log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log \frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{\iota,t}$	Eq.(2)

The dependent variable refers to SG&A cost; the independent variable refers to total revenue. The model's control variables are GNP (Gross National Product), Asset Intensity (Total Assets/ Revenues), and Employee Intensity (Number of Employees / Revenues). The interaction variable, Decrease Dummy, takes the value of 1 when sales revenue decreases between periods t − 1 and t, and 0 otherwise. The dummy variable Successive Decrease takes the value of 1 if firm's sales revenue decreases for two consecutive periods, and 0 otherwise.

This model can also be used in order to measure and assess the stickiness of operating expenses instead of SG&A cost. A slightly modified model for the operating expenses is used by the current study with the following formula:

$log\frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decrease\ i,t + \beta_4 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_5 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$	Eq.(3)

The dependent variable refers to operating expenses; the independent variable refers to total revenue. The model's control variables are GNP (Gross National Product), Asset Intensity (Total Assets/ Revenues), Employee Intensity (Number of Employees / Revenues). The interaction variable, Decrease Dummy, takes the value of 1 when sales revenue decreases between periods $t-1$ and t, and 0 otherwise. The dummy variable Successive Decrease takes the value of 1 if firm's sales revenue decreases for two consecutive periods, and 0 otherwise.

The most commonly robustness tests used in research are: Fama-MacBeth Standard Errors (Fama & Macbeth, 1973), OLS Standard Errors (Greene, 1990) and Firm and Fixed Effects (Farkas, 2005). Following Petersen's (2009) methodology, the model of the current study is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

4.2.2 Life Cycle Model

The life cycle model, introduced by the main study of Dickinson (2011) concerns the methodology used in order to define the stages of a business life cycle by using cash flows. The methodology suggests that cash flow patterns function as a proxy for the identification of life cycle stages as well as contribute to the depiction of economic characteristics and market behavior of firms across the life span. Cash flows are categorized as deriving from operating, investing and financing activities. These three types of cash flows are combined. By using the positive or negative sign, there are eight possible cash flow combinations that provide a firm life cycle stage mapping. The eight possible cash flow combinations correspond to the five distinct life cycle stages as follows:

- Introduction Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities
- Growth Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities
- Mature Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities
- Shake-out Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities
- Decline Phase: Negative CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Negative CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

Life Cycle stages can be used as shorter periods of economic activity of a firm in order to assess SG&As' cost and operating expenses' stickiness across the life cycle, using the aforementioned models of the previous paragraph.

4.2.3 Operating Performance Proxies

The operating performance is measured by the proxies Return on Equity and Return on Assets. Return on Equity refers to the net income of a firm divided by shareholders' equity. Return on Assets refers to net income of a firm divided by total assets:

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$	Eq.(4)

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$	Eq.(5)

These two proxies are used as control variables in the initial sticky cost model in order to measure cost asymmetry of SG&A cost as ROE and ROA fluctuate using the formulas:

$log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_{0+}\ \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} + \beta_2 *\ \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} * ROEt\ + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} * Successive\ Decreasei,t + \beta_5 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t}\ + \beta_6 *\ Decrease\_Dummy_{i,t} *\ log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} *\ log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{\iota,t}$	Eq.(6)

$log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_{0+}\ \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} + \beta_2 *\ \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} * ROAt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} * Successive\ Decreasei,t + \beta_5 *\ Decrease\_Dummy_{i,t} *\ \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t}\ + \beta_6 *\ Decrease\_Dummy_{i,t} *\ log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} *\ log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{\iota,t}$	Eq.(7)

These two proxies can also be used as control variables in the initial sticky cost model in order to measure cost asymmetry of operating expenses as ROE and ROA fluctuate.

Slightly modified models for the operating expenses are used by the current study with the following formulas:

$log \frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_0 + \beta_1 * log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} * ROEt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} * Successive\ Decreasei,t + \beta_5 * Decrease\_Dummy_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 * Decrease\_Dummy_{i,t} * log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log \frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log \frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$	Eq.(8)

$log \frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_0 + \beta_1 * log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} * ROAt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i\ ,\ t-1}} * Successive\ Decreasei,t + \beta_5 * Decrease\_Dummy_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 * Decrease\_Dummy_{i,t} * log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log \frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log \frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$	Eq.(9)

4.3 Methods of Data Statistical Analysis

The statistical process of analyzing the data sample for the extraction of research results is conducted using the Statistical Software Stata/SE version 16.0.

The statistical analyses conducted are:

1. Descriptive Statistics for the description of the main variables of the data sample (Mean (M), Median (Mdn), Standard Deviation (SD), Minimum (Min), Maximum (Max))

2. Regression Analysis for the measurement and assessment of SGAs expenses and operating expenses' stickiness for the whole period of economic activity for Shipping Firms.

3. Regression Analyses for the measurement and assessment SGAs expenses and operating expenses' stickiness for the shorter periods of life cycle stages for Shipping Firms.

4. Regression Analysis for the assessment of correlation between cost stickiness of SGAs, operating expenses and operating performance for Shipping Firms using the indices ROE and ROA.

5. Regression Analysis for the assessment of correlation between cost stickiness of SGAs, operating expenses and operating performance using the indices ROE and ROA for the shorter periods of life cycle stages for Shipping Firms.

6. Regression analysis for the measurement and assessment of SGAs expenses and operating expenses' stickiness for the whole period of economic activity for Construction and Transportation Companies as well as t-tests for the comparison of the averages of variables SG&A cost, operating expenses and total revenues between the Shipping firms, Construction and Transportation firms.

5TH CHAPTER

RESULTS

The current chapter presents the results of the study derived from the analysis of data. Firstly, descriptive statistics for the data-sample of the study are given. Furthermore, the next step concerns the findings over the asymmetric cost behavior of shipping firms. Furthermore, the results concerning the study of cost asymmetry across the different life cycle stages are analytically depicted. Moreover, the relationship between shipping firms' cost stickiness and operating performance is examined. Lastly, analyses for the Construction and Transportation sector are exhibited and comparisons between them and the Shipping sector are made.

5.1 Descriptive Statistics of the Sample

Table 1: Descriptive statistics of the main variables

Panel A: Descriptive statistics

	Number of Observations	Mean	Median	Standard deviation	Min	Max
$Assets^{j}_{i,t}$	31,319	6359.939	292.065	42488.81	0	1549596
$Emp^{j}_{i,t}$	25,912	4.01	0.3	13.48943	0	267.5
$FINCF^{j}_{i,t}$	28,137	-29.63413	.224	1669.995	-110.749	66494
$Growth^{j}_{i,t}$	32,888	2.29	2.58	2.50	-30.63	16.5
$Rev^{j}_{i,t}$	31,135	1888.236	129.35	8579.901	-6389.9	394328
$SG\&A^{j}_{i,t}$	23,587	155.5107	11.269	919.0031	-67.905	51345
$Teq^{j}_{i,t}$	31,250	1420.239	116.5	5475.999	-6972	134.047
$IVNCF^{j}_{i,t}$	28,137	-265.2308	-14.491	1821.394	-97.115	47484
$NI^{j}_{i,t}$	28,853	103.7187	1.7	1522.567	-99289	99803
$OANCF^{j}_{i,t}$	28,127	306.4705	13.393	2036.184	-8452	122151
$OPEX^{j}_{i,t}$	28,832	1363.959	71.992	6759.395	-1627	266191
$ROA^{j}_{i,t}$	28,742	-1.54	0.015	90.56	-10916	2369.428
$ROE^{j}_{i,t}$	15,011	0.18	0.053	14.2	-928.8	501.09
$Teq^{j}_{i,t}$	16,210	2190.798	259.9	7138.026	-5341	134047

Panel B: Main variables and their description

$Assets^{j}_{i,t}$	The total assets of firm i operating in j industry in year t.
$d^{j}_{i,t}$	A dummy variable that takes the value of 1 if firm's sales revenue decreases for one period, and 0 otherwise.
$ds^{j}_{i,t}$	A dummy variable that takes the value of 1 if firm's sales revenue decreases for

	two consecutive periods, and 0 otherwise.
$Growth^{j}_{i,t}$	The percentage growth in real Gross National Product during year t.
$Emp^{j}_{i,t}$	Number of employees of firm i operating in j industry in year t.
$Rev^{j}_{i,t}$	The sales revenues of firm i operating in j industry in year t..
$SG\&A^{j}_{i,t}$	The SG&A expenses of firm i operating in j industry in year t.
$FINCF^{j}_{i,t}$	The cashflows from financing activity of firm i operating in j industry in year t.
$IVNCF^{j}_{i,t}$	The cashflows from investing activity of firm i operating in j industry in year t.
$OANCF^{j}_{i,t}$	The cashflows from operating activity of firm i operating in j industry in year t.
$OPEX^{j}_{i,t}$	The operating expenses of firm i operating in j industry in year t.
$Ceq^{j}_{i,t}$	The stockholders' equity of firm i operating in j industry in year t.
$Teq^{j}_{i,t}$	The total equity of firm i operating in j industry in year t.
$NI^{j}_{i,t}$	The net income of firm i operating in j industry in year t.
$ROE^{j}_{i,t}$	The return on equity index of firm i operating in j industry in year t.
$ROA^{j}_{i,t}$	The return on assets index of firm i operating in j industry in year t.

The aforementioned table 1 refers to the descriptive statistics for the sample (Observations: 32.888) presenting the mean (M), standard deviation (SD), median (Mdn), minimum (min), maximum (max) for each of the main variables examined. For SG&A cost (Observations = 23,587), the mean is *M* = 155.5107 and the *SD* = 919.0031, which means that the sample is characterized by high variation. For operating expenses (Observations = 28,832), *M* = 1363.959 and the *SD* = 6759.395, which means that the sample is characterized by high variation and abnormal distribution of data. For revenues (Observations = 31,135), *M* = 1888.236 and the *SD* = 8579.901, which means anew that the sample is characterized by high variation and abnormal distribution of data.

5.2 Asymmetric Cost Behavior of Shipping Firms

The asymmetric cost behavior of shipping firms has been the main research question in the current study. In order to investigate cost stickiness in shipping firms, a multiple regression analysis has been conducted to test if the six independent variables significantly predict SG&A cost behavior. The results of the multiple regression analysis indicate that the six predictors can explain 22.49% of the total variance (R^2=.2249, F (11, 1722) = 176.54, p<0.01). The main results of the multiple regression analysis are presented in Table 2.

The estimated value of b1 is 0.255, indicating that that SGA costs generally increase (decrease) by 0.255%, after a percentage increase (decrease) in sales revenue. The estimated value of b2 is insignificant, providing strong support for a symmetrical pattern in cost behavior. Regarding asset intensity, there is a small contribution to SGA cost stickiness by 0.116%. As for employee intensity, there is a slight contribution to SGA cost stickiness by 0.039%.

Table 2: SG&A cost stickiness

	Coefficients
b_0 : constant	0.016** (2.23)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.255*** (12.8)
Two – Way Interaction Term	
b_2 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1})$	0.007 (0.1)
Three – Way Interaction Terms	
b_3: $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * ds_{i,t}$	0.006 (0.13)
b_4 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * Growth_t$	0.005 (0.76)
b_5 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * \log(Assets_{i,t}/Rev_{i,t})$	-0.116*** (-5.99)
b_6: $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * \log(Emp_{i,t}/Rev_{i,t})$	-0.039* (-1.77)
Main Terms	
b_7: $d_{i,t}$ (Decrease_Dumm$y_{i,t}$)	-0.01** (-2.01)
b_8: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.041*** (-6.66)
b_9: $Growth_t$	0.002*** (3.43)
b_{10}: $\log(Assets_{i,t}/Rev_{i,t})$	0.009** (2.23)
b_{11}: $\log(Emp_{i,t}/Rev_{i,t})$	-0.005** (-1.97)

Number of Observations	14,874
Adj. R-Squared	0.225

Notes:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_{0} + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}}$$

$$+\beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decrease\ i,t\ + \beta_4 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}}$$

$$*Growth_{i,t} + \beta_5 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} *$$

$$log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

In order to investigate anew into cost stickiness in shipping firms, a regression analysis has been conducted to test if the six independent variables significantly predict operating expenses. The main results of the multiple regression analysis indicate that the six predictors can explain 33.23 % of the total variance ($R^2 = .3323$, $F(11, 2021) = 310.32$, $p < 0.01$). The results of the multiple regression analysis are depicted in Table 3.

