Erasmus University Rotterdam

MSc in Maritime Economics and Logistics

2009/2010

Comparative Feasibility Investment Study between Newly Built and Second Hand Post-Panamax Container Vessels

by

Donald-Wayne Austin Jr.

Acknowledgements

I would like to thank my Thesis Supervisor in the Laboratory for Maritime Transport, in the School of Naval Architecture and Marine Engineering, in the National Technical University of Athens, Dr. D. V. Lyridis contributing and supporting me to conduct this study, as well as the director and founder of the department of Maritime Economics and Logistics, Dr. H. Haralambides providing his confidence about the topic and his guidance throughout the year.

It would be unfair to forget all the representatives of major shipping companies for their valuable assistance and confidential information.

Special thanks to my family and loved ones, without their full support and assistance, this work would have been impossible to complete.

Finally, I dedicate the thesis to my parents.

Donald-Wayne Austin Jr.

26-08-2010

Abstract

The aim of this study is to investigate the trends that appear in the Post-Panamax container vessel market. The objective of this dissertation is to forecast the NPV of newly built and second hand Post-Panamax containerships over a 10 year period. This will be done using a variety of mathematical models. The cash flows calculated are based on data provided from well known shipping firms in the industry. More specifically, information on delivery prices, operation expenses and time-charter rates for different sizes of Post-Panamax container vessels. The study is composed of three cases: newly built Post-Panamax container vessels, second hand five year old Post-Panamax container vessels and second hand ten year old Post Panamax containerships. The funding structure is based on best practice used by top ranking shipping banks. In order to obtain more in-depth results, cash flows were calculated based on different interest rates, to mirror the high volatility of the factor. The loan duration is ten years with twenty equal installments. The balloon payment is amortized periodically together with the principal payment at the end of the decade. Following the calculation of the discount rate, the NPV outcomes were compared to reach preliminary results for all cases. After the financial analysis, a risk-sensitivity analysis takes place in order to measure risk associated with each case. The risk analysis is based on twenty year spot earnings by applying thousands of iterations to reach significant results. Therefore, reliable conclusions were drawn, revealing that the ten year old second-hand Post-Panamax container vessels appear to yield higher returns to capital invested, regardless higher operating expenses compared to younger vessels.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ACP	Autoridad del Canal de Panama
APL	American President Lines
HDW	Howaldtswerke Deutsche Werft
ICTS	International Container Services Inc
IRR	Internal Rate of Return
NPV	Net Present Value
NRC	National Research Council
SIN	Shipping Intelligence Network
TEU	Twenty-Feet Equivalent Unit
ULCC	Ultra Large Container Carriers
UNCTAD	United Nations Conference on Trade and Development
WACC	Weighted Average Cost of Capital

Chapter 1. Introduction

1.1 Introduction

The box transportation is the section in the maritime industry with a constant rapid growth and is directly associated with key changes in world trade and world economy. No other industry is so deeply related with the globalization of world trade, counting canals and ports together with shippers, operators and shipowners (Payer, 2005).

From the early days containers entered the shipping market with Malcom McLean transforming the first portable container capable of being transferred by any mode, rail, vessel or truck, the growth of the sector increased rapidly allowing any type of innovation to be applied in the industry, (Hagel, Brown, Davison, 2008).

Since then, the container trade has expanded enormously all over the world developing the major routes, East-West and North-South trades. According to various studies it is estimated that by the end of 2010, 90% of the general cargo will be containerized (ICTSI, 2010).

Due to the vigorous effects of globalization, containerization and optimization of the whole network involving all transactions, movements, loading and discharging containers, the growth and development of these vessels kept on growing reaching high expectations, demanding constant increase of scale. As a result naval architects and classification societies have continuous work preparations in order to reach the requested global demand level (Prayer, 2005).

According to research done by Containerization International the TEU capacity grew 11% in five years from 2000 to 2005, of which 6% corresponds to containership growth. Moreover, container vessels increased to 7.5 million TEU since 1995 (Merge Global Reports, 2007) and the Post-Panamax size dominated the fleet with a share of over 25% compared to the total container fleet (Prayer, 2005).

The last 40 years the container trade has visit enormous changes and the size of the container vessels meet extremely high volumes, reaching 6,000 and 9,000 TEU capacity. These dimensions increase constantly, which allows naval architects to investigate new trends in designing new vessels as well as assessing port locks and port depths.

The first Post-Panamax containerships were introduced in the mid 80's from the engineers of HDW German shipyard to deliver to the American President Lines (APL), (Svendsen & Tiedemann, 2006). Since then, the most well known shipyards of Asia adopted the above techniques to construct more vessels of this size.

The growth of containerized boxes which is expected to maintain the past 20 years trend, heeling from 2009 crisis, receives essential changes. Thus, in order to get organized for the upcoming years and still continue to be commercially accepted, all key aspects of the industry, vessels and ports are pre plotted and designed in such a way to accustom this unique size. This refers specifically to the two major canals, Panama Canal and Suez Canal.

The dimensions, depth and breadth of the locks of the Panama Canal until now could accommodate Panamax Size vessels, not allowing Post-Panamax containers

to come through. The strategic location of the canal and the economic wealth it provides are the most important drivers influencing architects to expand the locks. According to ACP (Autoridad del Canal de Panama) in order for shipowners to reach economies of scale, the directors of the port authority have established a master plan in extending the locks of the canal to accept Post-Panamax size vessels, (ACP Reports, 2006).

All above factors are triggers that influenced me to conduct this study. The aim of this study is to compare and investigate which case (newly built or second-hand Post-Panamax containers) is considered as a more feasible, more profitable and less risky investment.

1.2 Research Questions

This study investigates the feasibility of such investments, based on different scenarios evaluating each case independently. In this regard, cash flow projections are the main aspect on which this dissertation is conducted. The aim of this study is to prove which case is more adequate, rejecting the more risky scenarios. The risk of each investment is assessed with multiple factors through a range of functions used in various risk analysis software packages.

During each recession period, as the current we live in, apart from pullbacks, opportunities are also created for global investors. If these opportunities are identified in time, they can bring significant benefits to the investors. Therefore, this study is conducted in order to identify these opportunities and reach specific conclusions. By analyzing a cash-flow of an investment from the moment the first signatures hit the table until the decommissioning of the ship, hopefully important conclusions will be obtained, that are consistent with the current picture of the Post-Panamax market, evaluating which sale or purchase could be considered as more profitable or not. The market that will be examined is the Post-Panamax market, which we will assume that operates on 10 year time charter market. The choice of the freight market is not random, but chosen because of the unpredictable nature of the spot market rates and the higher risk posed by vessels of this class. The results that will be obtained will be further examined based on historical market prices for this type of ship and historical freights for the same period. Additionally, in order for this study to yield more precise results the risk analysis of each case is examined not based on a 10 year time-charter market, but according to the last 20 year spot-earning market.

Furthermore, the choice of the size of the container vessels is not random. The Post-Panamax container vessels, as mentioned in the first section of the chapter, is a unique size, which needs to be further elaborated in order to investigate the trends that emerge from this spectacular size. This size was chosen due to its inimitable construction compared to Panamax Vessels, which studies similar to this one have already been examined. On the contrary Ultra Large Container Vessels which have entered the fleet since 2004, don't have sufficient data to complete such a feasibility study as their disadvantages and advantages have not yet been clear. Due to this reason the selection of Post-Panamax vessels is the more suitable choice, as they have been in the market already for approximately 15 years.

The basic research question of this study is the following:

Which investment is considered more profitable: a newly built or a second-hand Post-Panamax container vessel?

This dissertation, apart from the basic question, examines 3 other secondary questions:

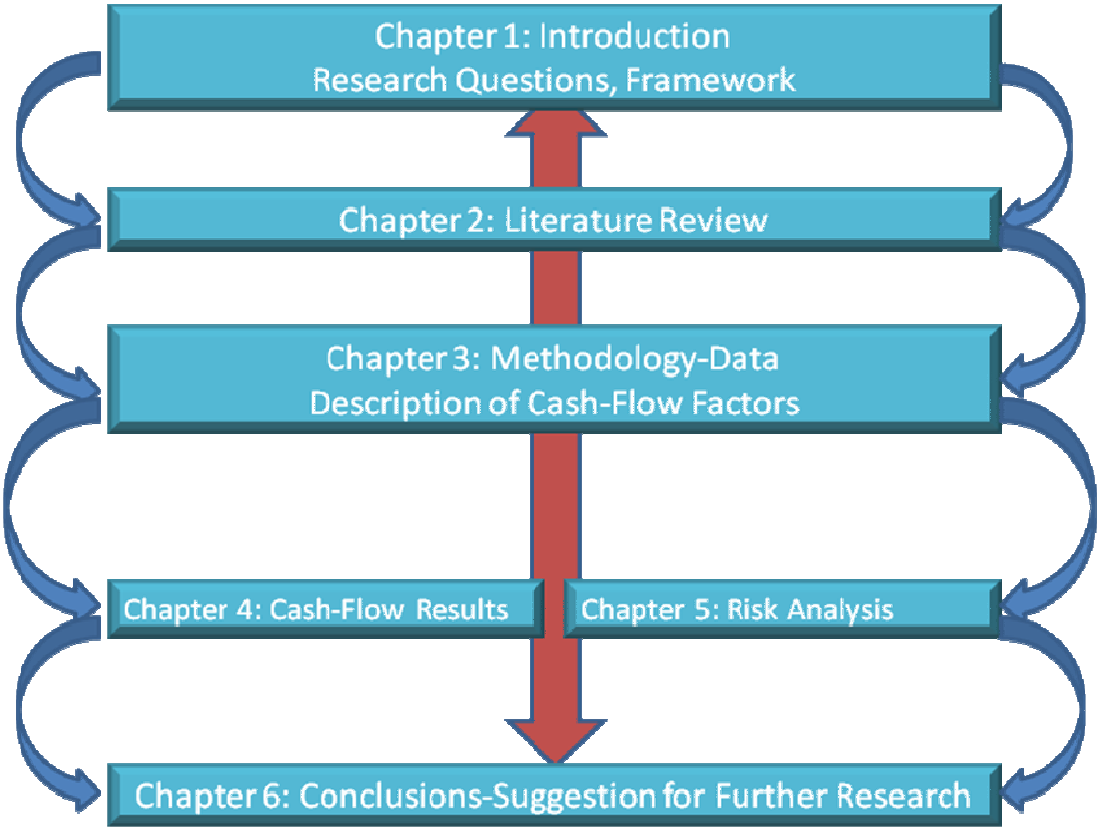
1. Which investment is considered more feasible: a 6,500 TEU vessel, an 8,500 TEU vessel or a 9,500 TEU Post-Panamax container vessel?
2. According to the volatility of the freight rates, how high could the level of risk be for such investments?
3. How could the risk be assessed for such investments, based on the fluctuations of the interest rate?

All research questions will be analyzed in the following chapters according to various combinations of cash-flows and then further assessed with the use of @Risk.

@RISK is a software used as an add-on for Microsoft Excel, capable in measuring and assessing the risk of various investments. This software has the ability to apply various iterations to several factors simultaneously, and obtaining histograms and graphs referring to the involved projects. (Palisade, 2010).

1.3 Thesis Structure

Figure: 1.3



Source: elaboration of the author

The thesis consists of six chapters. The Introduction presents the general outlay of the thesis justifying the choice of the topic. The second chapter, which is the literature review of this dissertation, outlines the structure of the shipping market, the shipping cycles, shipping investments and general information concerning financial issues. In addition, it describes the generations of containerships and discusses the market analysis of container vessels. This chapter concludes by analyzing the risks associated with such investments and describes the different factors from which shipowners generate income through adequate management and determines the operating structure of a shipping company. Chapter three describes the methodology used in the thesis and presents the data used to elaborate the cash flows. Therefore, the definitions of all concepts that describe a shipping investment are explained in this chapter. Chapter four introduces the freight volatility of the last 20 years through normal distribution curves and presents the results obtained from different combination of cash flows for all the sample of vessels with histograms, using the statistical software SPSS. This chapter illustrates every possible scenario defined in Chapter three. Thus, the third section of the chapter presents a break-even analysis of each investment used to conduct the financial analysis. Applying the cash-flow model for the entire sample, questioning the price of the freight rate in order the NPV after a 10 year period to be equal to zero implying the financial outcome of the investments as borderline. The break-even analysis is done with the solver function of excel. A risk and sensitive analysis takes place in Chapter five. The risk assessment and the sensitivity analysis measuring the influence the freight rates and interest rates have to the final price of the NPV are determined with the use of @Risk. Concluding, Chapter 6 provides a wide discussion of the results obtained from the previous chapters and draws conclusions regarding the forecasted models referring to which investment is considered less risky and more feasible. In addition it answers to all research questions and presents suggestions for further research.

Chapter 2. Literature Review

2.1 Shipping Market Structure

The history of the shipping industry since the first steamboats were built, over a century ago, is a history of ingenuity, inventiveness, professionalism, mythical expenses, as well as of certain miscalculations that brought about huge catastrophes. The shipping industry is subject to the laws of supply and demand, so we have to examine the necessary mechanisms that make the market function. For this reason Stopford (2009) notices:

> *"In the shipping industry market demand is said to be volatile, quick to change and unpredictable; supply ponderous and slow to change"*

As we proceed to the financial analysis in the following chapters, we should bear in mind the fact that the shipping market is composed of a number of people, ship-owners, brokers, ship-builders and bankers, (Stopford, 2009) all of which carry out each year the herculean task of transporting cargo containers, and believe that the shipping business is more than just a business.

Shipping business is one of the most globalized international industries, and in examining shipping finance we are referring to global economy as a whole. Seafaring trading is in one sense at the top of the global economic activities. The first reaction of shipowners after hearing of a global event is to assess its repercussions in shipping business. A lot of fortunes in the shipping business were created due to political conflict, for example the closing of the Suez Canal in the 50s and 60s (James Feyer, 2009). That way, neither can the political outlook of the shipping market be ignored, nor can the strategic importance of the shipping business be underestimated. As the business has gained a more international character, shipping industry offers the vehicle for an exceptional increase of trade.

If we plan to comprehend the financial and economic forces which drive the developments in the shipping market, we also have to comprehend the two-way interplay between the development of the shipping industry and the development of global economy.

Since the shipping industry is just one of the many links in the transportation chain and there are many stakeholders involved, we have to look beyond the mere maritime perspective. The purpose of the charterers is to get better and cheaper transport throughout the whole distance, from beginning to final destination. That led to the development of a transport system that allows for easy and fast access to almost every corner of the planet. The system is composed of roadways, railways, water ways in the mainland, shipping lanes and airship chartering. In practical terms, this system can be broken down into three zones: the maritime leg (deep-sea shipping), short sea transportation, and inland transportation.

The main task of the shipping industry is to transport the cargo to each corner of the world. According to UNCTAD, the waterborne transport carry's 90% of world trade. Even though this is the right point of departure for the research into acquiring the right ship, it is still too narrow as an economic definition. Moreover, even though in the eyes of the client the shipping industry is just a service, shipping companies provide a variety of services in order to satisfy any special needs of their clients. This service is not anymore about the mere sea transportation; instead, shipping

companies have evolved towards the provision of several services (logistics, distribution) in order to satisfy the changing needs of customers. These services possibly are characterized by a whole host of factors, the most important among them being:

1. *Price:* Chartering cost is always an essential aspect, but the larger its relationship is to the total cost, the biggest the emphasis charterers pay to it. It is important to mention that although price undoubtedly is an important factor there has been a trend over the years towards preferring high quality of service at a relatively higher price, rather than an unreliable service at cheap price.

2. *Speed*: Time in cargo transportation is measured as inventory cost, thus charterers of priceless goods appreciate speed. The cost of holding high-value goods may render the transport of small quantities cheaper, even if the charter cost is higher. Commercial reasons are also considered as a key factor affecting shippers to demand quick and efficient transportation (Stopford, 2009). Speed is also important in relation to time, especially since liner shipping is bound to keep the pace with the liner schedules published.

3. *Reliability*: The "just in time" storage control systems, transport reliability has stirred to other levels. Some charterers may be prepared to pay more for a service that guarantees timely operation, and provides the services it has contracted.

4. *Safety:* Loss or destruction during transport is a non-insured hazard, and creates a lot of complexities to the charterer, who has to be prepared to pay more and more for the safe transport of his cargo, without the risk of destruction.

Each part of the operation covers a different combination of needs. By studying the function of the operation, we need to know the different demands the goods impose on the transport system and comprehend how the system has evolved in order to deal with those demands.

2.2 The Shipping Cycle

2.2.1 Introduction

The shipping cycle represents one of the dominant elements of the shipping market, since a considerable number of decisions that concern the course of shipping companies depends on its development. In the same way that weather variations are of great concern to mariners, the variations of the shipping market focus the interest of the shipowners, among others. The shipping cycle in general comprises the "barometer" of global economic developments, as the shipping industry is subject to extensive and steep fluctuations.

The relationship among the cycles of the shipping market and business risks is direct. As it is characteristically mentioned, the cycle comprises a dominant and determinant element of business risk. Depending on the fluctuations of the value of charters and the price of ships, a host of several decisions need to be made, which comprise the element of risk. Regarding the shipping industry in particular, this risk

takes broader proportions, as it is characterized as a capital intensive industry. Therefore, business decisions that are taken in each step of the shipping cycle assume particular importance as far as the present and the future of the shipping business is concerned.

In the shipping industry, the main actors that provide seafaring shipping services can be distinguished as follows:

- "Industrial carriers" in the case of large industrial businesses which possess privately owned fleets for shipping their cargo. The case of the large oil companies as well as the big liner companies (e.g. Maersk, MSC etc.) are a characteristic example of "industrial carriers".
- Independent ship owners, those through the system of the charter markets provide ships for cargo transportation.

The investment decisions of the industrial carrier as well as those of the independent ship owner possess the element of investment risk and relate to the development of the shipping cycle.

2.2.2 Definition of the Shipping Cycle

The periodically repeated fluctuations of the basic economic variables such as production, employment, credit, and price level, give life to the phenomenon of the economic cycle. Depending on the duration of appearance of those fluctuations, the economic cycle is described as follows:

Long term cycle, Develops through a time horizon of 50 years, which includes 20 years of economic progress, followed by a 10 year time period of economic stability at a high-level, while in its last phase is comprised of 20 years of economic recession.

Midterm cycle, Comprises of a ten year period and is usually referred to as an investment *cycle as Rodrigue, Slack and Comptois (1997) state:*

"The container is a perfect example of such a diffusion".

Short term cycle, Referred to as a commercial cycle, and its development lasts for 3- 4 years.

According to a second opinion, the economic cycle is referred to as the commercial cycle, and is defined as the alternation in the economic robustness of a certain Economy, usually expressed through the level of the National Income, in a continuous manner.

The theory of the economic cycle also extends to the shipping industry, giving rise to the phenomenon of the shipping cycle. The shipping cycle analyzes the cyclical variations of the charter markets, taking into consideration the other parameters of the shipping economic, and especially the ship building, industry.

The shipping cycle is defined as the mechanism that aims at preventing the imbalances that arise between the supply and demand for ships.

Also, according to a second definition, the shipping cycle is defined as follows: extrinsic factors, severe fluctuations in the level of economic activity, and intrinsic factors such as changes in the active supply of capacity, have an effect in the variations of charter prices, resulting in the creation of a cycle, also known as the shipping cycle.

The main characteristics of the shipping cycle are:

a. The fluctuations seen in the level of the charter prices and the volatility of the freight rates are characterized by a cyclical sequence which fits the framework of the broader economic fluctuations. As it has been ascertained the fluctuations of the shipping cycle go step in step with those of the broader economic cycle, however, they manifest themselves with greater intensity. Campell (2001) reports:

   "The time pattern of shipping freight rates is dominated by the workings of two feedback loops, which govern fleet size and fleet utilization".

b. The shipping cycle is characterized as "unpredictable" and "abnormal" (Randers, 2007). Even though a series of events do take place (e.g. an increase in the level of international trade, an increase in the demand of seafaring shipping services, an increase in the level of fare prices, new ship construction, etc.), any attempt of predicting its development is especially risky. A number of non quantifiable factors also contribute to this effect, such as the "general psychology" that prevails in the shipping market.

c. In certain cases, the effect of important event, military or political, on the shipping cycle has been reported. Usually these events result in an increase in fare prices. Nonetheless, the effects of military or political events may only be border line, since in the long run they don't guarantee a stable future increase of the global shipping industry, but rather the opposite (Stopford, 2009).

2.2.3 Development Stages of the Shipping Cycle

The main criterion for separating the different stages of the shipping cycle fluctuations is considered to be the mean fare price. Taking into consideration this criterion, we can distinguish the following four stages (phases) of the shipping cycle: Introduction, growth, maturity, recession (Journal of transport geography, 1997).

Introduction: During the course of this phase, we can distinguish the following characteristics: Initially, we observe a surplus in ship tonnage. There is a congestion of ships in the ports, while the speed of the ships is reduced, in an attempt to save on fuel. In a second phase, the level of fare prices in the main fare markets is drastically reduced, and at the same time any underperforming ships are decommissioned. In the final stage, the persisting low fare price, in combination with the resulting negative income flow, aggravates the existing climate and several shipping businesses are driven to selling ships in low prices. The price of older ships reaches that of the level of a dissolution market.

Growth: During this stage, there is initially a small increase in the level of the fare price, which covers the operating cost of the ships, while there is a reduction in the number of decommissioned ships. All this is the result of an initial balance between the forces of supply and demand. The prevailing psychological climate in the market is still uncertain. As the liquidity of the shipping business starts to pick up, second hand vessel prices show a small increase.

Maturity: When all surplus tonnage has been engrossed, the market enters a phase where supply and demand are in perfect balance. The level of fare prices is high to the point of exceeding three times the operational cost of the ships. The fleet is moving at maximum speed, while only ships judged as underperforming are being decommissioned. The ease with which banks and the stock markets offer financing is a clear indication of the climate of euphoria that prevails in the shipping market. Prices of second hand ships are above their book value, while the price of those that are more modern or more recently constructed is, in some cases, higher of that of the newly built ones. Orders for construction of new ships show a steep increase.

Recession: When the supply of tonnage exceeds demand, the market enters a phase of recession. The causes can be sought in the economic cycle, in the deliveries of newly constructed ships, while the negative psychological climate can accelerate the collapse of the market. Freight rates are in decline, ships operate on slow-steam again, while the less “economical” among them seek cargo assignments. Even though liquidity is still at a high level, the psychological climate of the market suggests a complete state of frustration on the part of the shipping businesses.

Regarding the time periods between the stages of the shipping cycle, the following are reported:

The stage of maturity is longer in duration than the growth and recession stages, and can last for many months. However, the introduction stage is the longer lasting, and it can persist for many years.

2.3 Characteristics of Shipping Investments

Investment in high intensity capital industries requires a detailed comprehension of the operating environment. This is why we have illustrated the instability of the shipping markets in the sections above.

The targets and the type of investment have to be precisely defined. Commercial and governmental shipping targets, such as replacement, expansion, new entry as well as other types of shipping investments have to be discussed.

The shipping industry is an unstable industry, and the risks linked to shipping investments have to be precisely defined, especially when investing in Post-Panamax vessels, as the liner market nowadays is volatile. The categories of the shipping investor and the accumulation of investment capital in the industry need also to be analyzed, since they constitute a part of the industry’s shipping sector.

For many shipping companies the maximization of the investor’s wealth is going to be the main aim, even though for some companies, especially private fleet owners of cargo containers, the aim of the shipping departments is to ascertain transport requirements and control transportation costs.

Commercial shipping investment can also include targets which are not strictly commercially oriented. In some cases, shipping investments have been influenced by publicity and the prestige they possess. Other assessments have included tax evasion as a result of the global character and the global ownership structure of the shipping industry, as well as the evasion of controls concerning exchange rates, through the acquisition of foreign exchange devoid of property tax.

However, investment goals have to be dealt with as part of the company targets, and they will therefore have to be distinguished from strategies, tactics, policies, procedures and rules.

i. Investment in new constructions

On a macroeconomic level, investment of capital in new ships offers new fleet units, and, in concert with ship dismantlement, losses, and permanent adjustments, defines the level of the shipping supply.