The estimated value of b1 is 0.432, indicating that operating expenses generally increase (decrease) by 0.432%, after a percentage increase (decrease) in sales revenue. The estimated value of b2 is insignificant, providing strong support for a symmetrical cost behavior pattern. Regarding asset intensity, there is a contribution to cost stickiness by 0.185%. As far as employee intensity is concerned, there is a contribution to cost stickiness by 0.101%.

Table 3: Operating expenses' stickiness

	Coefficients
b_0 : constant	0.004 (0.55)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.432*** (17.03)
Two – Way Interaction Term	
b_2 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1})$	0.004 (0.04)

Three – Way Interaction Terms

b_3: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)* $ds_{i,t}$	0.027 (0.52)
b_4 : $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)* $Growth_t$	0.011 (1.24)
b5 : $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Assets_{i,t}$/$Rev_{i,t}$)	-0.185*** (-7.05)
b_6: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Emp_{i,t}$/$Rev_{i,t}$)	-0.101*** (-3.81)
Main Terms	
b_7: d $_{i,t}$ (Decrease_Dummy$_{i,t}$)	-0.005 (-0.79)
b_8: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.044*** (-5.82)
b_9: $Growth_t$	-0.002** (-2.08)
b_{10}: log($Assets_{i,t}$/$Rev_{i,t}$)	-0.001 (-0.37)
b_{11}: log($Emp_{i,t}$/$Rev_{i,t}$)	-0.015*** (-5.71)
Number of Observations	18,080
Adj. R-Squared	0.332

Notes:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.
This table presents the results of the regression analysis of the estimated model:

$$log\frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decrease\ i,t + \beta_4 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_5 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

5.3 Cost Asymmetry across Different Life Cycle Stages

Cost asymmetry across different life cycle stages is the second research question of the current study. In order to examine cost stickiness in shipping firms in 5 different life cycle stages, consecutive multiple regression analyses have been conducted for every life cycle stage to test if the six independent variables significantly predict SG&A costs. The main results of the multiple regression analysis for the introduction phase indicate that the six predictors can explain 16.92 % of the total variance (R^2=.1692, F(11,691) =24.89, p<0.01), whereas for the growth phase the existing model can predict 24.31% of the total variance (R^2=.2431, F(11,1274) = 72.15, p<0.01). For the mature phase, the existing model can predict 21.73% of the total variance (R^2=.2173, F(11,1090) = 62.39, p<0.01), whereas for the shake-out phase the existing model can explain 27.50% of the total variance (R^2 = 0.2750, F(11,717) = 25.72, p<0.01). For the decline phase a percentage of 20.36% is indicative of the predictability of the model (R^2 = 0.2036, F(11,411) = 14.87, p<0.01). The main results of the multiple regression analyses are depicted in Table 4.

In the case of Growth, Mature and Shake-out Phase, the estimated value of b2 is significant, providing strong support for an asymmetric cost behavior pattern, that of SG&A cost anti-stickiness. As for the Growth phase, regarding asset intensity, there is a contribution to cost stickiness by 0.28%. As far as employee intensity is concerned, there is a contribution to cost anti-stickiness by 0.086%. As far as the mature phase is concerned, regarding the asset intensity, there is a contribution to cost stickiness by 0.229 %. As for the variable growth, there is a contribution to cost anti-stickiness by 0.014%. As far as employee intensity is concerned, there is a contribution to cost anti-stickiness by 0.118 %. For the Shake-out Phase, concerning the asset intensity, there is a contribution to cost stickiness by 0.372%.

Table 4: SG&A cost stickiness	Introduction Phase	Growth Phase	Mature Phase	Shake-out Phase	Decline Phase
b_0 : constant	0.024 (0.75)	0.04*** (3.48)	0.016* (1.69)	0.03 (1.43)	0.01 (0.25)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.156*** (4.29)	0.321*** (12.23)	0.339*** (10.12)	0.322*** (4.64)	-0.004 (-0.07)
<u>Two – Way Interaction Term</u>					

$b_2 : d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1})$	-0.265	0.540***	0.382***	0.374**	0.232
	(-1.47)	(3.23)	(2.6)	(2.18)	(1.58)
<u>Three – Way Interaction Terms</u>					
$b_3: d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * ds_{i,t}$	0.127	-0.058	-0.026	-0.146	-0.019
	(1.06)	(-0.65)	(-0.46)	(-1.17)	(-0.24)
$b_4: d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * Growth_t$	-0.008	-0.007	0.014**	0.018	-0.007
	(-0.48)	(-0.64)	(2.01)	(1.46)	(-0.67)
$b_5: d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * \log(Assets_{i,t}/Rev_{i,t})$	-0.026	-0.28***	-0.229***	-0.372***	-0.037
	(-0.51)	(-3.02)	(-4.92)	(-3.64)	(-1.01)
$b_6: d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * \log(Emp_{i,t}/Rev_{i,t})$	-0.088	0.086*	0.118***	0.026	-0.063
	(-1.1)	(1.82)	(2.65)	(0.48)	(-1.61)
<u>Main Terms</u>					
$b_7: d_{i,t}$ (Decrease_Dummy$_{i,t}$)	-0.058***	0.008	-0.001	0.029*	-0.017
	(-3.06)	(0.88)	(-0.13)	(1.78)	(-0.83)
$b_8: ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.011	-0.05***	-0.027***	-0.069***	-0.056**
	(-0.47)	(-4.91)	(-3.71)	(-3.94)	(-2.57)
$b_9: Growth_t$	0.008***	0.001	0.001	0.002	0.002
	(3.53)	(0.59)	(1.58)	(1.02)	(0.93)
$b_{10}: \log(Assets_{i,t}/Rev_{i,t})$	0.022**	-0.002	-0.017***	0.003	0.035**
	(2.27)	(-0.27)	(-3.36)	(0.19)	(2.22)
$b_{11}: \log(Emp_{i,t}/Rev_{i,t})$	-0.005	-0.001	-0.0003	0.008	-0.009
	(-0.38)	(-0.28)	(-0.07)	(1.07)	(-0.56)
Number of Observations	1,684	5,456	5,093	1,456	808
Adj. R-Squared	0.169	0.243	0.217	0.275	0.204

<u>Notes</u>:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$\log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_{0} + \beta_1 \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decrease_{i,t} + \beta_4 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_5 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * \log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_6 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * \log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The life cycle model, introduced by the main study of Dickinson (2011) concerns the methodology used in order to define the stages of a business life cycle by using cashflows. The eight possible cash flow combinations correspond to the five distinct life cycle stages as follows:

Introduction Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Growth Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Mature Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities

Shake-out Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

Decline Phase: Negative CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Negative CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

In order to examine cost stickiness in shipping firms in 5 different life cycle stages, consecutive multiple regression analyses have been conducted for every life cycle stage to test if the six independent variables significantly predict operating expenses. The main results of the multiple regression analysis for the introduction phase indicate that the six predictors can explain 29.92% of the total variance (R^2=.2992, F(11, 778) =39.05, p<0.01), whereas for the growth phase the existing model can predict 30.52% of the total variance (R^2=.3052, F(11, 1504) =109.23, p<0.01). For the mature phase, the existing model can predict 34.81% of the total variance (R^2=.3481, F(11, 1320) =147.6, p<0.01), whereas for the shake-out phase the existing model can explain 44.71 % of the total variance (R^2=.4471, F(11, 871) =61.5, p<0.01). For the decline phase a percentage of 39.62 % is indicative of the predictability of the model (R^2=.3962, F(11, 522) =34.29, p<0.01). The main results of the multiple regression analyses are depicted in Table 5.

In the case of Introduction, Growth and Mature Phase the estimated value of b2 is significant, providing strong support for an asymmetric cost behavior pattern. For the Introduction phase the asymmetric cost behavior pattern is that of SG&A cost stickiness. Regarding asset intensity, there is a contribution to cost stickiness by

0.059%. As far as employee intensity is concerned, there is a contribution to cost stickiness by 0.144%. For the Growth phase, the asymmetric cost behavior pattern is that of SG&A cost anti-stickiness. As for the Growth phase, regarding asset intensity, there is a contribution to cost stickiness by 0.366%. As far as employee intensity is concerned, there is a contribution to cost anti-stickiness by 0.241%. For the Mature phase, the asymmetric cost behavior pattern is that of SG&A cost anti-stickiness. As far as the mature phase is concerned, regarding the asset intensity, there is a contribution to cost stickiness by 0.493%. As for growth, there is a contribution to cost anti-stickiness by 0.048%. As far as employee intensity is concerned, there is a contribution to cost anti-stickiness by 0.178%.

Table 5: Operating expenses' stickiness	Introduction Phase	Growth Phase	Mature Phase	Shake-out Phase	Decline Phase
b_0 : constant	0.018	0.011	0.033***	-0.017	0.025
	(0.64)	(1.04)	(3.11)	(-0.75)	(0.65)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.277***	0.529***	0.502***	0.624***	0.173***
	(6.41)	(15.4)	(7.2)	(10.5)	(2.92)
Two – Way Interaction Term					
b_2 : $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})$	-0.233***	1.016***	0.987***	0.018	0.093
	(-3.06)	(5.93)	(4.72)	(0.04)	(0.42)
Three – Way Interaction Terms					
b_3: $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*$ $ds_{i,t}$	0.187**	-0.342**	-0.202**	-0.142	0.034
	(2.45)	(-2.27)	(-2.21)	(-1.22)	(0.27)
b_4: $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*$ $Growth_t$	-0.01	0.006	0.048***	0.033**	0.011
	(-0.71)	(0.24)	(3.84)	(2.17)	(0.7)
b_5 : $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*\log(Assets_{i,t}/Rev_{i,t})$	-0.059*	-0.366***	-0.493***	-0.354***	-0.097
	(-1.93)	(-3.87)	(-8.67)	(-4.42)	(-1.63)
b_6: $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*\log(Emp_{i,t}/Rev_{i,t})$	-0.144***	0.241***	0.178**	-0.114	-0.170***
	(-4.77)	(4.41)	(2.55)	(-1.46)	(-2.81)
Main Terms					
b_7: $d_{i,t}$ (Decrease_Dummy$_{i,t}$)	-0.072***	0.024**	0.015*	0.028**	-0.016
	(-4.5)	(2.011)	(1.66)	(2.38)	(-0.63)
b_8: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	0.005	-0.096***	-0.05***	-0.052***	-0.053**
	(0.29)	(-5.17)	(-6.35)	(-3.42)	(-1.97)

b_9: $Growth_t$	0.005**	-0.003**	-0.003***	0.002	0.0005
	(2.22)	(-2.11)	(-3.14)	(1.11)	(0.24)
b_{10}: $\log(Assets_{i,t}/Rev_{i,t})$	0.02**	-0.016***	-0.024***	-0.027**	0.026
	(2.03)	(-2.59)	(-5.19)	(-2.38)	(1.31)
b_{11}: $\log(Emp_{i,t}/Rev_{i,t})$	-0.018*	-0.016***	0.0005	-0.011	-0.009
	(-1.74)	(-3.87)	(0.1)	(-1.27)	(-0.59)
Number of Observations	1,886	6,483	6,375	1,825	1,054
Adj. R-Squared	0.299	0.305	0.348	0.447	0.396

Notes:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log\frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_{0+}\ \beta_1\ log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{ Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decrease\ i,t + \beta_4 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_5 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen’s (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The life cycle model, introduced by the main study of Dickinson (2011) concerns the methodology used in order to define the stages of a business life cycle by using cashflows. The eight possible cash flow combinations correspond to the five distinct life cycle stages as follows:

Introduction Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Growth Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Mature Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities

Shake-out Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

Decline Phase: Negative CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Negative CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

5.4 Cost Stickiness and Operating Performance in Shipping Firms

Cost stickiness and operating performance is the third research query of the current study. In order to investigate into cost stickiness and operating performance (ROE) in shipping firms, a multiple regression analysis has been conducted to test if the seven independent variables significantly predict SG&A costs. The results of the multiple regression analysis indicated that the seven predictors can explain 21.85% of the total variance (R^2 = .2185, F(13, 970) = 93.37, p < 0.01). The main results of the multiple regression analysis are presented in Table 6.