The investment to replace a ship that is dismantled (scrapped) with a new ship has no effect on the supply of shipping services, but when the replaced ship is sold instead of being dismantled there is a positive influence in shipping supply. In the short to medium term, a part of this replacement investment can be postponed through the extension of the ship's life, which delays the clearance sale of the ship.

The investment of augmenting the fleet with a new ship represents additional shipping delivery services from the existing market operators. A part of this augmentation investment can be partly fulfilled through efficient factors of the shipping industry, such as an increased rate of operations and the progressive reuse of the decommissioned or the available for decommissioning ship tonnage.

An investment through the entry of a newly built ship is also considered an addition to the supply of shipping services, if it can be predicted that augmentation along with investment can create an oversupply.

ii. Investment in Second-hand ships

The replacement of a ship through acquisition of an equivalent ship from the used ships market reduces supply, if the replaced ship is going to be scrapped. If the selling is a commercial transaction, there is no influence in supply.

Acquisitions through fleet extension and entry of used ships have no effect on supply, since those ships already exist.

However, other forms of investment such as modifications and conversions that are geared towards extending a ship's life, and have an effect on factors such as ship size, transport tonnage, fuel efficiency and maximum operating speed, as well as useful economic life, are oriented towards supply, since they affect the supply of shipping services.

2.4 Containership Generations

Containerships are basically divided in six basic categories (Rodrigue, 2009).

The first generation consists of converted tankers that could carry up to 1,000 TEUs. This generation was born in the 60's when technology still remain unproven.

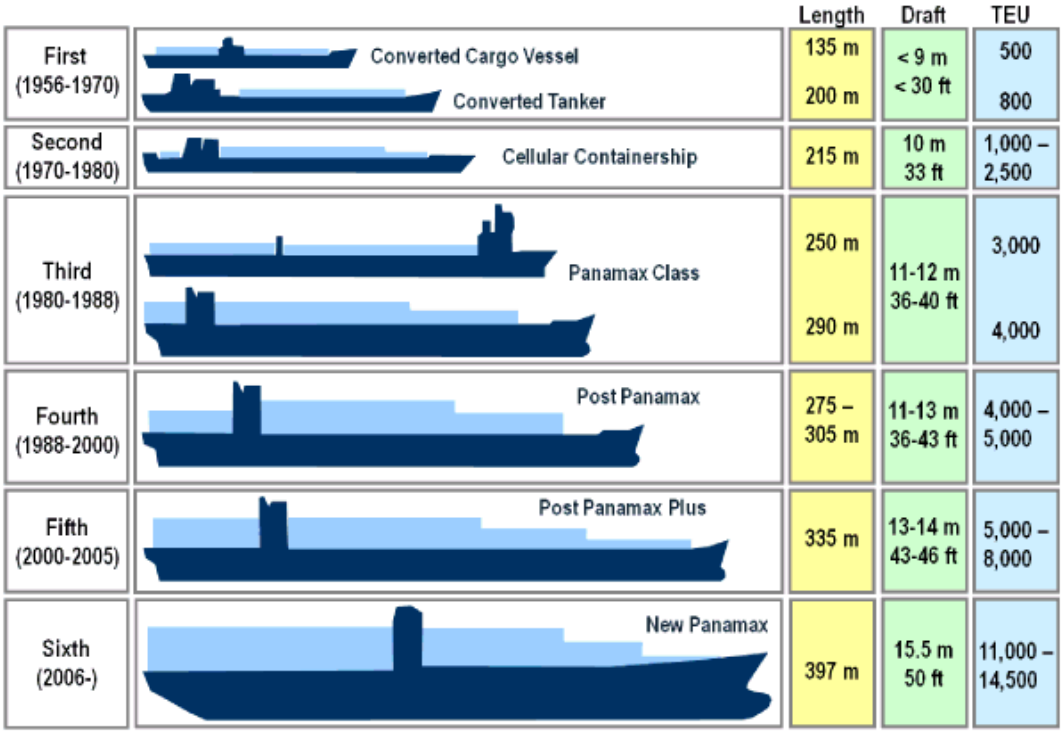
The second generation dedicated to cellular containerships that could carry up to 2,500 TEUs and reach 20-24 knots.

In the 80's in order to achieve economies of scale and keep the restrictions for the Panama Canal, the third generation of containership was introduced. This type of containership, known as Panamax class, could carry up 4,000 TEUs.

In the mid 90's the fourth generation was introduced. This unique size, called Post-Panamax vessels could carry up to 6,600 TEUs. Next to this size, the fifth generation (Post-Panamax plus) prepared its entrance into the market, carrying up to 9,000 TEU's.

Concluding, in 2006 the sixth generation came into the market; a revolution to what was already known, dominating the market with its exceptional size carrying up to 14,500 TEUs (i.e. Emma Maersk, MSC Daniela), causing troubles in ports (congestions etc.) and mainly affecting accessibility.

Figure: 2.4.1



Source: Rodrigue, 2009

2.5 Market Analysis

2.5.1 Liner Vessels

The global financial crisis of 2009 sent the shipping economy into recession. The steady increase of supplies on the one hand and the decrease of the demanded merchandise set the shipping rates at a low time-charter price. Maersk's CEO Eivind Kolding states:

"Most likely, some liner companies will have to cease business if freight rates do not come up".

According to SIN (2010), 45% of the planned liner vessel deliveries for 2009 hadn't reached the fleet at the start of 2010, influencing freight rates, which bounced back in the second quarter of 2010. Based on the same article, the order book for newly built box ships, although high, has reduced and cancelations are estimated to carry on in 2010.

After a six month negative trend in container trades in 2009, the loss doubled in the end of the year. Minor progress was reported in the beginning of 2010 as the capacity of the fleet decreased significantly. However, as the year moved on freight rates witnessed an increasing trend. Chris Bourne states:

"Freight demand will *continue to rise in the next two years*"

2.5.2 Container Market

The container industry had always been healthy until 2009 when the global financial crisis hit. Over the next year 9% reductions faced the container trades, striking on both major markets Asia-Europe and Asia-North America with a reduction of 15%, (Clarson's Research Services, 2010). Based on the same study, during 2009, North-South trade decreased 6%, intra-regional trade 11% and a minor growth of 2% was reported in the East-West trade. By the end of the year a remarkable fact was recorded, revealing a growth in volumes stronger than the one expected.

According to containerization international container handling will increase 576.4 million TEU by 2015 (Container Traffic Forecast Update, 2007).

Due to the high percentage of cancelled deliveries, the fleet grew only 5.6% in 2009. On the other hand, by the end of 2010, a growth of 13.7 million TEU is predicted to expand the fleet.

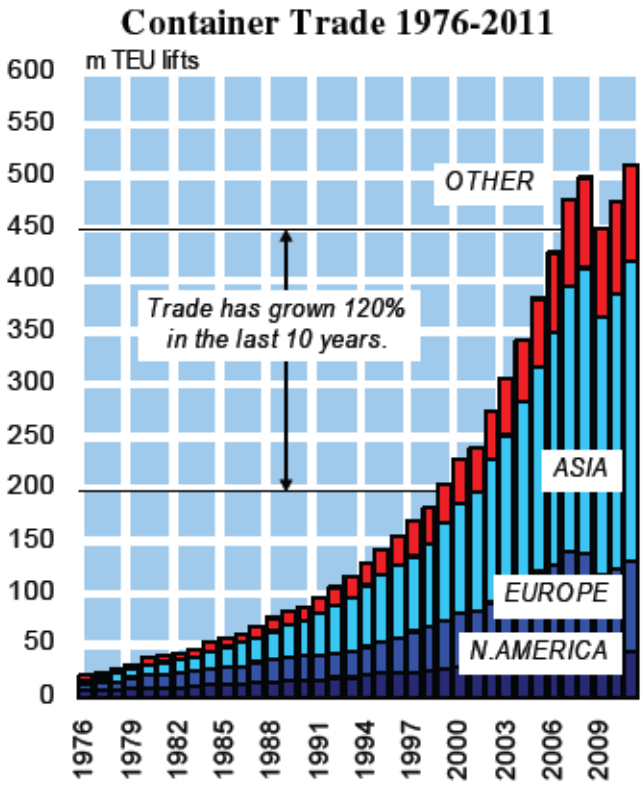
Clarkson's research department reports that in 2010, trade volumes improved significantly and the balance between supply and demand aroused. Regardless the fact that the market appears to rise it will still take years to recover according to Maersk's CEO Eivind Kolding. At this point the market showed some progress from the devastating loss of 2009, allowing operators to jump to another level attaining higher profits. However, after the tremendous losses in 2009 uncertainty remains, even though earnings continue to increase.

2.5.3 The Containership Fleet

Only 1.13 million TEU were delivered in 2009, which were far below the projections. Notable is the fact that 0.34 million TEU were sent to recycle yards; more than the last nine years. Also, breaker yards received 0.34 million TEU – more than the previous 9 months. During the same period the fleets of the smaller containership were in a downward trend while the larger sector was showing a growth (Post-Panamax revolution). The containership fleet counted 4,835 vessels in March 2010. Their total capacity was 13.1 million TEU, while 10.3 years was the average age of their vessels (SIN, 2010). With a total expectation of 0.94 million TEU for 2010 only 0.16 million TEU of capacity had reached the fleet.

The following graph illustrates the container trade from 1976 -2011.

Figure: 2.5.3.1



Source: Clarkson's Research Services

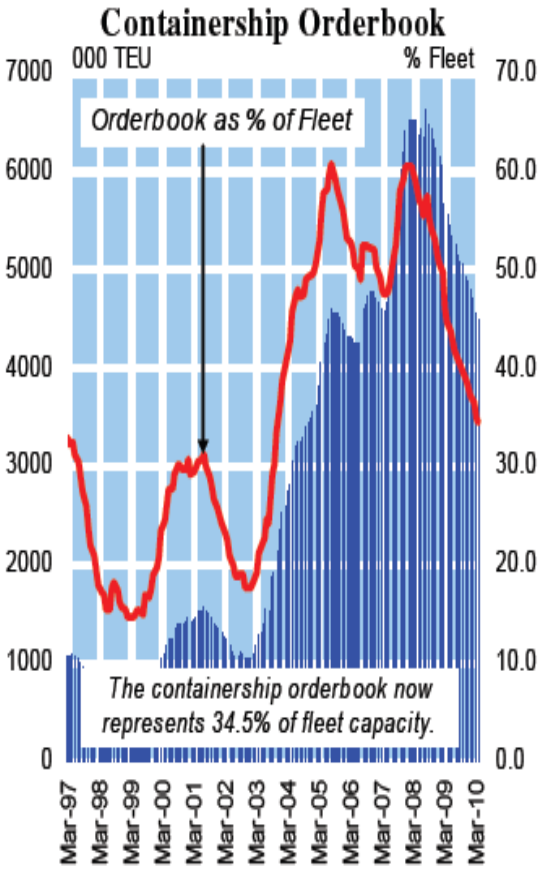
2.5.4 The Containership Orderbook

The financial crisis and the economic downturn that hit the container sector in 2009 sustained and the orderbook kept dwindling, positioning 773 containerships and 4.51 million TEU capacity in mid 2010, (Clarkson's Research Services, 2010). The financial uncertainty kept affecting dramatically shipowners in investing in new vessels, as an effect on the fleet growth. Statistics reveal that 45% of the expected deliveries for 2009 hadn't reached the market the first two months of 2010. It is spread that at least 100 contracts have been terminated since the beginning of 2009 and the predictions for 2010 count 0.94 million TEU capacity.

According to the same article and to data from Containerization International, 513 vessels (4.1 million TEU) on order of 3,000 TEU and above containerships representing 47% of the current 3000 and above TEU fleet. In order shipowners to reach economies of scale they will continue to expand in larger vessels, Panamax and Post-Panamax sizes, as the demand for vessels less than 3,000 TEU is much smaller, only 9% of the total capacity in order (0.4 million TEU).

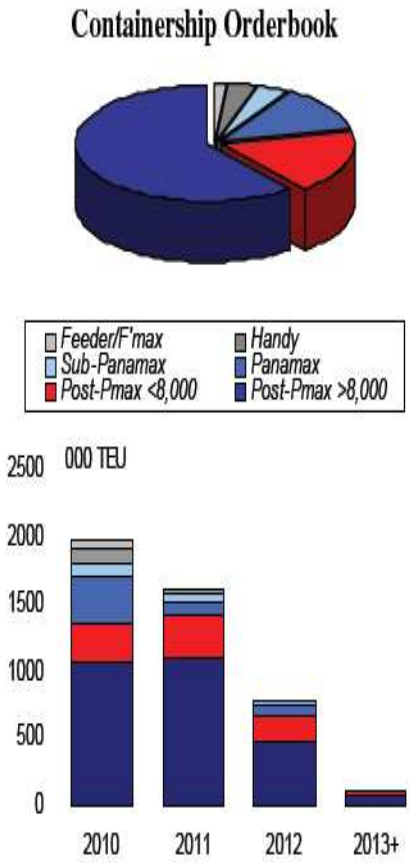
The following two figures present the total orderbook as a percentage of fleet and the evolution in Post-Panamax container vessels is clearly noticeable.

Figure: 2.5.4.1



Source: Clarkson's Research Services

Figure: 2.5.4.2



Source: Clarkson's Research Services

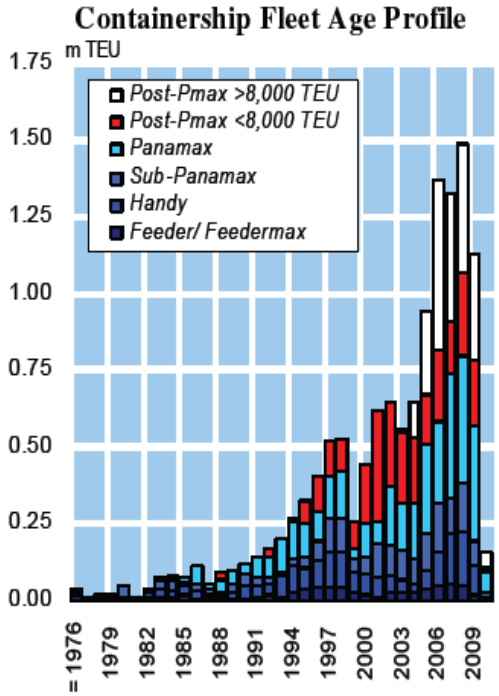
2.5.5 Future Developments

Improvements were being made in the majority of trades in the box volume sector. The Far East-Europe and mainlane Transpacific are expecting a growth of 5%-6% in end of 2010. Therefore, brighter days are ahead in the intra-Asian trade as well. Moreover, a 7.5% expansion is expected for the global box trade in 2010.

The high level of non-delivery reduced the containership growth. New buildings are not in financial favour, as a large proportion of the old fleet is still inactive. Conversely, the increase in box volumes improved the freight market and as a result, timecharter rates seen an upward swing, better than what had been projected for 2010, (SIN, 2010).

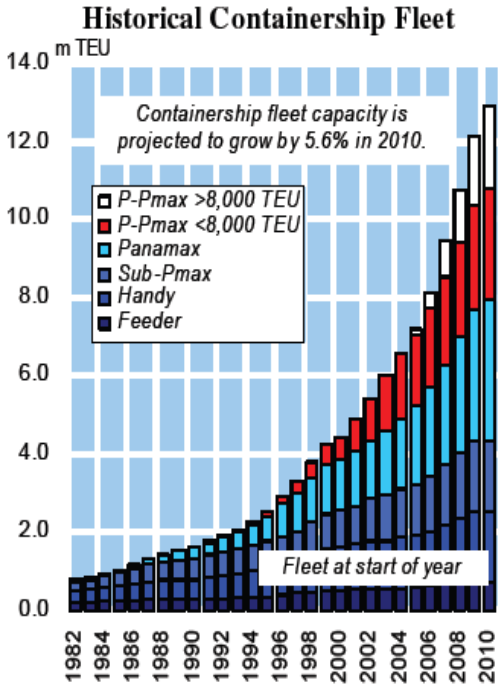
Figure 2.5.5.1 and Figure 2.5.5.2 illustrate the containership age profile and the historical containership fleet since 1982.

Figure: 2.5.5.1



Source: Clarkson's Research Services

Figure: 2.5.5.2



Source: Clarkson's Research Services

2.6 Risk Linked to Shipping Investments

Supposedly, the "investor" takes part in share yield for the minority investment. As a result, the risks for majority and minority shareholders are equivalent, and factors such as the risk of reduction of the preference shareholders or the exposure of minority shareholders to the majority shareholders and the Boards of Directors are omitted.

i. Company/ Market risk

The company or market risk is in effect composed of the "performance" and the risk of "asset value".

Performance risks include the risk of unfavorable changes in cargo fare prices due to the influences of supply and demand, as well as unfavorable changes in operations, voyage, cargo handling and financial expenses. Asset value risks include the risk of unfavorable changes in ship prices.

This type of risks can be reduced through income stabilization methods, cost control and the drawing up of a budget, research and detailed feasibility studies, as well as constant observation.

ii. Physical risks

Those are more traditional shipping risks, and they include loss or damage of the ship due to causes such as weather, collision etc, as well as the extreme case of unauthorized detainment of the ship. Unfavorable results can influence both, performance and asset value. Such risks can be limited through insurance and proper operational capability.

iii. Debtor risk

It represents the risk of debtors who do not honor their obligations, and as a result do not influence liquidity and performance (Currie and Velandia, 2002).

Careful selection of commercial partners (especially charterers), adequate procedures of debt repayment, and prudent losses are ways of handling this indirect risk.

iv. Foreign exchange risk

The global orientation of shipping transactions leads to an assortment of foreign exchange currency related to income and expenses. Fluctuations in those currencies lead to consequences in performance and the ability of debt settlement, as well as in the "real" exchange value of the currency as it relates to ship acquisition or availability.

Currency protection techniques and analysis of exchange rate developments in the international environment can oftentimes reduce this risk, as can the use of the same type of currency, where possible.

v. Financial risk

The shipping business, being a global industry, has companies that operate in or negotiate with different countries. Therefore, risk exposure extends to the specific risks associated with each country.

These include specific financial risks such as currency control in shipping of capital, or in tax regulations regarding shipping, political risks such as seizure of assets, and legal demands such as disclosure of information and restrictions of property of shipping companies.

Such risks can only be controlled through careful research and examination of the countries involved. The issue of financial risks in the shipping industry has been dealt with in great deal, by Alizhed and Nomikos (2009).

A relevant risk is the risk of governmental intervention which includes the risk of lack of legal resort when enforcing contractual obligations on government companies, which are controlled by the state.

vi. Interest rate risk

This is the risk of unfavorable changes in interest rates which consequently increase the cost of financing the debt. The widespread use of variable interest rates in credit capitals used for ship acquisition and the previous instability of interest rate levels have created the need for protectionism from interest rates by using analysis of interest rates developments in the international environment, and techniques of interest rate protection.

vii. Loss of risk of initial expenses

This is the risk of accumulation of frequent unrecoverable expenses in the preparation of feasibility studies that are rejected by the company itself, the creditors, or the financing of capital through the stock market; it can be reduced through

careful analysis of project selection and financing sources. Nevertheless, any reasonable expense can be initially justified if estimation of the right timing is wrong.

viii. Indirect risks

According to Mintz and Schwartz (1985), the risks of buying the business, as mentioned before, can be transformed into a credit risk as a result of their effect on assets and /or profitability, and the business could be rendered incapable of meeting the obligations of its debt.

There are two types of creditors in the shipping business: creditors who deal in main investment capital, such as financing organizations that provide the debt financing necessary for ship acquisition, and creditors for commercial purposes, such as providers of stores and warehouses, or banks that provide short term credit facilitation. A business that is incapable of paying up its debt due to insufficient liquidity of assets or reserves will enact debt settlement procedures from its creditors.

Prudency in loan dependence as well as adequate control of liquidity can contain the risks.

The credit risk is in effect a liquidity risk, where obligations that approach their due date cannot be met, and a subsequent risk is that of insolvency, where debts exceed assets.

ix. Pre- Risk: Managerial risk

This represents the risk of adverse developments that an investor can be exposed to, and arises from inadequate management. This risk is in effect a “pre-risk” that leads to the risks described above.

2.7 Income-Operation Expenses of a Vessel

The guarantee of a constant and sufficiently high income flow, and cost control through adequate management and operation are basic requirements for good performance and for an acceptable return on the investment.

2.7.1 Income

The main source of income of a shipping company is chartering. The specific way chartering produce income depends on the chartering policy of the company.

2.7.1.1 Types of Chartering

The four main chartering types that exist are the following:

Voyage Chartering

In the case of voyage chartering, a vessel is used for only one voyage and the chartering is paid either as a lump sum or at a pre arranged level per ton of shipped cargo. The chartering for a voyage is often called *direct chartering*. *Cargo* handling expenses are negotiable; however, all main operations and voyage expenses are paid by the shipowner.

In voyage chartering the duration of the voyage and the delay time needed for loading and unloading are arranged. The delay time represents the total arranged

time starting from submission of the readiness declaration (i.e. that the vessel is ready in all ways for loading and unloading after arrival at the port or terminal) regarding completion of the cargo unloading procedure.

Usually the cargo is paid in advance, thus the term “prepaid chartering”, during the delivery of the signed loading bills, even though the specifics of payment may vary depending on the different chartering companies. The loading bill acts as a receipt that specifies the description of the quantity and the specific details of the goods, and as a document of the title and the particulars of the commercial transaction between the carrier and the cargo owner.

The daily charge, also known as demurrage, is paid from the charterer to the ship owner if the time delay exceeds the allocated time limits, while rapid delivery, as a rule half of the demurrage, is paid from the ship owner to the charterer if the time delay is shorter than the pre-arranged limit. The dead freight is payable to the ship owner by the charterer for any part of a pre arranged cargo size that is not available for delivery.

Time Chartering

According to the term “time chartering”, which can be short, medium or long term, ships are chartered on a time basis and the charter is payable by day, usually on a monthly basis or in the middle of the month, in advance. Long term time chartering are also referred as “period” chartering, while time chartering for just a single round voyage is also known as “ trip chartering”, since it applies to only this one voyage.

The ship owner keeps paying for the capital and operational expenses, but the voyage and cargo handling expenses are undertaken by the charterer (in contrast to voyage chartering).

Besides the obligation of keeping the ship in sea-worthy condition, the ship owner is also responsible for ascertaining that the chartering contract terms regarding performance are met. If the ship fails to perform as expected or there is an interruption, it is considered to be “out of hire” or “laid-up” and the charter is not paid; relevant examples include sudden engine stoppages and transportation of a sick crew member. Furthermore, chartering rules are allowing for events such as speed, consumption, and the ability of transport and pumping (where applicable).

Bareboat Chartering

The final type of chartering is “bareboat chartering”, or “demise chartering”. Even though the owner retains ownership of the ship, he yields operational control to the charterer, in return for a long term lease, keeping only a degree of influence to the general policy, e.g. the right to veto senior crew members or problematic areas of commercial transactions.

The charterer incurs all the expenses, i.e. cargo handling, voyage, and operational expenses. Since the ship owner incurs only capital expenditures, bareboat chartering prices are possibly in levels sufficient to afford a constant yield, after covering capital expenses.

Bareboat charterings are often linked to new ship acquisitions, given the fact that the labor coverage acts as insurance for the creditors, under the condition that the

chartering contract is well written and the charterer is outstanding. Consequently, the charterers will often possess a great deal of influence in the construction and the design of the vessel itself. Bareboat chartering can also offer the charterer the chance to buy the vessel at the conclusion of the charter period, which usually corresponds to the vessel's economic life, and oftentimes for a nominal price.

2.7.1.2 The Policy of Chartering

Policy of chartering mainly depends on market expectations as well as in risk and performance return. The least risky option is bareboat chartering, where the main aim is the assurance of a steady income flow to cover capital expenditures.