Regarding SG&A cost stickiness and operating performance (ROE) in shipping firms, no statistically significant relationship between the two variables is noticed, as the value of b_3 is statistically insignificant. Regarding asset intensity, there is a contribution to cost stickiness by 0.143%.

Table 6: SG&A cost stickiness and operating performance

	Coefficients
b_0 : constant	0.007 (0.86)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.235*** (10.83)
<u>Two – Way Interaction Term</u>	
b_2 : $d_{i,t}$ * $\log(Rev_{i,t}/Rev_{i,t-1})$	0.101 (1.59)
<u>Three – Way Interaction Terms</u>	
b_3: $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$* ROE_t	0.00000502 (0.01)
b_4: $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$* $ds_{i,t}$	0.028 (0.69)
b_5 : $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$* $Growth_t$	0.009 (1.57)
b_6 : $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$*$\log(Assets_{i,t}/Rev_{i,t})$	-0.143*** (-6.68)
b_7: $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$*$\log(Emp_{i,t}/Rev_{i,t})$	-0.007 (-0.38)
<u>Main Terms</u>	
b_8: $d_{i,t}$ (Decrease_Dummy$_{i,t}$)	-0.013** (-2.21)
b_9 : $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.032*** (-4.99)
b_{10}: $Growth_t$	0.0014** (2.07)
b_{11}: $\log(Assets_{i,t}/Rev_{i,t})$	0.003 (0.59)

b_{12}: log($Emp_{i,t}$/$Rev_{i,t}$)	-0.008*** (-2.66)
b_{13} : ROEt	-0.00013 (-0.78)
Number of Observations	8,713
Adj. R-Squared	0.219

Notes:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * ROEt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decreasei,t + \beta_5 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The operating performance is measured by the proxies Return on Equity and Return on Assets. Return on Equity refers to the net income of a firm divided by shareholders' equity. Return on Assets refers to net income of a firm divided by total assets:

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$

In order to examine anew cost stickiness and operating performance (ROA) in shipping firms, a multiple regression analysis has been conducted to test if the seven independent variables significantly predict SG&A costs. The results of the multiple regression analysis indicate that the seven predictors can explain 22.52 % of the total variance (R^2 = .2252, F(13, 1722) = 149.59, p < 0.01). The main results of the multiple regression analysis are presented in Table 7.

Regarding SG&A cost stickiness and operating performance (ROA) in shipping firms, no statistically significant relationship between the two variables is noticed, as the value of b_3 is statistically insignificant. Regarding employee intensity, there is a contribution to cost stickiness by 0.111%.

Table 7: SGA stickiness and operating performance

	Coefficients
b_0 : constant	0.017** (2.32)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.257*** (12.84)
<u>Two – Way Interaction Term</u>	
b_2 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1})$	-0.009 (-0.11)
<u>Three – Way Interaction Terms</u>	
b_3: $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) *$ ROAt	0.0005 (0.75)
b_4: $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * ds_{i,t}$	0.009 (0.2)
b_5 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * Growth_t$	0.005 (0.83)
b_6 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * \log(Assets_{i,t}/Rev_{i,t})$	-0.111*** (-5.21)
b_7: $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * \log(Emp_{i,t}/Rev_{i,t})$	-0.043 (-1.56)
<u>Main Terms</u>	
b_8: $d_{i,t}$ ($Decrease\_Dummy_{i,t}$)	-0.011** (-2.03)
b_9: $ds_{i,t}$ (Successive $Decrease_{i,t}$)	-0.041*** (-6.68)
b_{10}: $Growth_t$	0.002*** (3.43)
b_{11}: $\log(Assets_{i,t}/Rev_{i,t})$	0.009** (2.24)
b_{12}: $\log(Emp_{i,t}/Rev_{i,t})$	-0.005* (-1.83)
b_{13} : ROA_t	0.001 (1.22)
Number of Observations	14,874
Adj. R-Squared	0.225

<u>Notes</u>:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * ROAt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decreasei,t + \beta_5 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen’s (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The operating performance is measured by the proxies Return on Equity and Return on Assets. Return on Equity refers to the net income of a firm divided by shareholders’ equity. Return on Assets refers to net income of a firm divided by total assets:

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$

In order to examine anew cost stickiness and operating performance (ROE) in shipping firms, a multiple regression analysis has been conducted to test if the seven independent variables significantly predict operating expenses. The results of the multiple regression analysis indicate that the seven predictors can explain 25.87 % of the total variance (R^2= .2587, F(13, 1095) = 125.51, p< 0.01). The main results of the multiple regression analysis are presented in Table 8.

Regarding Operating expenses’ stickiness and operating performance (ROE) in shipping firms, no statistically significant relationship between the two variables is noticed, as the value of b_3 is statistically insignificant. As for asset intensity, there is a contribution to cost stickiness by 0.192%. Concerning employee intensity, there is a contribution to cost stickiness by 0.052%.

Table 8: Operating expenses’ stickiness and operating performance

	Coefficients
b_0 : constant	-0.013 (-1.46)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.405*** (15.11)
<u>Two – Way Interaction Term</u>	

b_2 : $d_{i,t}$ * $\log(Rev_{i,t}/Rev_{i,t-1})$	0.069 (0.74)
<u>Three – Way Interaction Terms</u>	
b_3: $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$* ROE$t$	0.0007 (0.91)
b_4: $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$* $ds_{i,t}$	0.062 (1.15)
b_5 : $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$* $Growth_t$	0.005 (0.6)
b_6 : $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$*$\log(Assets_{i,t}/Rev_{i,t})$	-0.192*** (-5.77)
b_7: $d_{i,t}$ *$\log(Rev_{i,t}/Rev_{i,t-1})$*$\log(Emp_{i,t}/Rev_{i,t})$	-0.052* (-1.79)
<u>Main Terms</u>	
b_8: $d_{i,t}$ (Decrease_Dumm$y_{i,t}$)	-0.002 (-0.27)
b_9: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.048*** (-5.42)
b_{10}: $Growth_t$	-0.003*** (-3.10)
b_{11}: $\log(Assets_{i,t}/Rev_{i,t})$	-0.005 (-0.97)
b_{12}: $\log(Emp_{i,t}/Rev_{i,t})$	-0.020*** (-6.11)
b_{13} : ROE_t	-0.0001 (-0.44)
Number of Observations	10,026
Adj. R-Squared	0.259

<u>Notes</u>:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log\frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dumm}y_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}}$$

$$+\beta_3 \text{ Decrease\_Dumm}y_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * ROEt + \beta_4 * \text{Decrease\_Dumm}y_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} *$$

$$Successive\ Decreasei,t + \beta_5 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 *$$

$Decrease\_Dummy_{i,t}* \ log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * \ log\frac{Assets_{i,t}}{Revenue_{i,t}} \ +\beta_7* \ Decrease\_Dummy_{i,t}* \ log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} *$
$log\frac{Employees_{i,t}}{Revenue_{i,t}} +\varepsilon_{i,t}$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The operating performance is measured by the proxies Return on Equity and Return on Assets.

Return on Equity refers to the net income of a firm divided by shareholders' equity.

Return on Assets refers to net income of a firm divided by total assets.

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$

In order to examine anew cost stickiness and operating performance (ROA) in shipping firms, a multiple regression analysis has been conducted to test if the seven independent variables significantly predict operating expenses. The results of the multiple regression analysis indicate that the seven predictors can explain 33.27 % of the total variance (R^2 = .3327, F (13, 2021) = 265.12, p < 0.01). The main results of the multiple regression analysis are presented in Table 9.

Regarding Operating expenses' stickiness and operating performance (ROA) in shipping firms, no statistically significant relationship between the two variables is noticed, as the value of b_3 is statistically insignificant. As for asset intensity, there is a contribution to cost stickiness by 0.196%. Concerning employee intensity, there is a contribution to cost stickiness by 0.092%.

Table 9: Operating expenses' stickiness and operating performance

	Coefficients
b_0 : constant	0.004 (0.51)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.431*** (16.97)
<u>Two – Way Interaction Term</u>	
b_2 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1})$	0.040 (0.42)
<u>Three – Way Interaction Terms</u>	
b_3: $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * ROAt$	-0.0002

	(-0.18)
b_4: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)* $ds_{i,t}$	0.025 (0.48)
b_5 : $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)* $Growth_t$	0.010 (1.16)
b_6 : $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Assets_{i,t}$/$Rev_{i,t}$)	-0.196*** (-6.84)
b_7: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Emp_{i,t}$/$Rev_{i,t}$)	-0.092*** (-3.02)
<u>Main Terms</u>	
b_8: $d_{i,t}$ (Decrease_Dumm$y_{i,t}$)	-0.005 (-0.77)
b_9: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.044*** (-5.87)
b_{10}: $Growth_t$	-0.002** (-2.09)
b_{11}: log($Assets_{i,t}$/$Rev_{i,t}$)	-0.001 (-0.39)
b_{12}: log($Emp_{i,t}$/$Rev_{i,t}$)	-0.015*** (-5.64)
b_{13} : ROA_t	-0.001 (-0.95)
Number of Observations	18,080
Adj. R-Squared	0.333

<u>Notes</u>:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log\frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dumm}y_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}}$$

$$+ \beta_3 * \text{Decrease\_Dumm}y_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * ROAt \quad + \beta_4 * \text{Decrease\_Dumm}y_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} *$$

$$Successive\ Decreasei,t + \quad \beta_5 * \quad Decrease\_Dummy_{i,t} * \quad \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} \quad *Growth_{i,t} \quad + \beta_6 *$$

$$Decrease\_Dummy_{i,t} * \ log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * \ log\frac{Assets_{i,t}}{Revenue_{i,t}} \ + \beta_7 * \ Decrease\_Dummy_{i,t} * \ log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} *$$

$$log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The operating performance is measured by the proxies Return on Equity and Return on Assets. Return on Equity refers to the net income of a firm divided by shareholders' equity. Return on Assets refers to net income of a firm divided by total assets:

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$

5.5 Operating performance across different life cycle stages

On this subchapter, the results concerning the operating performance across different life cycle stages are presented in following tables 10, 11, 12, 13. Table 10 illustrates the results of the regression analysis conducted to measure SGA cost stickiness and operating performance (ROE).

In order to examine cost stickiness in shipping firms in 5 different life cycle stages, consecutive multiple regression analyses have been conducted for every life cycle stage to test if the seven independent variables significantly predict SGA costs. The main results of the multiple regression analysis for the introduction phase indicate that the seven predictors can explain 19.27 % of the total variance (R^2=.1927, F(13, 341) = 11.55, p<0.01), whereas for the growth phase the existing model can predict 22.87 % of the total variance (R^2= .2287, F(13, 711) = 37.89, p<0.01). For the mature phase, the existing model can predict 19.45 % of the total variance (R^2= .1945, F(13, 665) = 43.86, p<0.01), whereas for the shake-out phase the existing model can explain 29.73 % of the total variance (R^2= .2973, F(13, 395) = 14.58 , p<0.01). For the decline phase a percentage of 23.27 % is indicative of the predictability of the model (R^2= .2327, F (13, 210) =6.94, p<0.01).

The main results of the multiple regression analyses are depicted in Table 10. In the case of Growth, Mature, Shake-out Phase and Decline Phase, the estimated value of b2 is significant, providing strong support for an asymmetric cost behavior pattern of SG&A cost anti-stickiness. As for the Decline Phase, the value of b3 is significant, claiming a correlation between SG&A cost stickiness and ROE. This interrelation implies that an increase in term that includes ROE (operating performance), leads to a decrease to SG&A anti-stickiness by 0.017%. As for growth variable in Mature Phase, there is a contribution to cost anti-stickiness by 0.014%. Regarding Asset Intensity in Introduction, Growth, Mature and Shake-out Phase, there is a reduction in cost anti-stickiness to a percentage equivalent to the respective coefficient b6. As far as Employee Intensity is concerned, there is a contribution to cost anti-stickiness to a percentage equivalent to the respective coefficient b7.