Voyage charter and time charter will depend on market and forecasts. There, exists a conflict of interest between ship owners and charterers. In an underperforming market charterers will offer long to medium term time charters in low prices to make ends meet and avoid higher prices, conversely, during a market boom charterers will prefer short term voyage charters to avoid committing to low prices and to profit from the high prices during the rise of the market. However, in healthy markets, owners will seek long term time charters to deal with decreases and avoid low prices, while charterers will prefer short term voyage charters to avoid committing to high prices and take advantage of the lower prices when the market falls.

Usually, voyage charters take place wherever an irregular flow of cargo exists, in relation to timing and destination. Trade of cargo affected by short term demand, is therefore more related with the voyage charter mechanism.

Even though voyage charter offers the best counterbalance between risk and performance, the safest and more stable income flow of time charterers consists of the advantageous prices offered, which have a positive outcome in the prevailing market prices. A long term time charter whose prices are "locked" to the low market prices can prove to be extremely costly. However, the increased income security that results from time charters has led to numerous new ship acquisitions, which become attractive to the creditors due to the long term employment from first class charterers, such as oil and steel companies.

In practice, a prudent owner will apportion between different types of charter. An expanded charter portfolio will constitute an important part of the owner's strategic risk reduction, and this takes place often, according to the financier's demands.

2.7.2 Operating Costs

Expenses are on the opposite side of income in the operational equation. Operating costs, also called current costs, are necessary for the proper operation and maintenance of the ship (plus any existing reserve for covering unforeseen expenses or recurring costs), and they consist of the crew, maintenance and repair, store and lubes, insurance, miscellaneous and administration costs.

Crew Costs

Crew costs traditionally represent the biggest part of operational costs, even though increasing automation has reduced crew numbers in newest ships, Zei (2006).

According to Hummels (1999), at the beginning of the '90s, environmental disasters, increasing awareness of possible expenses due to pollution, and problems with the

global insurance market were largely responsible for the sharp rise of insurance costs. Even though economies of scale cause general operating costs to drop on a per ton basis, as ship size increases, insurance costs tend to rise proportionally to ship size, in contrast to crew expenses that tend to decrease proportionally to ship size.

Downard (1981), mentions three parameters that affect crew costs: manning of scale, nationality, and conditions of service.

Manning scales are dictated by the minimum legal requirements of registration and by any national or individual treaty between owners and mariner's unions, NRC(1990). Apart from those constraints, manning levels are also dictated by the specific policy of the owner concerning crew size.

Crew nationality depends on the same factors governing manning scales.

Conditions of service have a defining influence in services contract, which defines pay, leave, overtime, and additional services in kind. Legal requirements and union treaties dictate the lowest levels, which are supplemented by the owner, who takes into consideration the size, type, and cargo of the ship.

A quality crew is in effect counted towards the safe and profitable operation of the ship, as well as in the assurance of employment, which is achieved through the satisfaction of the charterers regarding performance and safety. Outstanding crews are considered to be of extreme importance regarding security at sea.

The dominance of human error, beyond all other causes of damage or loss, such as construction failures, equipment failures, and mechanical failures stresses the importance of a capable, specialized, and well trained crew, according to Cameron and Williams (1993), who notices:

"*60% of all claims, including 90% of collisions, are due to human error, more specifically due to errors of deck officers, engineers, crew, shore staff, and pilot.*"

Crew Costs

Crew costs derive from the following expenses:

- Basic Wages & Bonus
- Leave and Other Expenses
- Crew Pre-Joining Expenses
- Crew Travel Expenses
- Crew Medical Expenses
- Victualling Expenses

Maintenance and Repair Costs

The above costs cover all costs relating to the maintenance of the ship and consist from the following:

- Decks Repair Costs
- Engine Repair Costs
- Cabin Repair Costs
- Repair Team Expenses
- Surveys/Inspections/Security Plan Expenses

Store and Lube Costs

Store and lube costs are costs relating to all consumable and non-consumable elements required for the safe and effective operation of the ship and are composed from the following costs:

- Cabin Costs
- Deck Costs
- Port Expenses
- Bunkering Expenses
- Cargo Expenses
- Canal Dues
- Engine Expenses
- Lubricant Expenses

Insurance costs

In nearly all cases, the need for protection against physical loss or damage, and against responsibility towards a third party, leads to insurance coverage. Normally, insurance is a mandatory coverage based on international charters, governmental legislation, and the demands of the mortgage holder, (Stopford, 2009).

Insurance is a paramount prerequisite for the protection of the ship owner, as a means of insuring a creditor, and as a means of increasing employment potential due to the charterer's requirements.

Types of insurance normally undertaken derive from the following expenses:

- Hull & Machinery Premium Expenses
- Hull & Machinery War Risk Expenses
- P & I Expenses
- P & I FD Expenses
- P & I Excess Pollution Expenses

Miscellaneous costs

Miscellaneous costs cover the following expenses:

- Management Costs
- Tonnage-Tax
- Communications
- Sundries
- Protective Agency Costs
- Lay-up Costs
- Superintendents Travel
- Reactivation Costs

Voyage costs

In contrast to the standard operating costs of the company, voyage costs arise from the specific voyages the ship engages in. Consequently, unless the plan of each voyage is known, voyage costs are difficult to be scheduled and vary according to

each voyage. Voyage costs include warehouses, ports, towing, navigation, and canal fees.

Chapter 3. Methodology-Data

The methodology used to conduct the financial analysis and reach the conclusions of this study will be analytically described in this chapter. The methodology is based on cash flow projections in order to estimate the NPV of diverse investment plans in Post-Panamax container vessels. The results relating to the NPV, obtained from the cash flows are compared with the delivery and purchase price of newly built and second-hand respectively Post-Panamax containerships, in order to investigate the relationship between these two variables. The different number and size of the vessels, as well as the data related to each containership used to predict the financial analysis are further examined in this section and are based on existing data provided from major companies involved in the shipping industry.

In order to examine precisely which investment is more feasible the study is based on 3 cases of which each case depends on 8 different scenarios.

After evaluating the freight volatility according to 20 year data from SIN (2009) we concluded that the actual freight rates relating to the vessel models used in this thesis have been fluctuating between the range of -40% and 50%. Therefore, the eight different scenarios relate to a different percentage of freight rates; combination of cash-flows with constant freight rates during the whole repayment of the debt (10 years), decreased freight rates 20% and 40%, as well as increased freight rates 10%, 20%, 30%, 40%, 50%. It should be stated that any scenario concerning the value of the freight rate remained constant during all cash flow projections, based on a 10 year time-charter contract as it is impossible to predict the trend of such a sensitive factor.

Moreover, the first case consists of 7 newly built Post-Panamax container ships, of which two have a of capacity of 9500 TEU, two 8500 TEU and three 6500 TEU. The second and third cases involve second-hand Post-Panamax vessels, five years old and ten years old respectively. Both cases, second and third, are consisted of two 9500 TEU vessels, two 8500 TEU and two 6500 TEU containerships.

In order this study to be more precise; chapter four measures the risk of each investment, with the use of @Risk. The risk analysis evaluates and calculates the average NPV of each investment based on spot-earnings of the past 20 years.

This chapter is divided in two basic sections. The first section describes every value associated with the cash flow projection and the second section presents a table introducing the data (earnings, operating expenses, and delivery-purchase prices) of the newly built and second hand Post-Panamax container vessels used to conduct the analysis.

3.1 Methodology

3.1.1Basic Definitions

Capital: The economic good defined in monetary units, which possesses the ability to produce other goods. In this study it is considered as 40% of the total cost of the investment.

Bank Loan: is the volume of funds the investor borrows in order to acquire the investment; it is a debt between the bank and the shipping company. In this case it is 50% of the total cost of the investment.

Interest: Yield (increase) of capital for a specific time period.

Interest Rate: Interest on capital for a monetary unit in a specific time period. It is usually expressed as a percentage (%) for a one-year period, e.g. an annual percentage of 10% suggests the increase of a capital that consists of 100 monetary units by 10 monetary units in a year.

The total interest rate derives from the *spread* rate and the *libor* rate. The spread rate refers to a hypothetical amount the investor could receive if all assets were lent and invested at the flowing rates. Libor rate refers to a daily or monthly rate based on interest rates, shipping banks make use of unprotected funds from the interbank market. According to A.B. shipping bank the spread rate, which is a stable rate, is equivalent to 3% at the moment (June, 2010). According to the same bank, the libor rate is 1.34%, which implies that the total interest rate is equal to 4.34%. Therefore, to obtain more precise results as the interest rate differs from period to period; the study was conducted with various combinations of interest rates, 3%, today's value 4.34%, 5%, 6%, and 7%, although its commonly used nowadays, ship-owners to sign libor swap contracts in order to keep the libor rate and the currencies stable throughout the whole repayment of the loan.

3.1.2 Concepts that Describe a Shipping Investment

Operating Days

Operating days are defined as the days the ship is in operation in a given time period (in this thesis a 30 day period), and is calculated by subtracting the days the ship is out of operation from the total days of this period.

Operating Expenses

Operating Expenses (OPEX) of a ship are the costs that occur because of its operation throughout its life period. Costs are mainly composed of crew payroll and all costs associated with it, insurance premiums, lubricants and spares, as well as maintenance and repair costs. Excluded from operating expenses are fuel costs, port costs, agent fees, tolls for passing through canals, further insurance for war risks and commissions which are included in voyage costs, as analyzed in chapter two. During the cash flow projections all expenses regarding the operation

of the vessels increase 3% every six months due to inflation and maintenance of the ships.

Operating Income

Operating Income of a ship are all the earnings before taxes and interest arising from the operation of the ship, as described in chapter two. The earnings relating to each vessel are introduced in the second part and as mentioned in the beginning of the chapter different scenarios were examined with decreased income 40% and 20%, as well as increased 10%, 20%, 30%, 40% and 50% in order to inspect all cases, worst and best possible.

Cash Flow

The term Cash Flow refers to the movement of cash from and to a company, a project, or a financial product. It is usually calculated at the end of a particular period.

Operating Cash Flow

Operating cash flow is defined as the amount that occurs if we subtract operating expenses from operating income, i.e. it is the cash inflow that results during operation of a ship minus the outflow. Operating cash flow can be either positive or negative.

Net Cash Flow

Net cash flow is defined by the difference of two elements: cash inflow and cash outflow. This difference, same as in operating cash flow, can be positive or negative. Cash flow refers to a specific operating period, for this particular thesis to a period of a decade. Therefore, for an investment plan, the table of annual cash flows relating to the economic life time of the investment is drawn up.

In order to draw up a cash flow table, knowledge of the following figures is necessary:

- Total investment capital
- Annual expenditures (fixed and variable operating costs, interest, amortizations, additional capital disbursements)
- Annual incomes
- Annual depreciations

The net cash flow of the investment plan is defined as the algebraic sum of all the years of life of the investment. However, given that all net cash flows are taking place in different time periods it is necessary, before calculating the sum of the net cash flows, to calculate them at the specific time of evaluation, i.e. to calculate the present value of each net cash flow.

Net Present Value (NPV)

Net Present Value is defined as the present value of annual incomes minus the present value of annual expenses minus the present value of annual expenses, including investments.

Discount Rate or Weighted Added Cost of Capital (WACC)

Discount rate is defined as the rate that guarantees us the minimum acceptable returns. The definition of the discount rate depends on the cost of capital and the business risk of the particular investment. That way, the necessary discount rate reflects the cost of a safe investment augmented by an acceptable safety coefficient, which is influenced by a number of factors. Oftentimes, the necessary discount rate depends on subjective judgment, based on the investor's experience. Nevertheless, quantitative methods have also been developed, based on portfolio theory, which determine the capital cost from bond loans and stock capitals.

Choosing a discount rate is by itself a special matter. Discount rate depends on capital cost, which is a function of the pattern of financing and the risk implicit in the particular investment.

In a perfect capital market for an investment with the same risk characteristics discount rate is equal to the weighted added cost of capital.

Therefore to calculate the WACC, the following formula is used:

$$WACC = k_D \times (\frac{D}{V}) \times (1 - T_{C)} + k_E \times (\frac{E}{V})$$

Where:

k_E = Cost of Equity

k_D = Return of Debt, which derives from the total interest rate (in this case 0.0434)

D = Market Value of Debt

E = Market Value of Equity

V = Market Value of Debt & Equity

T_C = Marginal Tax Rate = 0, as this tax is measured according to gross tonnage and all investments are considered to be under a Liberian flag.