Table 10: SGA cost stickiness and operating performance	Introduction Phase	Growth Phase	Mature Phase	Shake-out Phase	Decline Phase
b_0 : constant	0.008 (0.17)	0.049*** (3.31)	0.018* (1.68)	0.058** (2.23)	0.042 (0.82)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.151*** (3.15)	0.297*** (10.37)	0.281*** (7.66)	0.220** (2.25)	-0.187* (-1.90)
Two – Way Interaction Term					
b_2 : $d_{i,t} *\log(Rev_{i,t}/Rev_{i,t-1})$	0.046 (0.31)	0.751*** (3.30)	0.413** (2.29)	0.948*** (2.91)	0.434*** (2.73)
Three – Way Interaction Terms					
b_3 : $d_{i,t} *\log(Rev_{i,t}/Rev_{i,t-1})*ROE t$	-0.002 (-0.79)	-0.0003 (-0.08)	-0.001 (-0.44)	-0.031 (-1.25)	-0.017* (-1.80)
b_4: $d_{i,t} *\log(Rev_{i,t}/Rev_{i,t-1})* ds_{i,t}$	-0.019 (-0.23)	-0.124 (-1.34)	0.009 (0.14)	-0.147 (-0.91)	0.135* (1.78)
b_5 : $d_{i,t} *\log(Rev_{i,t}/Rev_{i,t-1})* Growth_t$	0.016 (1.65)	-0.003 (-0.22)	0.014* (1.85)	0.019 (1.14)	-0.008 (-0.92)
b_6 : $d_{i,t} *\log(Rev_{i,t}/Rev_{i,t-1})*\log(Assets_{i,t}/Rev_{i,t})$	-0.114*** (-2.63)	-0.238*** (-2.67)	-0.227*** (-4.24)	-0.415*** (-4.24)	-0.094 (-1.65)
b_7:$d_{i,t} *\log(Rev_{i,t}/Rev_{i,t-1})*\log(Emp_{i,t}/Rev_{i,t})$	-0.011 (-0.23)	0.167** (2.50)	0.126** (2.37)	0.180** (2.58)	-0.037 (-0.85)
Main Terms					
b_8: $d_{i,t}$ (Decrease_Dummy$y_{i,t}$)	-0.038 (-1.58)	0.004 (0.47)	-0.013* (-1.93)	0.024 (0.92)	-0.032 (-1.31)
b_9: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.028 (-1.16)	-0.057*** (-4.54)	-0.018** (-2.12)	-0.076*** (-3.15)	-0.010 (-0.41)
b_{10}: $Growth_t$	0.009***	-0.0004	0.0015*	-0.0007	-0.001

	(3.04)	(-0.37)	(1.78)	(-0.32)	(-0.56)
b_{11}: log($Assets_{i,t}$/$Rev_{i,t}$)	0.005 (0.43)	0.004 (0.50)	-0.014** (-2.41)	-0.005 (-0.28)	0.034 (1.57)
b_{12}: log($Emp_{i,t}$/$Rev_{i,t}$)	-0.011 (-0.70)	0.003 (0.55)	-0.0006 (-0.13)	0.012 (1.23)	0.004 (0.20)
b_{13} : ROEt	-0.0000491 (-0.23)	0.0004 (0.50)	0.0000662 (0.52)	-0.01* (-1.72)	-0.007* (-1.84)
Number of Observations	767	3,212	3,349	783	407
Adj. R-Squared	0.193	0.229	0.195	0.297	0.233

Notes:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * ROEt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decrease i,t + \beta_5 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The life cycle model, introduced by the main study of Dickinson (2011) concerns the methodology used in order to define the stages of a business life cycle by using cashflows. The eight possible cash flow combinations correspond to the five distinct life cycle stages as follows:

Introduction Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Growth Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Mature Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities

Shake-out Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

Decline Phase: Negative CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Negative CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

The operating performance is measured by the proxies Return on Equity and Return on Assets. Return on Equity refers to the net income of a firm divided by shareholders' equity. Return on Assets refers to net income of a firm divided by total assets:

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$

In order to examine cost stickiness and operating performance (ROA) in shipping firms in 5 different life cycle stages, consecutive multiple regression analyses have been conducted for every life cycle stage to test if the seven independent variables significantly predict SGA costs.

The main results of the multiple regression analysis for the introduction phase indicate that the seven predictors can explain 17.61 % of the total variance (R^2=.1761, F (13, 691) = 22.85, p<0.01), whereas for the growth phase the existing model can predict 24.33 % of the total variance (R^2= .2433, F (13, 1274) = 61.58, p<0.01).

For the mature phase, the existing model can predict 22.05 % of the total variance (R^2= .2205, F(13, 1090) = 54.72, p<0.01), whereas for the shake-out phase the existing model can explain % of the total variance (R^2= .2818, F(13, 717) = 26.08, p<0.01).

For the decline phase a percentage of 20.45 % is indicative of the predictability of the model (R^2= .2045, F (13, 411) = 44.89, p<0.01).

The main results of the multiple regression analyses are depicted in Table 11.

In the case of Growth, Mature, Shake-out Phase, the estimated value of b2 is significant and positive, providing strong support for an asymmetric cost behavior pattern, that of SG&A cost anti-stickiness. As for the Introduction, Mature, Shake-out Phase, the value of b3 is significant, claiming a correlation between SG&A cost stickiness and ROA (operating performance). This interrelation implies that an increase in the term that includes ROA (operating performance), leads to an increase in SG&A anti-stickiness by a percentage equivalent to the respective coefficient b3. As for growth variable in Mature Phase, there is a contribution to cost anti-stickiness by 0.016%. Regarding Asset Intensity in Growth, Mature and Shake-out Phase, there is a reduction in cost anti-stickiness to a percentage equivalent to the respective coefficient b6. As far as Employee Intensity in Mature Phase is concerned, there is a contribution to cost anti-stickiness by 0.15%.

Table 11: SGA expenses' stickiness and operating performance	Introduction Phase	Growth Phase	Mature Phase	Shake-out Phase	Decline Phase
b_0 : constant	0.044	0.040***	0.016*	0.031	0.011
	(1.44)	(3.46)	(1.76)	(1.47)	(0.27)
b_1: log($Rev_{i,t}$/$Rev_{i,t-1}$)	0.167***	0.321***	0.335***	0.323***	-0.006
	(4.51)	(12.22)	(9.92)	(4.65)	(-0.11)
<u>Two – Way Interaction Term</u>					
b_2 : $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)	-0.250	0.537***	0.447***	0.468***	0.250
	(-1.33)	(3.18)	(2.30)	(2.84)	(1.48)
<u>Three – Way Interaction Terms</u>					
b_3 : $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*ROAt	0.009***	0.015	0.165**	0.084***	-0.0006
	(3.56)	(0.16)	(2.01)	(2.99)	(-0.89)
b_4: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)* $ds_{i,t}$	0.130	-0.046	0.012	-0.109	-0.016
	(1.20)	(-0.48)	(0.19)	(-0.90)	(-0.19)
b_5: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)* $Growth_t$	-0.008	-0.007	0.016**	0.018	-0.007
	(-0.50)	(-0.59)	(2.19)	(1.45)	(-0.66)
b_6 : $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Assets_{i,t}$/$Rev_{i,t}$)	-0.031	-0.299***	-0.190***	-0.433***	-0.041
	(-0.59)	(-2.58)	(-3.66)	(-3.99)	(-1.00)
b_7: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Emp_{i,t}$/$Rev_{i,t}$)	-0.077	0.078	0.150***	0.040	-0.058
	(-0.98)	(1.40)	(3.21)	(0.76)	(-1.11)
<u>Main Terms</u>					
b_8: $d_{i,t}$ (Decrease_Dumm$y_{i,t}$)	-0.055***	0.007	0.0002	0.032*	-0.017
	(-2.85)	(0.86)	(0.034)	(1.91)	(-0.85)
b_9: $ds_{i,t}$ (Successive $Decrease_{i,t}$)	-0.011	-0.049***	-0.023***	-0.066***	-0.056**
	(-0.49)	(-4.69)	(-2.94)	(-3.78)	(-2.53)
b_{10}: $Growth_t$	0.008***	0.0007	0.001	0.002	0.002
	(3.33)	(0.59)	(1.53)	(1.01)	(0.93)
b_{11}: log($Assets_{i,t}$/$Rev_{i,t}$)	0.018*	-0.002	-0.013***	0.002	0.036**
	(1.86)	(-0.39)	(-2.66)	(0.13)	(2.25)
b_{12}: log($Emp_{i,t}$/$Rev_{i,t}$)	0.002	-0.001	0.001	0.008	-0.008
	(0.16)	(-0.32)	(0.30)	(1.10)	(-0.48)
b13 : ROAt	0.007***	-0.009	0.045***	-0.003	-0.002
	(3.74)	(-0.45)	(3.06)	(-1.36)	(-1.45)
Number of Observations	1,684	5,456	5,093	1,456	808
Adj. R-Squared	0.176	0.243	0.221	0.282	0.204

Notes:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

This table presents the results of the regression analysis of the estimated model:

$$log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * ROAt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decreasei,t + \beta_5 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The life cycle model, introduced by the main study of Dickinson (2011) concerns the methodology used in order to define the stages of a business life cycle by using cashflows. The eight possible cash flow combinations correspond to the five distinct life cycle stages as follows:

Introduction Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Growth Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Mature Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities

Shake-out Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

Decline Phase: Negative CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Negative CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

The operating performance is measured by the proxies Return on Equity and Return on Assets. Return on Equity refers to the net income of a firm divided by shareholders' equity. Return on Assets refers to net income of a firm divided by total assets:

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$

In order to examine cost stickiness in shipping firms in 5 different life cycle stages, consecutive multiple regression analyses have been conducted for every life cycle stage to test if the seven independent variables significantly predict operating expenses. The main results of the multiple regression analysis for the introduction phase indicate that the seven predictors can explain 26.91 % of the total variance (R^2= .2691, F(13, 369) = 17.45, p<0.01), whereas for the growth phase the existing model can predict 21.69 % of the total variance (R^2= .2169, F(13, 803) = 37.37, p<0.01). For the mature phase, the existing model can predict 27.40 % of the total variance (R^2= .2740, F(13, 759) = 79.43, p<0.01), whereas for the shake-out phase the existing model can explain 40.89 % of the total variance (R^2= .4089, F(13, 460) = 41.47, p<0.01). For the decline phase a percentage of 33.74 % is indicative of the predictability of the model (R^2= .3374, F (13, 246) = 12.84, p<0.01). Table 12 presents the results of the regression analysis conducted to measure operating expenses' stickiness and operating performance (ROE).

In the case of Growth, Mature, Shake-out Phase, the estimated value of b2 is significant and positive, providing strong support for an asymmetric cost behavior pattern, that of operating expenses' anti-stickiness. As for the Mature phase, the value of b3 is significant, claiming a correlation between operating expenses' stickiness and ROE (operating performance). This interrelation implies that an increase in the term that includes ROE (operating performance), leads to an increase in operating expenses' anti-stickiness by 0.008%.

As for the variable growth in Growth, Mature and Decline Phase, there is a contribution to cost anti-stickiness in Mature and Decline Phase, whereas there is a contribution to stickiness in Growth Phase to a percentage equivalent to the respective coefficient b5. Regarding Asset Intensity in Introduction, Growth, Mature and Shake-out Phase, there is a reduction in cost anti-stickiness to a percentage equivalent to the respective coefficient b6. As far as Employee Intensity in Growth, Mature and Decline Phase is concerned, there is a contribution to cost anti-stickiness in Growth and Mature Phase, whereas there is a contribution to cost stickiness in Decline Phase to a percentage equivalent to the respective coefficient b7.

Table 12: Operating expenses' stickiness and operating performance	Introduction Phase	Growth Phase	Mature Phase	Shake-out Phase	Decline Phase
b_0 : constant	0.013	0.007	0.041***	0.022	-0.044
	(0.28)	(0.44)	(3.50)	(0.70)	(-0.81)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.258***	0.48***	0.543***	0.522***	0.055
	(5.55)	(11.85)	(10.84)	(8.66)	(0.91)
<u>Two – Way Interaction Term</u>					
b_2 : $d_{i,t}*\log(Rev_{i,t}/Rev_{i,t-1})$	0.007	0.763**	1.333***	0.678**	0.149
	(0.05)	(1.97)	(4.18)	(2.23)	(1.00)
<u>Three – Way Interaction Terms</u>					
b_3 : $d_{i,t}*\log(Rev_{i,t}/Rev_{i,t-1})*ROE_t$	0.003	-0.098	0.008**	-0.014	-0.007
	(1.19)	(-0.56)	(2.14)	(-0.580)	(-0.49)
b_4: $d_{i,t}*\log(Rev_{i,t}/Rev_{i,t-1})*ds_{i,t}$	0.145*	-0.086	-0.237*	-0.070	0.095
	(1.80)	(-0.32)	(-1.82)	(-0.56)	(1.00)
b_5 : $d_{i,t}*\log(Rev_{i,t}/Rev_{i,t-1})*Growth_t$	-0.003	-0.062**	0.0429***	0.020	0.024*
	(-0.27)	(-2.21)	(2.92)	(1.25)	(1.82)
b_6 : $d_{i,t}*\log(Rev_{i,t}/Rev_{i,t-1})*\log(Assets_{i,t}/Rev_{i,t})$	-0.124***	-0.320**	-0.591***	-0.445***	-0.057
	(-2.69)	(-2.32)	(-7.02)	(-6.66)	(-0.92)
b_7: $d_{i,t}*\log(Rev_{i,t}/Rev_{i,t-1})*\log(Emp_{i,t}/Rev_{i,t})$	-0.083	0.239**	0.313***	0.078	-0.148***
	(-1.54)	(2.09)	(3.12)	(0.84)	(-3.31)
<u>Main Terms</u>					
b_8: $d_{i,t}$ (Decrease_Dummy$_{i,t}$)	-0.047*	0.007	0.021**	0.020	0.003
	(-1.89)	(0.38)	(2.42)	(1.43)	(0.10)
b_9: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.016	-0.101***	-0.054***	-0.040**	-0.044
	(-0.54)	(-3.45)	(-4.66)	(-2.23)	(-1.51)
b_{10}: $Growth_t$	0.003	-0.006***	-0.005***	-0.0005	0.001
	(1.02)	(-3.36)	(-3.27)	(-0.23)	(0.59)
b_{11}: $\log(Assets_{i,t}/Rev_{i,t})$	0.013	-0.019**	-0.030***	-0.037**	0.028
	(0.97)	(-2.01)	(-5.1)	(-2.47)	(0.95)
b_{12}: $\log(Emp_{i,t}/Rev_{i,t})$	-0.021	-0.020***	0.005	-0.001	-0.026
	(-1.33)	(-3.13)	(1.02)	(-0.10)	(-1.25)

b13 : ROEt	-0.0000125	0.002	0.0004*	-0.009**	-0.003
	(-0.04)	(0.40)	(1.87)	(-2.34)	(-0.54)
Number of Observations	849	3,586	3,936	942	492
Adj. R-Squared	0.269	0.217	0.274	0.409	0.337

Notes:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log\frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_0 + \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * ROEt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decrease i,t + \beta_5 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The life cycle model, introduced by the main study of Dickinson (2011) concerns the methodology used in order to define the stages of a business life cycle by using cashflows. The eight possible cash flow combinations correspond to the five distinct life cycle stages as follows:

Introduction Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Growth Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Mature Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities

Shake-out Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

Decline Phase: Negative CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Negative CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

The operating performance is measured by the proxies Return on Equity and Return on Assets.

Return on Equity refers to the net income of a firm divided by shareholders' equity.

Return on Assets refers to net income of a firm divided by total assets.

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$

In order to examine cost stickiness in shipping firms in 5 different life cycle stages, consecutive multiple regression analyses have been conducted for every life cycle stage to test if the seven independent variables significantly predict operating expenses. The main results of the multiple regression analysis for the introduction phase indicate that the seven predictors can explain 30.34 % of the total variance (R^2= .3034, F(13, 778) = 36.31, p<0.01), whereas for the growth phase the existing model can predict 39.32 % of the total variance (R^2= .3932, F(13, 1504) = 136.48, p<0.01). For the mature phase, the existing model can predict 39.11 % of the total variance (R^2= .3911, F(13, 1320) = 145.21, p<0.01), whereas for the shake-out phase the existing model can explain 46.35 % of the total variance (R^2= .4635, F(13, 871) = 70.96, p<0.01). For the decline phase a percentage of 40.47 % is indicative of the predictability of the model (R^2=.4047, F (13, 522) = 34.54, p<0.01).

Table 13 presents the results of the regression analysis conducted to measure operating expenses' stickiness and operating performance (ROA).

In the case of Growth and Mature Phase, the estimated value of b2 is significant and positive, providing strong support for an asymmetric cost behavior pattern, that of operating expenses' anti-stickiness. As for the Introduction, Shake-out and Decline phase, the value of b3 is significant, claiming a correlation between operating expenses' stickiness and ROA (operating performance). This interrelation implies that an increase in the term that includes ROA (operating performance), leads to an increase in operating expenses' anti-stickiness by a percentage equivalent to the respective coefficient b3.

As for the variable growth in Mature and Shake-out Phase, there is a contribution to cost anti-stickiness by a percentage equivalent to the respective coefficient b5. Regarding Asset Intensity in all Phases, there is a reduction in cost anti-stickiness to a percentage equivalent to the respective coefficient b6. As far as Employee Intensity is concerned, there is a contribution to cost anti-stickiness in Growth and Mature Phase, whereas there is a contribution to cost stickiness in Introduction and Decline Phase to a percentage equivalent to the respective coefficient b7.

Table 13: Operating expenses' stickiness and operating performance	Introduction Phase	Growth Phase	Mature Phase	Shake-out Phase	Decline Phase
b_0 : constant	0.043	0.027**	0.045***	-0.013	0.001
	(1.56)	(2.51)	(4.25)	(-0.560)	(0.032)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.285***	0.524***	0.516***	0.624***	0.166***
	(6.58)	(15.41)	(6.98)	(10.54)	(2.91)
<u>Two – Way Interaction Term</u>					
b_2 : $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})$	-0.108	1.286***	1.040***	0.223	0.045
	(-1.35)	(7.98)	(4.11)	(1.03)	(0.19)
<u>Three – Way Interaction Terms</u>					
b_3 : $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*ROAt$	0.009***	0.102	-0.016	0.202**	-0.004***
	(3.07)	(1.18)	(-0.07)	(2.21)	(-2.67)
b_4: $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*$ $ds_{i,t}$	0.211***	0.105	-0.131	-0.079	-0.014
	(2.78)	(0.68)	(-1.21)	(-0.73)	(-0.12)
b_5 : $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*$ $Growth_t$	-0.013	0.010	0.041***	0.033**	0.015
	(-0.90)	(0.46)	(3.54)	(2.31)	(1.04)
b_6 : $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*\log(Assets_{i,t}/Rev_{i,t})$	-0.096***	-0.694***	-0.534***	-0.477***	-0.098*
	(-2.88)	(-9.26)	(-7.17)	(-5.74)	(-1.68)
b_7: $d_{i,t}$ $*\log(Rev_{i,t}/Rev_{i,t-1})*\log(Emp_{i,t}/Rev_{i,t})$	-0.086**	0.202***	0.174*	-0.080	-0.207***
	(-2.41)	(3.58)	(1.92)	(-1.17)	(-2.87)
<u>Main Terms</u>					
b_8: $d_{i,t}$ (Decrease_Dummy$_{i,t}$)	-0.073***	0.009	0.007	0.033***	-0.010
	(-4.53)	(0.84)	(0.83)	(2.78)	(-0.42)
b_9: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	0.008	-0.068***	-0.047***	-0.047***	-0.063**
	(0.44)	(-3.87)	(-5.21)	(-3.20)	(-2.43)
b_{10}: $Growth_t$	0.004*	-0.002*	-0.003***	0.002	0.001
	(1.91)	(-1.91)	(-2.850)	(1.09)	(0.58)
b_{11}: $\log(Assets_{i,t}/Rev_{i,t})$	0.014	-0.034***	-0.030***	-0.029**	0.028
	(1.47)	(-5.28)	(-5.78)	(-2.54)	(1.41)
b_{12}: $\log(Emp_{i,t}/Rev_{i,t})$	-0.009	-0.016***	0.001	-0.009	-0.017
	(-0.87)	(-3.83)	(0.29)	(-1.13)	(-1.11)
b_{13}: $ROAt$	0.006**	-0.367***	-0.176***	-0.0003	-0.008**

	(2.51)	(-9.48)	(-6.06)	(-0.03)	(-2.28)
Number of Observations	1,886	6,483	6,375	1,825	1,054
Adj. R-Squared	0.303	0.393	0.391	0.464	0.405

Notes:

The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

This table presents the results of the regression analysis of the estimated model:

$$log \frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_0 + \beta_1 * log \frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * ROAt + \beta_4 * \text{Decrease\_Dummy}_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decreasei,t + \beta_5 * Decrease\_Dummy_{i,t} * \log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_6 * Decrease\_Dummy_{i,t} * log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log \frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_7 * Decrease\_Dummy_{i,t} * log \frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log \frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

The life cycle model, introduced by the main study of Dickinson (2011) concerns the methodology used in order to define the stages of a business life cycle by using cashflows. The eight possible cash flow combinations correspond to the five distinct life cycle stages as follows:

Introduction Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Growth Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Positive CF from Financing Activities

Mature Phase: Positive CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities

Shake-out Phase: Negative CF from Operating Activities, Negative CF from Investing Activities, Negative CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Positive CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

Decline Phase: Negative CF from Operating Activities, Positive CF from Investing Activities, Positive CF from Financing Activities or Negative CF from Operating Activities, Positive CF from Investing Activities, Negative CF from Financing Activities

The operating performance is measured by the proxies Return on Equity and Return on Assets.

Return on Equity refers to the net income of a firm divided by shareholders' equity.

Return on Assets refers to net income of a firm divided by total assets.

Return on Equity = $\frac{Net\ Income}{Average\ Total\ Equity}$

Return on Assets = $\frac{Net\ Income}{Average\ Total\ Assets}$

5.6 Comparison of Shipping, Construction and Transportation Firms in terms of Asymmetric Cost Behavior

On this subchapter, the results of the regression analysis conducted in order to measure SG&A cost stickiness in Construction and Transportation Sector are presented in tables 14 and 15. The results of the multiple regression analysis for the Construction sector indicate that the six predictors can explain 41.59 % of the total variance (R^2=.4159, F (11, 101) = 42.65, p<0.01). The findings of the multiple regression analysis for the Transportation sector indicate that the six predictors can explain 48.88 % of the total variance (R^2=.4888, F(11,156) = 100.32, p<0.01).

Table 14 demonstrates the results of the regression analysis conducted in order to estimate SG&A cost stickiness in Construction and Transportation firms.

For the Construction Sector, the estimated value of b1 is 0.515, indicating that SG&A costs generally increase (decrease) by 0.515%, after a percentage increase (decrease) in sales revenue. The estimated value of b2 is insignificant, providing strong support for a symmetrical cost behavior pattern.

For the Transportation Sector, the estimated value of b2 is significant, providing strong support for an asymmetric cost behavior pattern, that of cost stickiness. The estimated value of b1 is 0.715, indicating that SG&A costs generally increase by 0.715 %, after a percentage increase in sales revenue and generally decrease by 0.2% (b1+b2), after a percentage decrease in sales revenue. As far as employee intensity is concerned, there is a contribution to cost stickiness by 0.335 %.