The Cost of Equity is calculated using the Capital Asset Pricing Model

$k_E = r_f + \beta(r_m - r_f)$

Where:

r_f = Risk Free Rate of Return, or Return of Treasury Bills,(in this case is equal to the libor rate, 1.34)

β = Firm Specific Beta, (β = cov(x,y) / var(x)). The value of β varied between 1.638 – 1.512

x = quarterly index, since 1990 (source: from S&P 500)

y = quarterly freight rates, since 1990 (source: Clarskon's Database)

r_m = Market Rate of Return (r_m= 10.64, according to S&P 500)

$r_m - r_f$ = Market Risk Premium ($r_m - r_f$ = 10.64 – 1.34 = 9.30)

The WACC for all investments varied between 7.5% and 8.7%, as the cash flow models exceed 1000.

Internal Rate of Return (IRR)

IRR is mathematically defined as the discount rate which makes cash flows equal to zero, i.e. the rate which equalizes the initial investment with the value of all future cash flows. The difference between the rate given by IRR and the discount rate is due to the fact that the first one is determined by the characteristics of the cash flow table, while the discount rate is extrinsically defined by the investor.

NPV

When an alternative plan is examined independent of other options, the terms of its acceptance or rejection relative to the following two criteria are adapted as follows:

- For the Net Present Value
  - NPV>0, the investment is good
  - NPV=0, the financial outcome of the investment is borderline
  - NPV<0, the investment is rejected
- For the IRR
  - NPV>0, from the minimum accepted discount rate, the investment is good
  - NPV=0, with minimum accepted discount rate, the investment is borderline, and proceeds if there is no better alternative
  - NPV<0, from the minimum accepted discount rate, the investment is rejected

Regardless of the criterion that is used, a comparison between two or more alternative investment plans is carried out; the plan selected is the one that offers the best returns, i.e. the highest NPV or the highest IRR. As mentioned before, both methods are widely used, usually combined together, since each of these methods has advantages and disadvantages.

Regardless of the method employed for the assessment of investment plans, the fact shouldn't be discounted that the validity of the calculations depends on an accurate table of cash flows. In this respect, it is prudent for the following theoretical principles to be followed (Torries, 1998):

- The variables entered in the table will have to be completely known. In reality, the variables entered in the model are seldom precisely determined and completely known. There is always a risk arising from a number of sources of uncertainty, and to this direction various techniques are used, such as sensitivity analysis, probabilistic inference using Monte Carlo etc.

- The alternative plans that are to be assessed must have comparable discount rates, which will reflect the risks of the different choices. The term "comparable" doesn't mean "identical". Each plan carries a different risk for the investor, therefore the discount rate may be different.

- All alternative plans compared in a cash flow table should be drawn up by utilizing a common model for managing taxes, income, depreciation etc. That means that comparisons should be made on a common basis (e.g. comparisons of NPV before or after taxes in all plans, depreciations according to the standing framework etc.).

An example of one of the various cash flow models used to conduct this analysis can be found in Appendix A.

3.2 DATA

The table below represents all operational data in relation to newly built and second hand Post-Panamax container ships according to key shipping companies in the field.

Table: 3.2.1

NEWLY BUILD POST-PANAMAX CONTAINER VESSELS				
Vessel	***TEU Capacity***	***Delivery Cost***	***OPEX (Daily)***	***Earnings (Daily)***
P.-P. Con. Vessel 1	9,500	$ 85,500,000.00	$ 6,943	$ 34,000
P.-P. Con. Vessel 2	9,500	$ 84,000,000.00	$ 7,480	$ 32,000
P.-P. Con. Vessel 3	8,428	$ 61,000,000.00	$ 8,287	$ 15,000
P.-P. Con. Vessel 4	8,530	$ 66,400,000.00	$ 8,588	$ 21,000
P.-P. Con. Vessel 5	6,554	$ 63,900,000.00	$ 7,028	$ 12,000
P.-P. Con. Vessel 6	6,572	$ 50,000,000.00	$ 6,890	$ 21,000
P.-P. Con. Vessel 7	6,500	$ 48,500,000.00	$ 7,692	$ 15,000

Source: Top ranked shipping firms

Table: 3.2.2

SECOND HAND POST-PANAMAX CONTAINER VESSELS *(5-years old)*				
Vessel	***TEU Capacity***	***Purchase Cost***	***OPEX (Daily)***	***Earnings (Daily)***
P.-P. Con. Vessel 1	9,580	$ 57,000,000	$ 8,432	$ 45,000
P.-P. Con. Vessel 2	9,500	$ 61,000,000	$ 9,037	$ 35,000
P.-P. Con. Vessel 3	8,464	$ 53,000,000	$ 7,780	$ 26,000
P.-P. Con. Vessel 4	8,500	$ 48,400,000	$ 8,025	$ 11,500
P.-P. Con. Vessel 5	6,246	$ 37,700,000	$ 7,920	$ 9,000
P.-P. Con. Vessel 6	6,500	$ 35,200,000	$ 7,945	$ 14,000

Source: Top ranked shipping firms

Table: 3.2.3

SECOND HAND POST-PANAMAX CONTAINER VESSELS *(10-years old)*				
Vessel	***TEU Capacity***	***Purchase Cost***	***OPEX (Daily)***	***Earnings (Daily)***
P.-P. Con. Vessel 7	9,500	$ 46,600,000	$ 9,495	$ 30,000
P.-P. Con. Vessel 8	9,500	$ 37,900,000	$ 9,626	$ 28,000
P.-P. Con. Vessel 9	8,500	$ 35,400,000	$ 8,937	$ 15,000
P.-P. Con. Vessel 10	8,530	$ 32,000,000	$ 9,245	$ 26,000
P.-P. Con. Vessel 11	6,500	$ 22,000,000	$ 8,526	$ 22,000
P.-P. Con. Vessel 12	6,252	$ 20,000,000	$ 8,385	$ 9,000

Source: Top ranked shipping firms

Chapter 4. Cash-Flow Analysis - Results

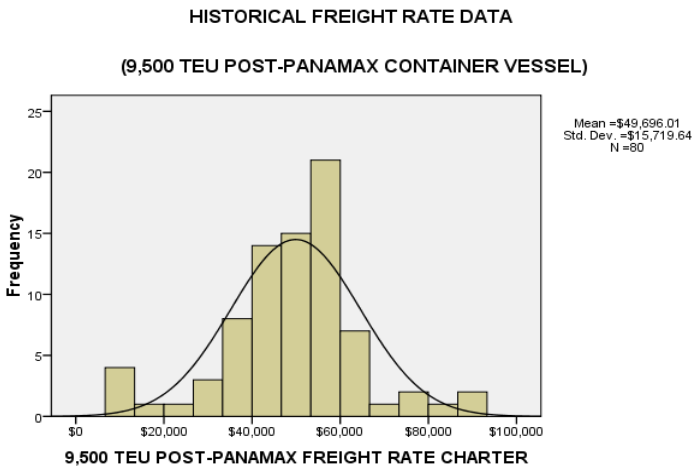
In this chapter, based on the methodology analyzed in chapter three, the results of the cash flow models will be presented in order to forecast the NPV of such investments. After examining the freight volatility as described in chapter three, we will move on with the results of the NPV of new and second hand Post-Panamax containerships. This will be done through presentation of graphs; due to page limitations only three scenarios of each case will be presented in this chapter, the worst case scenario with 40% decreased freight rates, best case scenario with 50% increased freight rates and the freight rate value the shipping companies have obtained through their contracts. As mentioned in chapter three, all cases are based on a ten year time-charter contract. The results are divided in three cases, newly built, second hand five years old and second hand ten years old. The complete sets of figures used for the purpose of this analysis can be found in Appendix B. The chapter concludes with a break-even analysis, by applying the cash-flow model for the entire sample, by questioning the price of the freight rate in order the NPV after a 10 year period to be equal to zero implying the financial outcome of the investments as borderline.

4.1 Freight Volatility

The following graphs illustrate the freight volatility for each size of Post-Panamax vessels, 9500 TEU, 8500 TEU and 6500 TEU respectively.

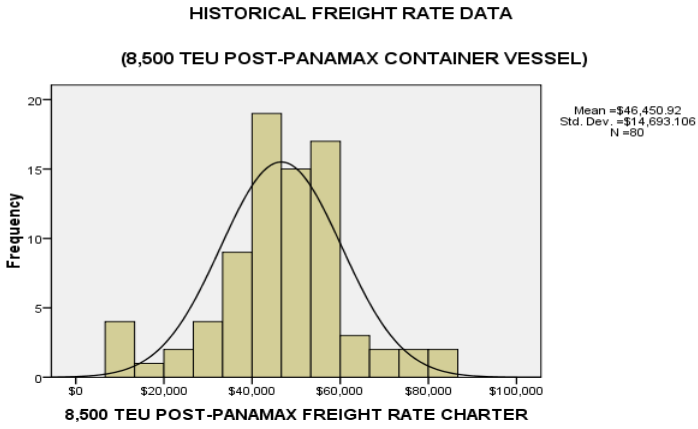
In addition, the historical freight rate data is based on a 20 year period. Therefore, the following histograms are presented with their normal distribution curves. The mean and standard deviation derived from the elaboration of the data, using SPSS for each case and it's noteworthy to mention that the current freight rates used to conduct the further analysis are much lower than the mean freight prices that derived from the histograms.

Figure 4.1a



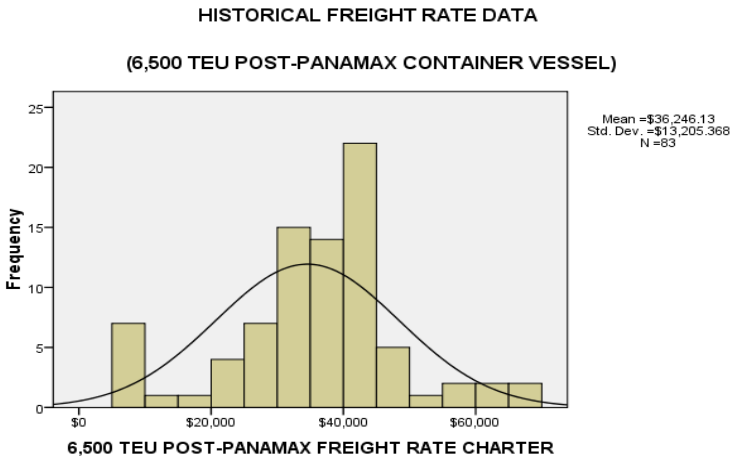
Source: author based on Clarkson's database

Figure 4.1b



Source: author based on Clarkson's database

Figure 4.1c



Source: author based on Clarkson's database

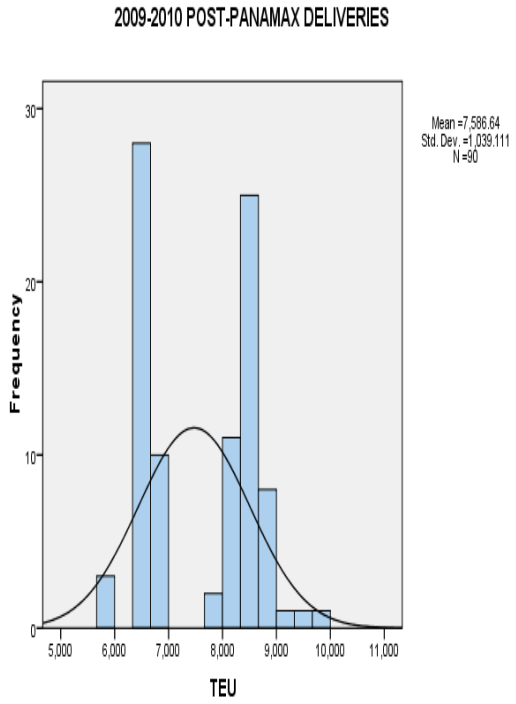
In Chapter 5, based on the above graphs, an analysis is developed, using @Risk measuring the sensitivity of the charter rates by simulating the above data and performing various iterations.