Table 14: SG&A cost stickiness

	Construction Sector	Transportation Sector
b_0 : constant	0.058*	0.007
	(1.87)	(0.34)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.515***	0.715***
	(3.30)	(17.34)
<u>Two – Way Interaction Term</u>		
b_2 : $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1})$	-0.041	-1.079***
	(-0.14)	(-3.61)
<u>Three – Way Interaction Terms</u>		
b_3: $d_{i,t} * \log(Rev_{i,t}/Rev_{i,t-1}) * ds_{i,t}$	0.002	0.175**
	(0.01)	(2.26)

b_4 : $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)* $Growth_t$	0.017	0.016
	(0.62)	(0.67)
b_5 :$d_{i,t}$*log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Assets_{i,t}$/$Rev_{i,t}$)	-0.119	0.065
	(-0.95)	(0.42)
b_6: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Emp_{i,t}$/$Rev_{i,t}$)	-0.008	-0.335***
	(-0.08)	(-3.06)
Main Terms		
b_7: $d_{i,t}$ (Decrease_Dummy$_{i,t}$)	0.001	-0.007
	(0.063)	(-0.59)
b_8: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.044*	-0.009
	(-1.82)	(-0.77)
b_9: $Growth_t$	0.0008	-0.0003
	(0.36)	(-0.27)
b_{10}: log($Assets_{i,t}$/$Rev_{i,t}$)	0.008	-0.011
	(0.29)	(-1.39)
b_{11}: log($Emp_{i,t}$/$Rev_{i,t}$)	0.012	0.0006
	(1.39)	(0.07)
Number of Observations	1,101	1,415
Adj. R-Squared	0.416	0.489

Notes:
The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.
This table presents the results of the regression analysis of the estimated model:

$$log\frac{SG\&A_{i,t}}{SG\&A_{i,\ t-1}} = \beta_{0+}\ \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * \textit{Successive Decrease}_{i,t} + \beta_4 * \textit{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_5 * \textit{Decrease\_Dummy}_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_6 * \textit{Decrease\_Dummy}_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

In order to investigate into cost stickiness in construction and transportation firms, multiple regression analyses has been conducted respectively to test if the six independent variables significantly predict operating expenses. The results of the multiple regression analysis for the Construction sector indicate that the six predictors can explain 72.63 % of the total variance (R^2=.7263, F(11, 106) = 240.99, p<0.01). The findings of the multiple regression analysis for the Transportation sector indicate that the six predictors can explain 79.16% of the total variance (R^2=.7916, F(11, 192) = 270.99, p<0.01).

Table 15 demonstrates the results of the regression analysis conducted in order to estimate operating expenses' stickiness in Construction and Transportation firms.

For the Construction Sector, The estimated value of b1 is 0.630, indicating that operating expenses generally increase (decrease) by 0.63%, after a percentage increase (decrease) in sales revenue. The estimated value of b2 is insignificant, providing strong support for a symmetrical cost behavior pattern.

For the Transportation Sector, the estimated value of b2 is significant, providing strong support for an asymmetric cost behavior pattern, that of cost stickiness. The estimated value of b1 is 0.661, indicating that operating expenses generally increase by 0.661 %, after a percentage increase in sales revenue and decrease by 0.044%, after a percentage decrease in sales revenue. As for the variable growth, there is a reduction of cost stickiness by 0.026%. As far as employee intensity is concerned, there is a contribution to cost stickiness by 0.266%.

Table 15: Operating expenses stickiness

	Construction Sector	Transportation Sector
b_0 : constant	0.061**	0.014
	(2.54)	(0.62)
b_1: $\log(Rev_{i,t}/Rev_{i,t-1})$	0.630***	0.661***
	(4.41)	(5.65)
<u>Two – Way Interaction Term</u>		
b_2 : $d_{i,t}$ * $\log(Rev_{i,t}/Rev_{i,t-1})$	-0.215	-0.617**
	(-1.03)	(-2.14)
<u>Three – Way Interaction Terms</u>		
b_3: $d_{i,t}$ * $\log(Rev_{i,t}/Rev_{i,t-1})$* $ds_{i,t}$	0.079	0.129
	(0.54)	(1.31)
b_4 : $d_{i,t}$ * $\log(Rev_{i,t}/Rev_{i,t-1})$* $Growth_t$	0.037	0.026***
	(1.45)	(3.07)

b_5: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Assets_{i,t}$/$Rev_{i,t}$)	-0.098	-0.014
	(-1.32)	(-0.21)
b_6: $d_{i,t}$ *log($Rev_{i,t}$/$Rev_{i,t-1}$)*log($Emp_{i,t}$/$Rev_{i,t}$)	-0.0680	-0.266***
	(-1.34)	(-2.67)
<u>Main Terms</u>		
b_7: $d_{i,t}$ (Decrease_Dumm$y_{i,t}$)	-0.033**	-0.024***
	(-2.25)	(-2.85)
b_8: $ds_{i,t}$ (Successive Decrease$_{i,t}$)	-0.02	0.004
	(-1.40)	(0.56)
b_9: $Growth_t$	0.003*	0.002**
	(1.93)	(2.36)
b_{10}: log($Assets_{i,t}$/$Rev_{i,t}$)	0.018	-0.012**
	(1.07)	(-2.32)
b_{11}: log($Emp_{i,t}$/$Rev_{i,t}$)	0.013**	0.00013
	(2.41)	(0.02)
Number of Observations	1,245	2,233
Adj. R-Squared	0.726	0.792

<u>Notes</u>:
The table presents coefficients and the associated t-statistics (in parentheses).

*, **, *** Denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.
This table presents the results of the regression analysis of the estimated model:

$$log\frac{OPEX_{i,t}}{OPEX_{i,\ t-1}} = \beta_{0+}\ \beta_1 * log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} + \beta_2 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} + \beta_3 * \text{Decrease\_Dummy}_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,\ t-1}} * Successive\ Decrease_{i,t} + \beta_4 * Decrease\_Dummy_{i,t} * \log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * Growth_{i,t} + \beta_5 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Assets_{i,t}}{Revenue_{i,t}} + \beta_6 * Decrease\_Dummy_{i,t} * log\frac{Revenue_{i,t}}{Revenue_{i,t-1}} * log\frac{Employees_{i,t}}{Revenue_{i,t}} + \varepsilon_{i,t}$$

Following Petersen's (2009) methodology, the model is estimated by using firm-clustered standard errors to control for autocorrelation and heteroscedasticity.

Following the above analysis, two sample T-tests referring to the samples of Shipping Sector-Construction Sector and Shipping Sector-Transportation Sector for the variables SG&A expenses, operating expenses, total revenue are executed. There is not a significant difference in SG&A expenses between Shipping Sector (M = 155.51, SD = 919.0031) and Construction Sector (M = 176.502, SD = 327.2444); t

(24977) = -.849, *p* = .395. However, a significant difference in SG&A cost is reported between Shipping Sector (*M* =155.51, *SD* = 919.0031) and Transportation Sector (*M* = 176.5, *SD* = 327.24); *t* (25485) = -16.98, *p* <.00001.

There is not a significant difference in operating expenses between Shipping Sector (*M* = 1363.96, *SD* = 6759.39) and Construction Sector (*M* = 1494.581, *SD* = 2698.259); *t* (30394) = -.7609, p =.4467. A significant difference in operating expenses is reported between Shipping Sector (*M* = 1363.96, *SD* = 6759.39) and Transportation Sector (*M* = 4221.2, *SD* = 7716.849); *t* (31712) = -21.3449, *p* <.00001.

There is not a significant difference in total revenues between Shipping Sector (*M* = 1888.236, *SD* = 8579.901) and Construction Sector (*M* = 1640.947, *SD* = 3085.519); *t* (32698) = 1.1365, *p* = .255756. However, there is a significant difference in total revenues between Shipping Sector (*M* = 1888.236, *SD* = 8579.901) and Transportation Sector (*M* = 4970.66, *SD* = 8861.55); *t* (34015) = -18.40, *p* < .00001.

6TH CHAPTER

DISCUSSION

On this chapter, the results of the current study are analytically discussed. Firstly, the results for the asymmetric cost behavior of the shipping firms are canvassed, as well as cost asymmetry across different life cycle stages. What is more, the findings for the relationship between cost stickiness and operating performance in shipping firms are further elaborated. An analysis on cost stickiness and operating performance across different life cycle stages is also discussed. Furthermore, analyses and comparisons between the Shipping, Construction and Transportation Sector are further conversed. The findings of the current study are compared to those of other similar studies, where similarities and differences are observed, which could be proven fruitful and useful for the shipping industry. Lastly, the conclusions of the current study are reported, as well as the restrictions of the research and the propositions for further research.

6.1 Asymmetric Cost Behavior of Shipping Firms

On this subchapter, the results of the asymmetric cost behavior of shipping firms are discussed and analyzed in a thorough way, with a connection being made with the results of related research in the literature. As far as SG&A cost stickiness in shipping firms is concerned, the current study shows that shipping firms generally exhibit symmetric cost behavior. However, patterns of asymmetric cost behavior are observed for several life cycle stages, as the value of b_2 is statistically significant for these stages. This finding comes partly in contradiction with the initial hypothesis of our study, that shipping firms generally exhibit asymmetric cost behavior across the life cycle, as a result of managerial decisions in resource handling with different levels of business activity. Another study (Weidenmier & Subramaniam, 2003) that is conducted on the asymmetric cost behavior of firms with high levels of tangible assets and inventories, concludes that these firms usually exhibit asymmetric cost behavior, a finding partly in contradiction to the finding of the current study. These discrepancies in the research of Weidenmier and Subramaniam (2003) and the current study are probably explained by the possibility or not of timely managerial decisions in resource handling, according to the phase of shipping cycle that every shipping company is.

The statistically significant estimated value of b_1 reveals that SG&A costs generally increase (decrease) by 0.255%, after a percentage increase (decrease) in sales revenue. The positive value of b1 is expected, since there is generally an increase in SG&A costs, after an increase in revenues and a decrease in SG&A costs, after a decrease in revenues. The statistically significant value of b_5 indicates that an increase in the term Asset Intensity contributes to SG&A cost stickiness. The significant value of b_6 shows an increase in the term Employee Intensity leads to an increase in SG&A cost stickiness.

As far operating expenses' stickiness is regarded, a pattern of symmetrical cost behavior is generally observed, as the value of b_2 is not statistically significant. However, patterns of asymmetric cost behavior are observed for several life cycle stages, as the value of b_2 is statistically significant for these stages. This finding also comes partly in contrast with the initial hypothesis of the study, that shipping firms show asymmetric cost behavior. This tendency for asymmetric cost behavior in some life cycle stages can possibly be explained by the inability of shipping firms to always make prompt and fruitful managerial decisions in resource handling according to the volatility of the shipping market, as the firms pass through the life cycle stages.

The statistically significant estimated value of b_1 reveals that operating expenses generally increase (decrease) by 0.432%, after a percentage increase (decrease) in sales revenue, a generally expected result. The statistically significant value of b_5 (Asset Intensity) indicates a contribution to operating expenses' stickiness. The significant value of b_6 shows that an increase in the term Employee Intensity leads to operating expenses' stickiness.

6.2 Cost Asymmetry across Different Life Cycle Stages

On this subchapter, the asymmetric cost behavior of SG&A costs as well as operating expenses across different life cycle stages is discussed, along with the connection points with the existing literature. Concerning SG&A cost asymmetry across the life cycle, statistically significant findings are observed for several life cycle phases. This result is in accordance to the initial hypothesis of the current study, that cost asymmetry fluctuates across different life cycle stages. For the first life cycle phase, the introduction phase, there is a statistically significant estimated value of b_1 revealing that SG&A cost increase (decrease) by 0.156% after a percentage increase (decrease) in sales revenue. No pattern of asymmetric cost behavior is observed, since the value of b_2 is not statistically significant, claiming a rather symmetrical cost behavior.

For the second life cycle phase, the growth phase, the value of b_2 is statistically significant, a finding that indicates an asymmetric cost behavior pattern, that of SG&A cost anti-stickiness. The significant value of b_1 suggests that SG&A cost increase by .321% after a 1% increase in sales revenue and decrease by .861% (b1+b2) after a 1% decrease in sales revenue. The statistically significant value of Asset Intensity indicates a reduction in SG&A cost anti-stickiness. The significant value of Employee Intensity shows a contribution to SG&A cost anti-stickiness.

The third life cycle phase, the mature phase, shows statistically significant results. The statistically significant value of b_2 indicates an asymmetric cost behavior pattern of SG&A cost anti-stickiness. The significant value of b_1 suggests that SG&A cost increase by .339% after a 1% increase in sales revenue and decrease by .721% after a 1% decrease in sales revenue. The statistically significant value of the variable growth indicates a contribution to SG&A cost anti-stickiness. The significant value of Asset Intensity indicates a reduction in SG&A cost anti-stickiness. The significant value of Employee Intensity shows a contribution to SG&A cost anti-stickiness.

The fourth life cycle stage, the shake-out phase is characterized by an asymmetric cost behavior pattern of SG&A anti-stickiness, as the value of b_2 is statistically significant. The significant value of b_1 suggests that SG&A cost increase by 0.322% after a 1% increase in sales revenue and decrease by .696% after a 1% decrease in sales revenue. The statistically significant value of Asset Intensity indicates a reduction in SG&A cost anti-stickiness.

The 5th life cycle stage, the decline phase is characterized by a rather symmetrical cost behavior pattern, as the value of b2 is not statistically significant.

The results of another study (Zisis and Naoum, 2021) show that in the introduction and growth phase, SG&A costs show cost stickiness, whereas in the mature and decline phase an anti-stickiness pattern is reported. The shake-out phase is characterized by a symmetrical cost pattern. This result comes partly in contradiction to the result of the current study, as the growth and shake-out phase are characterized by anti-stickiness cost patterns, whereas the introduction and the decline phase are characterized by symmetrical cost patterns. These contradictory results can possibly be explained by the different managerial decisions of shipping firms led by the tremendous volatility of the market, the phase of shipping cycle and the life cycle stage of the firm.

As far as operating expenses' cost behavior across life cycle stages is concerned, there are statistically significant findings for several life cycle phases. This result is also in accordance to the initial hypothesis of the current study, where asymmetric cost behavior fluctuates across the life cycle.

For the first life cycle stage-introduction phase- an asymmetric cost behavior pattern is observed, that of cost stickiness, as the value of b2 is statistically significant. The significant value of b_1 suggests that operating expenses increase by .277 % after a 1% increase in sales revenue and decrease by .044% after a 1% decrease in sales revenue. The statistically significant values of Asset Intensity and Employee Intensity contribute to operating expenses' stickiness.

The second life cycle stage – growth phase- is characterized by an asymmetric cost behavior pattern of cost anti-stickiness, as the value of b2 is statistically significant. The significant value of b_1 suggests that operating expenses increase by .529 % after a 1% increase in sales revenue and decrease by 1.545% after a 1% decrease in sales revenue. The statistically significant value of Asset Intensity leads to reduction in operating expenses' anti-stickiness. The significant value of Employee Intensity contributes to operating expenses' anti-stickiness.

The third life cycle stage – mature phase- is characterized by an asymmetric cost behavior pattern -that of cost anti-stickiness- as the value of b2 is statistically significant. The significant value of b_1 suggests that operating expenses increase by .502 % after a 1% increase in sales revenue and decrease by 1.489% after 1% decrease in sales revenue. The statistically significant value of Asset Intensity leads to a slight reduction in operating expenses' anti-stickiness. The significant value of Employee Intensity makes a contribution to operating expenses' anti-stickiness.

The fourth life cycle stage – shake-out phase- is characterized by a rather symmetrical cost behavior pattern, as the value of b2 is not statistically significant.

The significant value of b_1 suggests that operating expenses increase (decrease) by .624 % after a 1% increase (decrease) in sales revenue. There is a small contribution to operating expenses' stickiness by Asset Intensity.

The fifth life cycle stage – decline phase- is characterized by a rather symmetrical cost behavior pattern, as the value of b2 is not statistically significant. The significant value of b_1 suggests that operating expenses increase (decrease) by .173% after a 1% increase (decrease) in sales revenue. The significant value of Employee Intensity makes a slight contribution to operating expenses' stickiness.

The results of another study (Naoum, Ntounis & Vlismas, 2020) support that the shipping companies tend to show sticky cost behavior when managers tend to make adjustments for resources faster when revenues decrease, than they do when revenues increase.

In the introduction phase, revenues are not usually stable and exhibit fluctuations, a fact that leads to resource adjustment by managers and contributing to sticky cost behavior. In the growth phase, revenues are growing at a rapid pace and in the mature phase revenues are growing at a slower pace than that of growth, leading to fewer adjustments in terms of assets and resources. These facts can partially explain the asymmetric cost behavior of operating expenses in the first, second and third life cycle stage.

6.3 Cost Stickiness and Operating Performance in Shipping Firms

On this subchapter, the results of the asymmetric cost behavior and operating performance of shipping firms are discussed, with a connection being made with the results of related research in the literature. As far as SGA cost stickiness and operating performance (ROE) in shipping firms is generally concerned, no statistically significant relationship between the two variables is observed, as the value of b_3 is statistically insignificant. This result shows that an increase or decrease in ROE index shows no contribution to SG&A cost stickiness. This finding comes in contradiction to the initial hypothesis made for this research question, that of a negative relationship between stickiness and operating performance. The significant value of b_1 suggests that SG&A costs increase (decrease) by .235 % after a 1%

increase (decrease) in sales revenue. The statistically significant value of Asset Intensity contributes to SG&A cost anti-stickiness.

Regarding SG&A cost stickiness and operating performance (ROA) in shipping firms, no statistically significant relationship between the two variables is noticed, as the value of b3 is statistically insignificant. This result shows that an increase or decrease in ROA index shows no contribution to SG&A cost stickiness. This aforementioned finding is not in accordance to the initial hypothesis that stickiness and operating performance tend to have a negative relationship. The significant value of b_1 suggests that SG&A costs increase (decrease) by .257 % after a 1% increase (decrease) in sales revenue. The statistically significant value of Asset Intensity makes a small contribution to SG&A cost stickiness.

As far as operating expenses stickiness and operating performance (ROE) in shipping firms is concerned, no statistically significant relationship between the two variables is noticed, as the value of b_3 is statistically insignificant. This result shows that an increase or decrease in ROE index shows no contribution to operating expenses' stickiness. This result is unpredictable according to the initial research hypothesis, as a negative relationship between the two variables was initially expected. The significant value of b_1 suggests that operating expenses increase (decrease) by .405 % after a 1% increase (decrease) in sales revenue. The statistically significant values of Asset Intensity and Employee Intensity make a contribution to operating expenses' stickiness.

As far as operating expenses stickiness and operating performance (ROA) in shipping firms is concerned, no statistically significant relationship between the two variables is noticed, as the value of b_3 is statistically insignificant. This result shows that an increase or decrease in ROA index shows no contribution to operating expenses' stickiness. This result is unexpected according to the initial research assumption- a negative relationship between the two variables was hypothesized. The significant value of b_1 suggests that operating expenses increase (decrease) by .431% after a 1% increase (decrease) in sales revenue. The statistically significant values of Asset Intensity and Employee Intensity make a contribution to operating expenses' stickiness.

Another study (da Silva, da Silva Zonatto, Dal Magro & Klann, 2019) that examines the relationship between stickiness and operating performance, supports the findings that firm profitability and performance is influenced by sticky cost phenomenon and earnings management, a finding contradictory to the findings of the current study, where a neutral relationship between operating performance and stickiness is implied. This can be explained by the fact that operating performance is correlated with asymmetric cost behavior only for some life cycle stages and that the impact of operating performance on cost stickiness fluctuates across the life cycle.

6.4 Cost Stickiness and Operating Performance across Different Life Cycle Stages

On this subchapter, the results concerning the relationship between cost asymmetry and operating performance across different life cycle stages in shipping firms are discussed. As far as SG&A cost stickiness and operating performance (ROE) in shipping firms is concerned, significant findings are observed for several life cycle stages, specifically for the fifth life cycle stage. This finding is in accordance to the initial research assumption, whereas in other life cycle stages no other significant relationship between operating performance and cost asymmetry is observed.

For the first life cycle stage –the introduction phase- the significant value of b_1 suggests that SG&A costs increase (decrease) by .151% after a 1% increase (decrease) in sales revenue. The statistically significant value of Asset Intensity indicates a contribution to SG&A cost stickiness.

The second life cycle stage-the growth phase- is characterized by SG&A cost anti-stickiness ($b_2>0$). The statistically significant value of b_1 suggests that SG&A costs increase by .297% after a 1% increase in sales revenue and decrease by 1.048% after a 1% decrease in sales revenue. The statistically significant value of Asset Intensity indicates a contribution to SG&A cost stickiness, whereas the significant value of Employee Intensity makes a slight contribution to SG&A cost anti-stickiness.

For the third life cycle stage- the mature phase- an anti-stickiness pattern for SG&A cost is observed ($b_2>0$). The significant value of b_1 suggests that SG&A costs increase by .281% after a 1% increase in sales revenue and decrease by .694% after a 1% decrease in sales revenue. The significant value of variable growth shows a contribution to SG&A cost anti-stickiness, whereas the statistically significant value of Asset Intensity contributes to SG&A cost stickiness. The significant value of Employee Intensity shows a slight contribution to SG&A anti-stickiness.

For the fourth life cycle stage- the shake-out phase- an anti-stickiness pattern is observed (b_2>0). The significant value of b_1 suggests that SG&A costs increase by .22 % after a 1% increase in sales revenue and decrease by 1.168% after a 1% decrease in sales revenue. The statistically significant value of Asset Intensity contributes to a reduction in SG&A cost anti-stickiness, whereas the significant value of Employee Intensity shows a slight contribution to SG&A cost anti-stickiness.

For the fifth life cycle stage- the decline phase- an anti-stickiness cost model is implied (b_2>0). The significant value of b_1 suggests that SG&A costs increase by .187 % after a 1% increase in sales revenue and decrease by .247%. The statistically significant value of b3 along with the significant value of b13 indicate that an increase in index ROE by 1%, leads to a decrease in SG&A cost anti-stickiness by .017%. That finding indicates that an increase in operating performance measured by ROE, leads to a reduction in SG&A cost anti-stickiness. This finding is in accordance with the initial assumption that operating performance and asymmetric cost behavior tend to have a rather negative relationship.

As far as SG&A cost stickiness and operating performance (ROA) in shipping firms is concerned, significant findings are observed for several life cycle stages. This result is expected according to the initial research assumption, that cost stickiness is differently associated with operating performance across life cycle stages. Statistically significant results are observed for the Introduction and Mature Phase, where a positive relationship between operating performance and asymmetric cost behavior is implied.

For the first life cycle stage –the introduction phase- the significant value of b_1 suggests that SG&A costs increase (decrease) by .167% after a 1% increase (decrease) in sales revenue. The statistically significant value of b_{13} along with the significant value of b_3 implies that an increase in index ROA by 1%, leads to an increase in SG&A cost by .009%. This finding implies that an increase in operating performance leads to a contribution to SG&A cost anti-stickiness.

The second life cycle stage-the growth phase- is characterized by an anti-stickiness cost pattern. The statistically significant value of b_1 suggests that SG&A costs increase by .321 % after a 1% increase in sales revenue and decrease by .858% after a decrease in sales revenue. The statistically significant value of Asset Intensity contributes to a reduction in SG&A cost anti-stickiness.

For the third life cycle stage- the mature phase- is characterized by an anti-stickiness cost pattern. The significant value of b_1 suggests that SG&A costs increase by .335% after a 1% increase in sales revenue and decrease by .858% after a 1% decrease in sales revenue. The statistically significant value of b_{13} along with the significant value of b_3 imply that an increase in index ROA by 1%, leads to an increase in SG&A cost anti-stickiness by 0.165%. This finding indicates that an increase in operating performance measured by ROA leads to a contribution to the anti-stickiness SG&A cost pattern. The significant value of variable growth implies a contribution to SG&A cost anti-stickiness. The statistically significant value of Asset Intensity indicates a reduction in SG&A cost anti-stickiness, whereas the significant value of Employee Intensity makes a slight contribution to SG&A cost anti-stickiness.