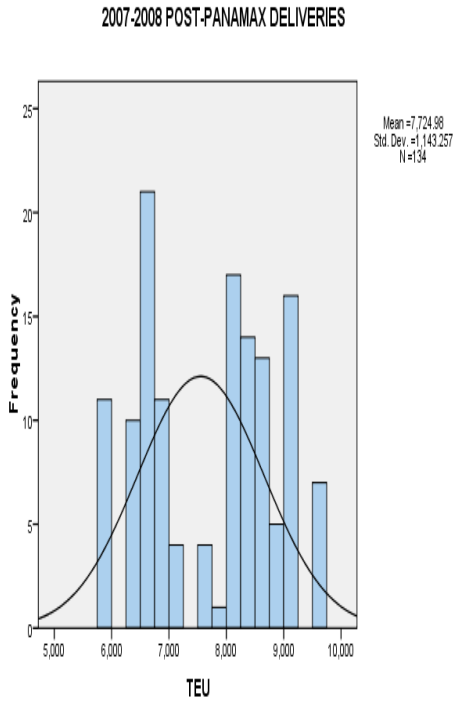
4.2 Case 1 Results – Newly Built Post-Panamax Container Vessels

The following two graphs display histograms of 2009-2010 and 2007-2008 deliveries of Post-Panamax vessels and their normal distribution curves.

Figure: 4.2a

Figure: 4.2b





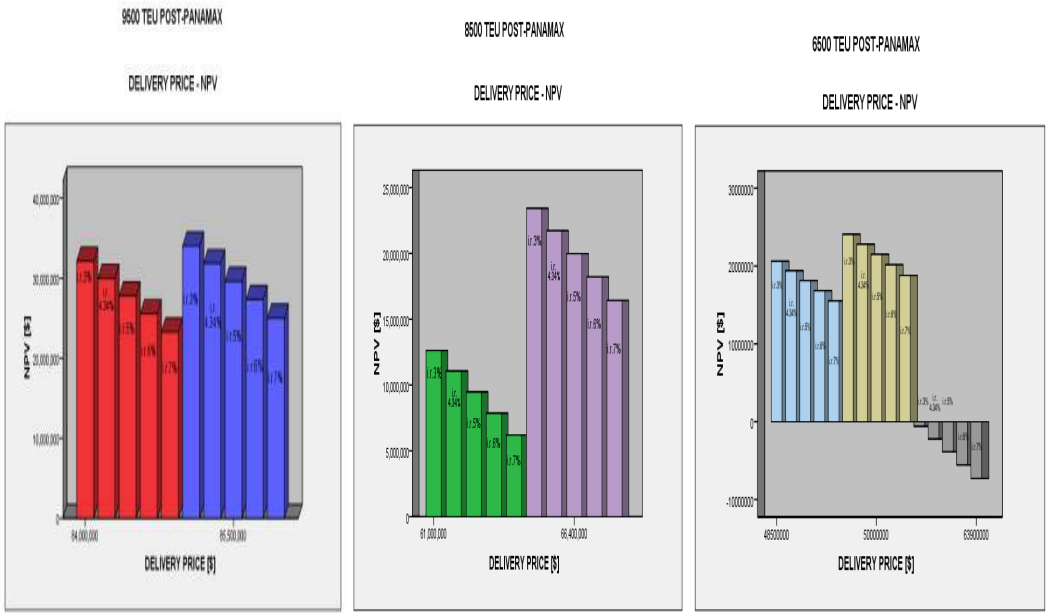
Source: author based on Clarkson's database

When comparing the two figures, it can be observed that due to the financial crisis the deliveries decreased. In 2009-2010 the deliveries with the highest percentage were in vessels of 6,500 TEU and 8,500 TEU. On the other hand, the previous years the 9,500 TEU vessels achieved high number of sales.

4.2.1 Scenario 1 – 2010 Actual Freight Rates

The following figures illustrate the relationship between delivery price and NPV of new built Post-Panamax vessels. Each figure represents a different size of vessel, as well as each set of coloured bars corresponds to one vessel model, forecasting the NPV for different interest rates, 3%, 4.34% (total interest rate in June 2010), 5%, 6% and 7%.

Figure: 4.2.1.1 Figure: 4.2.1.2 Figure: 4.2.1.3



Source: author based on elaboration of the data

In Figure 4.2.1.1 the red and blue bars represent two 9500 TEU containerships with a $84,000,500 and $85,500,000 delivery cost. As it can be observed both cases have high NPV values after 10 years, (between $25,000,000 and $35,000,000) due to the low daily operating expenses, which start around $7000 per day and the high earnings, around $30,000 daily. It is noticeable that with any combination of interest rate the NPV remains high for both investments.

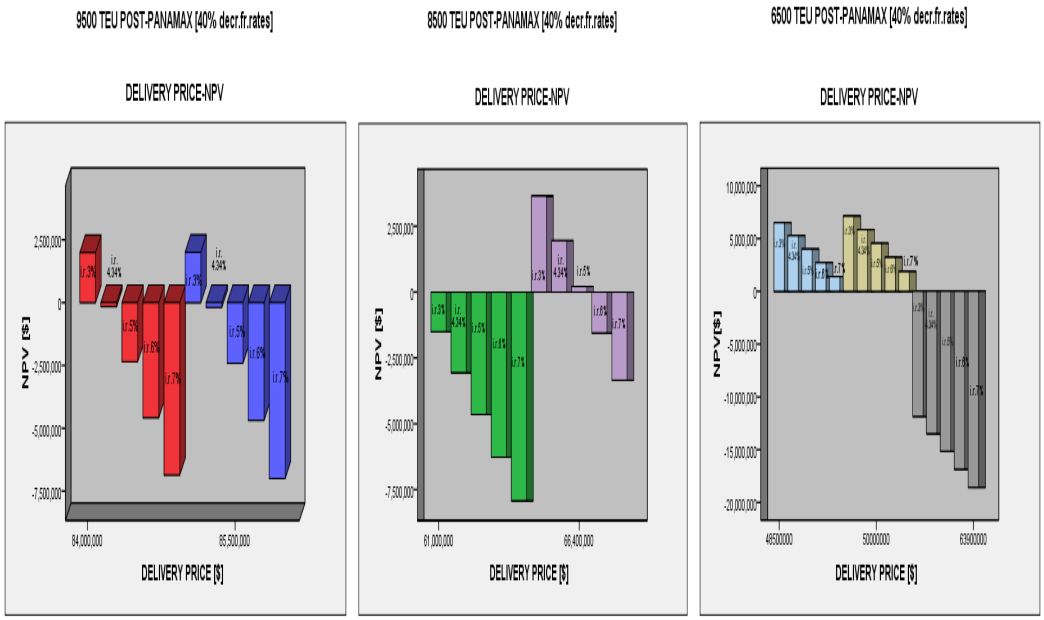
In Figure 4.2.1.2 the green, as well as the purple bars stand for two 8500 TEU ships. The green bars represent a vessel of $61,000,000 delivery cost and the purple of $64,400,000. It is visible that the case with the higher delivery cost reflects to a higher NPV value as the expenses in both cases are approximately $8,000 and the earnings $15,000 and $21,000 respectively. Fluctuations in interest rates still do not affect such investments.

Figure 4.2.1.3 illustrates three 6500 TEU new built container ships. The operating expenses for all three models range between $7,000-$7,500.The delivery prices vary between $48,500,000 and $63,900,000. The light blue and yellow case produce profitable investments as the NPV in both cases remains high throughout all levels of interest rate. The daily earnings of these two cases are $15,000 and $21,000. On the other hand, the third case which is the most expensive with earnings around $12,000 daily appears to have a negative trend in response to the NPV due to the high delivery cost and low earnings. Investments similar to this one should be rejected.

4.2.2 Scenario 2 – 40% Decreased Freight Rates

In this section the correlation between NPV and delivery price of each model will be presented with the freight rates decreased 40% in order to forecast the profitability of each investment in the worst case scenario.

Figure: 4.2.2.1 Figure: 4.2.2.2 Figure: 4.2.2.3



Source: author based on elaboration of the data

In figure 4.2.2.1, which represents the 9500 TEU vessels, it is clearly observed that with decreased freight rates 40% the NPV appears to have a negative value for most interest rates, resulting in rejecting the investment. Both models are considered profitable when the interest rate is between 3% and 4.34%. The moment it reaches 5%, the negative trend is clearly shaped.

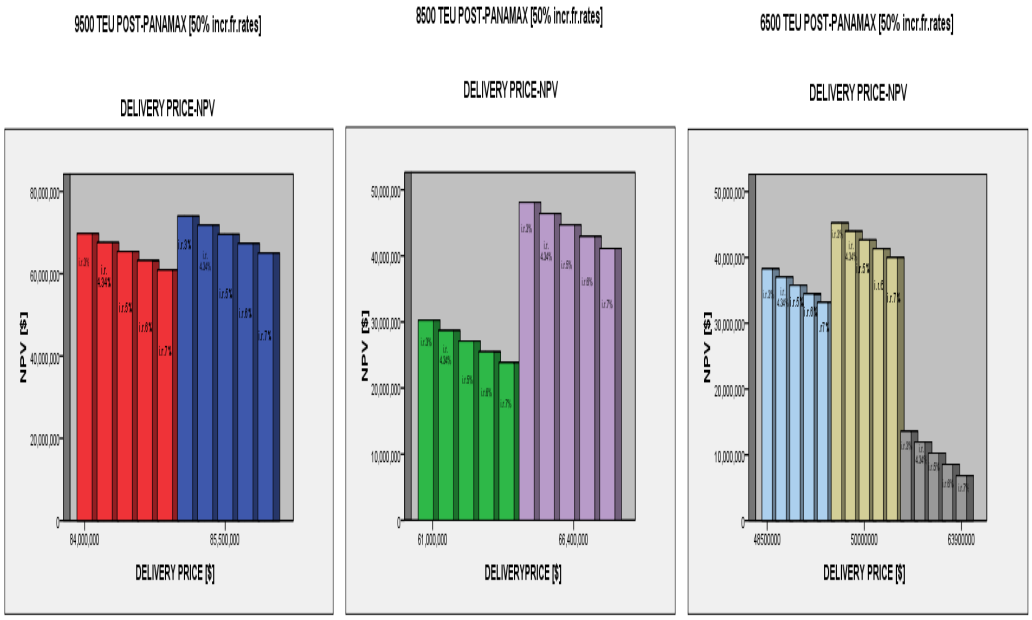
Figure 4.2.2.2 illustrates the NPV – delivery price relationship for 8500 TEU vessels with freight rates decreased 40% compared to the first scenario. It is obvious with 40% decreased freight rates the 8500 TEU vessel illustrated by the green bars, delivery cost of $61,000,000 appears to have a negative NPV. On the other hand, the other model represented by the purple bars, although its delivery cost is a “hair” higher, it appears to have a positive NPV for interest rates 3% and 4.34% between $2,000,000 - $4,000,000.

Figure 4.2.2.3 demonstrates the relationship, NPV-delivery price for three 6500 TEU vessels with decreased freight rates 40%. In comparison to the other two graphs, it appears to generate the highest profits (NPV varies from $2,000,000 - $8,000,000) due to the absolute association between delivery price, earnings and expenses. The third model (illustrated with grey bars) of this category appears to have negative values as in the first scenario and should be rejected when the freight rates are so low.

4.2.3 Scenario 3 – 50% Increased Freight Rates

The third scenario presents a 50% increase of the freight rates, which is considered as the “hand-picked” scenario according to the level of the freight rates for the last 20 years. Similar, to the previous scenarios the relationship between NPV and delivery price for all vessel categories will be presented and analyzed in this section.