For the fourth life cycle stage- the shake-out phase- an anti-stickiness cost pattern is observed. The significant value of b_1 suggests that SG&A costs increase by .323% after a 1% increase in sales revenue and decrease by 0.791%. The statistically significant value of Asset Intensity indicates a reduction in SG&A cost anti-stickiness.

For the fifth life cycle stage, there are no significant results. An unexpected, but statistically insignificant result ($b_1<0$) is observed. This is partly due to the small number of observations allocated at this stage (observations = 808).

As far as operating expenses' stickiness and operating performance (ROE) in shipping firms is concerned, significant findings are observed for several life cycle stages. This finding is partly expected according to the initial hypothesis. A positive relationship between operating performance and cost asymmetry is supported for the Mature Phase.

For the first life cycle stage –the introduction phase- the significant value of b_1 suggests that operating expenses increase (decrease) by .258% after a 1% increase (decrease) in sales revenue. The statistically significant value of Asset Intensity indicates a reduction in operating expenses' anti-stickiness.

For the second life cycle stage- the growth phase- an anti-stickiness cost pattern is observed. The significant value of b_1 suggests that operating expenses increase by .478% after a 1% increase in sales revenue and decrease by 1.243%. The significant value of variable growth implies a reduction in operating expenses' anti-stickiness. The statistically significant value of Asset Intensity indicates a reduction in operating expenses' anti-stickiness, whereas the significant value of Employee Intensity makes a slight contribution to operating expenses' anti-stickiness.

For the third life cycle stage- the mature phase- an anti-stickiness cost pattern is noticed. The significant value of b_1 suggests that operating expenses increase by .543 % after a 1% increase in sales revenue and decrease by 1.876%. The statistically significant value of b_{13} along with the significant value of b_3 implies that an increase in index ROE by 1%, leads to an increase in operating expenses' anti-stickiness by .008%. The significant value of variable growth implies a contribution to operating expenses' anti-stickiness. The statistically significant value of Asset Intensity indicates a reduction in operating expenses' anti-stickiness, whereas the significant value of Employee Intensity makes a slight contribution to operating expenses' anti-stickiness.

For the fourth life cycle stage- the shake-out phase- an anti-stickiness cost pattern is observed. The significant value of b_1 suggests that operating expenses increase by .522% after a 1% increase in sales revenue and decrease by 1.2%. The statistically significant value of Asset Intensity indicates a reduction in operating expenses' anti-stickiness.

For the fifth life cycle stage-the decline phase- the significant value of variable growth implies a contribution to operating expenses anti-stickiness, whereas the significant value of Employee Intensity makes a slight contribution to operating expenses' stickiness.

As far as operating expenses' stickiness and operating performance (ROA) in shipping firms is concerned, significant findings are observed for several life cycle stages. This finding is partly expected according to the initial research assumption.

For the Introduction and Shake-out Phase, a positive relationship between operating performance and cost asymmetry is implied, whereas for the Decline Phase, a negative relationship is suggested.

For the first life cycle stage –the introduction phase- the significant value of b_1 suggests that operating expenses increase (decrease) by .285 % after a 1% increase (decrease) in sales revenue. The statistically significant value of b_{13} along with the significant value of b_3 imply that an increase in index ROA by 1%, leads to an increase in operating cost by .009%. This finding suggests that an increase in operating performance, as measured by ROA, leads to a contribution to operating expenses' anti-stickiness pattern. The statistically significant values of Asset Intensity and Employee Intensity indicate a contribution to operating expenses' stickiness.

For the second life cycle stage- the growth phase- an anti-stickiness pattern is observed. The significant value of b_1 suggests that operating expenses increase by .524% after a 1% increase in sales revenue and decrease by 1.81% after a decrease in sales revenue. The statistically significant value of Asset Intensity indicates a reduction in operating expenses' anti-stickiness. The statistically significant value of Employee Intensity indicates a contribution to operating expenses' anti-stickiness.

For the third life cycle stage- the mature phase- is characterized by an anti-stickiness cost pattern. The significant value of b_1 suggests that operating expenses increase by .516% after a 1% increase in sales revenue and decrease by 1.556%. The significant value of variable growth implies a contribution to operating expenses' anti-stickiness. The statistically significant value of Asset Intensity indicates a reduction in operating expenses' anti-stickiness, whereas the significant value of Employee Intensity makes a slight contribution to operating expenses' anti-stickiness.

For the fourth life cycle stage- the shake-out phase- the significant value of b_1 suggests that operating expenses increase (decrease) by .624% after a 1% increase (decrease) in sales revenue. The statistically significant value of b_3 implies that an increase in index ROA by 1%, leads to an increase in operating expenses by .202%. This finding suggests an increase in operating performance, as measured by ROA, contributes to operating expenses' anti-stickiness. The significant value of variable growth implies a contribution to operating expenses' anti-stickiness. The statistically significant value of Asset Intensity indicates a contribution to operating expenses' stickiness.

For the fifth life cycle stage- the decline phase- the significant value of b_1 suggests that operating expenses increase (decrease) by .166% after a 1% increase (decrease) in sales revenue. The statistically significant value of b_{13} along with the significant value of b_3 imply that an increase in index ROA by 1%, leads to a decrease in operating expenses by .004%. This finding indicates that an increase in operating performance contributes to operating expenses' stickiness. The statistically significant value of Asset Intensity and Employee Intensity suggest a contribution to operating expenses' stickiness.

The statistically significant results of the current research query are in accordance with those of da Silva, da Silva Zonatto, Dal Magro and Klann (2019), where a relationship between firm profitability & performance, sticky cost phenomenon and earnings management is indicated.

6.5 Comparison of Shipping, Construction & Transportation Firms in terms of Asymmetric Cost Behavior

On this subchapter, a comparison between Shipping, Construction and Transportation firms in terms of asymmetric cost behavior is made. For the Construction sector, as far as SG&A and operating expenses' cost stickiness in Construction Sector is concerned, the study indicates. that asymmetric cost behavior is not observed, as the value of b_2 in both cases (SG&A and operating expenses) is not statistically significant. This finding comes in contrast with the initial hypothesis of our study, that Construction firms generally exhibit asymmetric cost behavior, as a result of managerial decisions in resource handling with different levels of business activity. However, this finding is probably explained under the fact that Construction firms tend to show asymmetric cost behavior under certain market conditions (reduced production) and life cycle stages. The study of Abdelhay, Youssef and Awad (2021) implies an asymmetric cost behavior only for the mature stage in case of SG&A cost. Other studies (Anderson, 2003) claim that Construction firms that are characterized by a high intensity of employees and assets tend to show asymmetric cost behavior especially in case of reduced production, when there is a need for downsize.

As far as SG&A costs in Transportation firms are concerned, the current study shows statistically significant results. The value of b_2 is statistically significant and negative, a finding that indicates an asymmetric cost behavior pattern-that of SG&A cost stickiness. This result is in accordance to the initial hypothesis of the study. The significant value of b_1 suggests that SG&A cost increase by .715% after a 1% increase in sales revenue and decrease by .364% after a 1% decrease in sales revenue. The significant value of Employee Intensity shows a contribution to SG&A cost stickiness.

Regarding operating expenses in Transportation firms, the study indicates anew statistically significant results. The value of b_2 is statistically significant and negative, a finding that indicates an asymmetric cost behavior pattern-that of operating expenses' stickiness. This result comes along with the initial assumption of the current study. The significant value of b_1 suggests that operating expenses increase by .661% after a 1% increase in sales revenue and decrease by .044% after a 1% decrease in sales revenue. The significant value of the variable growth shows a reduction in operating expenses' stickiness, whereas the significant value of Employee Intensity shows a contribution to operating expenses' stickiness. These results are in accordance to those of another study (Cannon, 2011) that claim that firms belonging to the air transportation industry exhibit sticky cost behavior as a result of managerial decisions in terms of resource handling.

Comparing the Shipping and Construction Sector in terms of Revenues, SG&A costs and operating expenses, no significant results are observed. However, by comparing the Shipping and Transportation Sector, significant results are noticed. A significant difference between the Shipping Sector and the Transportation Sector in operating expenses is observed, with those of Transportation Sector being more increased. A significant difference between the Shipping Sector and the Transportation Sector in SG&A costs is also noticed, with the SG&A costs of the Transportation sector being more increased. A significant difference between the Shipping Sector and the Transportation Sector in total revenues is also observed, with the total revenues of the Transportation sector being more augmented.

6.6 Conclusions

The current study uses panel data to show that generally shipping firms do not exhibit asymmetric cost behavior in terms of SG&A cost and operating expenses. Asymmetric cost behavior patterns are only reported for several life cycle stages. The stages that are characterized by an asymmetric cost pattern in case of SG&A cost (anti-stickiness pattern) are the Growth, Mature and Shake-out Phase, whereas in case of operating expenses the stages that exhibit an asymmetric cost behavior are the Introduction (stickiness pattern), Growth and Mature Phase (anti-stickiness pattern).

As far as operating performance and asymmetric cost behavior is concerned, the current study demonstrates that generally their correlation is not statistically significant both in case of SG&A and operating expenses for shipping firms. However, statistically significant relationships emerge for several life cycle stages.

For SG&A cost, there is a statistical significant relationship between operating performance (ROE) and asymmetric cost behavior in the Decline Phase, claiming that an increase in operating performance leads to a decrease in SG&A cost anti-stickiness. Statistically significant results are observed for the Introduction and Mature Phase, where a positive relationship between operating performance (ROA) and asymmetric cost behavior in SG&A cost is implied. For the Introduction and Mature Phase, there is a contribution to SG&A cost anti-stickiness.

For Operating expenses, a positive relationship between operating performance (ROE) and cost asymmetry is supported for the Mature Phase, implying that an increase in index ROE contributes to operating expenses' anti-stickiness. Statistically significant results are reported for the Introduction and Shake-out Phase, where a positive relationship between operating performance and cost asymmetry is implied, whereas for the Decline Phase, a negative relationship is suggested. This finding suggests that in case of Introduction and Shake-out Phase, an increase in operating performance, as measured by ROA, leads to a contribution to operating expenses' anti-stickiness pattern, whereas in case of the Decline Phase leads to a contribution to operating expenses' stickiness pattern.

For the Construction sector, as far as SG&A and operating expenses' cost stickiness in Construction Sector is concerned, the current study indicates no statistically significant results. As far as SG&A costs in Transportation firms are concerned, the current study shows statistically significant results, indicating an asymmetric cost behavior pattern-that of SG&A cost stickiness.

Comparing the Shipping and Transportation Sector, significant results are observed. Significant differences between the Shipping Sector and the Transportation Sector in operating expenses, revenues and SG&A cost are observed, with those of Transportation Sector being more increased than the Shipping Sector. These results could be fruitful for managers of shipping firms in order to make decisions based on cost asymmetry according to the life cycle stage that the firm currently is.

6.7 Restrictions and Propositions for Further Research

Each and every research is subject to some restrictions of methodological nature. Restrictions are a useful part of scientific research, since they define the current study and stand as a motive for potential future scientists to further investigate an issue of academic interest in a different and more thorough way.

This Msc. Thesis is restricted by the fact that the sample for the main hypotheses is limited to firms of shipping and parallel shipping sectors. Future studies could include a larger sample of firms of various sectors of economic activity, where various combinations and comparisons could be made.

Furthermore, the sample used in this study is quite small in terms of observations. Future studies could include larger samples in terms of observations in order for the cost asymmetry phenomenon to be studied more thoroughly. The panel data of the current study are also restricted to a time period of 30 years (1992-2022). A further examination of sticky cost phenomenon in previous years of economic activity could be as well a fruitful research decision.

The life cycle stages that are used for the research purposes of this study are 5: introduction, growth, mature, shake-out and decline. Future research could include other models of life cycle analysis and make a comparison between the results of the current life cycle model and the alternative ones. What is more, operating performance is measured in this study by the two proxies ROE and ROA. Further research could incorporate other measures of operating performance in order to examine the relationship between sticky cost analysis and operating performance.

Lastly, the research notions used in this study could be combined with other variables in order to shed more light into the different perspectives of asymmetric cost behavior and operating performance through the life cycle stages.

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