Figure: 4.2.3.1 Figure: 4.2.3.2 Figure: 4.2.3.3



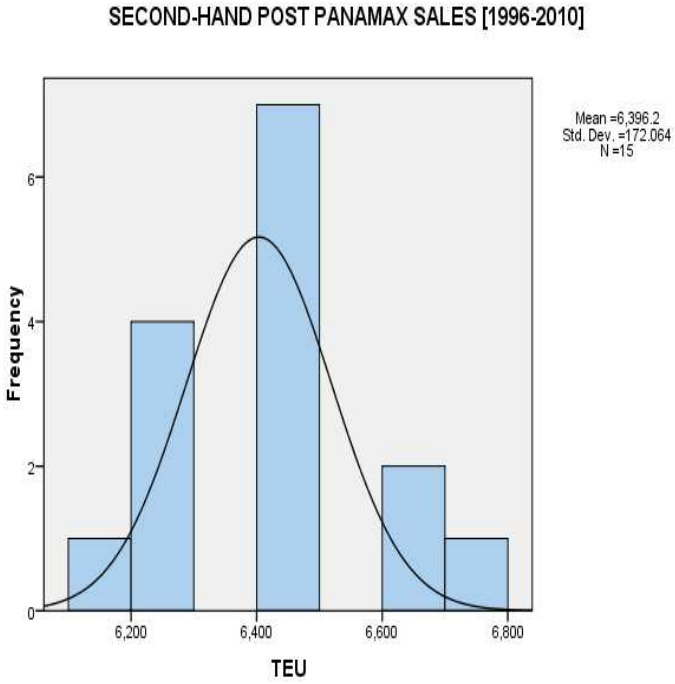
Source: author based on elaboration of the data

Figures 4.2.3.1, 4.2.3.2, 4.2.3.3 appear to have extremely high NPV. The first category of 9,500 TEU, vary between $60,000,000 – $80,000,000. The second category of 8,500 TEU signified by green and purple bars reach as well high levels of NPV between $25,000,000 – 50,000,000 and the third category of Post-Panamax vessels, the smaller size of this family of ships achieve to reach the significant point of $50,000,000.

4.3 Case 2 Results – Second hand Post-Panamax Container Vessels (5 year old)

The graph below presents a histogram with its normal distribution curve for second hand Post-Panamax sales since 1996.

Figure: 4.3a



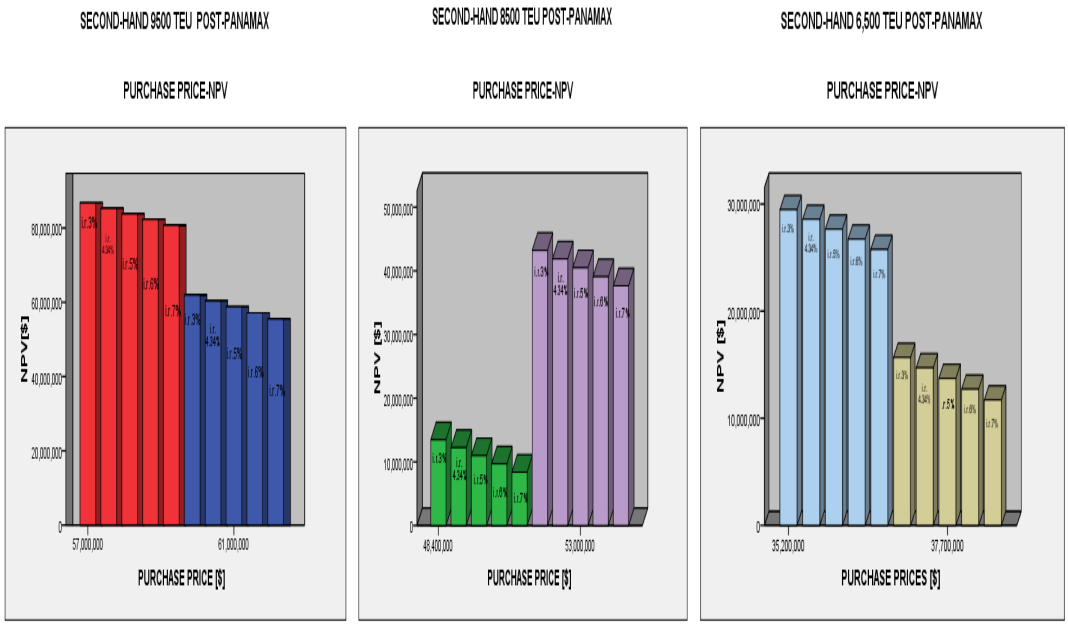
Source: author based on Clarkson's database

It is observed that the highest sales of second-hand Post-Panamax container carriers are seen in 6,500 TEU vessels.

4.3.1 Scenario 1 – 2010 Actual Freight Rates

In this part of the study the results relating to the NPV and purchase price of the second-hand Post-Panamax (5 years old) will be described and compared with the results of the newly built container vessels.

Figure: 4.3.1.1 Figure: 4.3.1.2 Figure: 4.3.1.3



Source: author based on elaboration of the data

Figure 4.3.1.1 demonstrates how the NPV – purchase price develops for different interest rate values. The high NPV values are clearly observed and reach the price of $80,000,000. The purchase prices of the second-hand 9,500 TEU vessels are $57,000,000 for the case presented in red bars and $61,000,000 for the model marked in blue bars. The operating expenses for these ships are between $8,500 - $9,000, a little higher than the ones in the case 1, due maintenance as older vessels. The earnings though are higher than the new built vessels, $45,000 for the first model and $35,000 for the second one, due to the reason that these ships had previous signed charter party contracts.

In figure 4.3.1.2 the green bars represent a 8,500 TEU second hand vessel with a purchase price of $48,400,000 and the purple bars a 8,500 TEU second hand vessel with a purchase price of $53,000,000. It is noticeable that the purchase prices of these second hand vessels have dropped by $15,000,000 - $20,000,000 compared to the delivery price of the new built container ships of this category. The expenses cost are around $8,000 and the earnings $11,500 for the one presented with green colour and $26,000 for the one shown in purple bars. The big difference between these two prices is an effect based on the date the time-charter contract was signed. In comparison to the new built 8,500 TEU, the two described vessels of this scenario appear to have higher NPV, around $15,000,000 for the first model and $50,000,000 for the second, which are considered as more profitable investments.

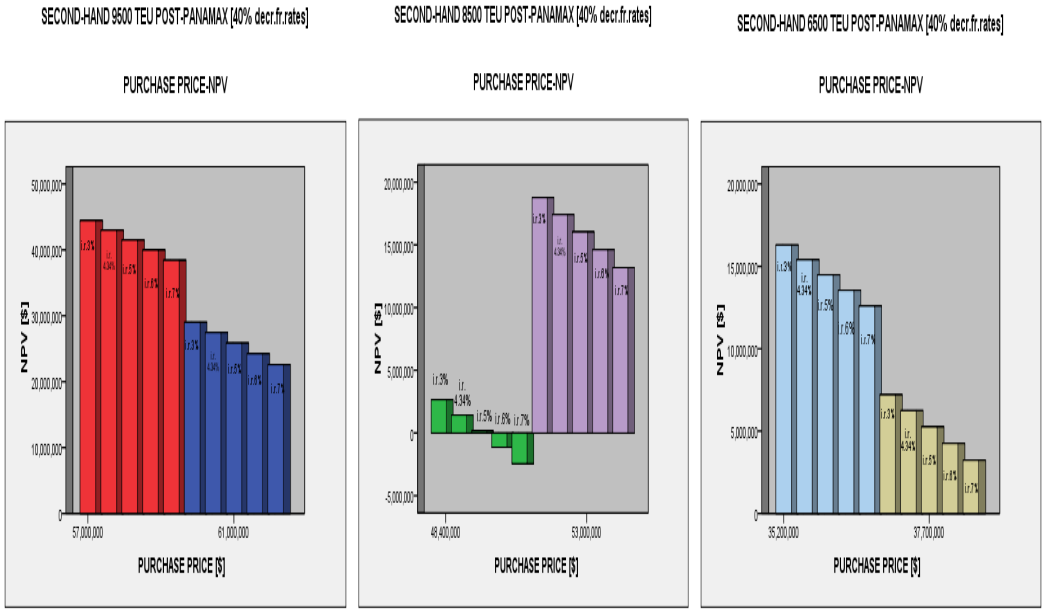
Figure 4.3.1.3 illustrates two second-hand 6,500 TEU vessels, one in light blue bars and the other in brown colour. The first model has a purchase price of $35,200,000 and the second model $37,700,000. In this case as well, the purchase price has dropped around $15,000,000 compared to new builds. The expenses are around $8,000 and the earnings $14,000 for the model marked with light blue bars and $9,000 respectively for the brown colour model. The level of the NPV price is similar

to the new built vessels of this category between $15,000,000 - $30,000,000, excluding the rejected investment in case study 1.

4.3.2 Scenario 2 – 40% Decreased Freight Rates

Scenario 2 of case study 2 refers to the presentation of the relationship between NPV and purchase price for second-hand Post-Panamax containers with the freight rates decreased 40% compared to case 2 scenario 1.

Figure: 4.3.2.1 Figure: 4.3.2.2 Figure: 4.3.2.3



Source: author based on elaboration of the data

Figure 4.3.2.1 compared to figure 4.2.2.1 of the new build scenario are characterised as more feasible investments, as in all levels of interest rate, concerning both models the NPV remains enormously high, reaching the price of $45,000,000.

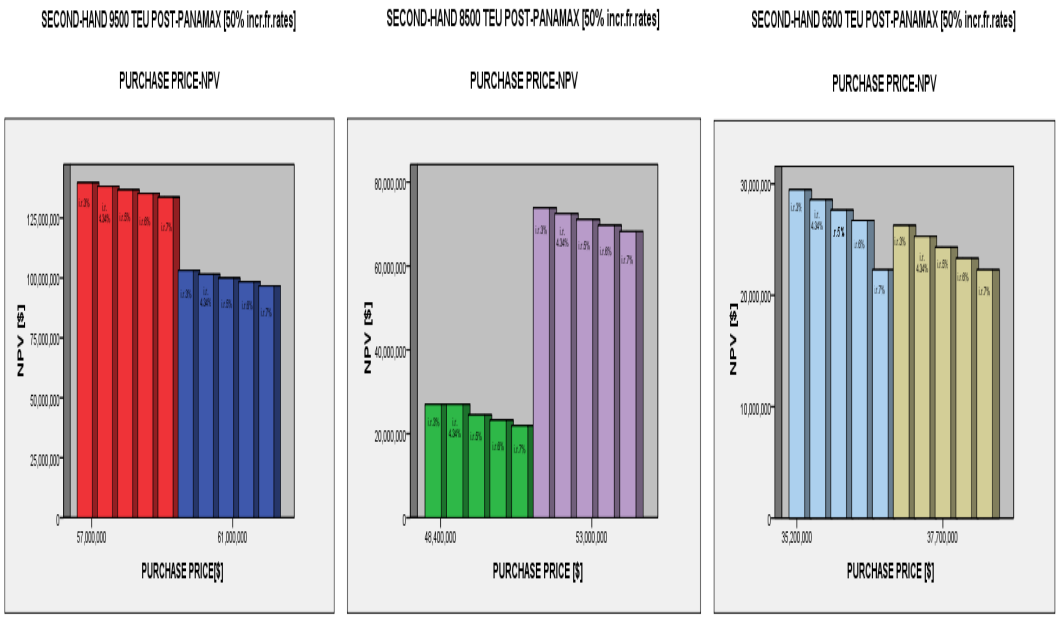
The model presented in Figure 4.3.2.2 with green colour presents negative NPV for interest rate 6% and 7% due to the high effects the decreased earnings have on the final value of the NPV. On the other hand the second model of this category, presented with purple bars seems to retain the NPV in high levels even if the freight rates decrease 40%. Comparing these two cases (new built and second-hand), insinuates that second hand 8500 TEU vessels (5 year old) are more feasible than new built of the same category, even when the freight rates are so low.

Figure 4.3.2.3 justifies that the NPV price for these models (6,500 TEU ships) of all interest rates varies from $4,000,000 to $6,000,000. Corresponding to the new built case, the NPV level of five year old second hand container ships is an “inch” higher, due to the low purchase price and better charter contracts of previous years.

4.3.3 Scenario 3 – 50% Increased Freight Rates

This section will analyze the effects the NPV will have on second hand Post-Panamax container vessels if the freight rates increase 50%. The following graphs verify the levels of the NPV for 5 year old 9,500, 8,500 and 6,500 TEU container vessels and through the analysis, conclusions are reached relating to which investment is considered as more profitable.

Figure: 4.3.3.1 Figure: 4.3.3.2 Figure: 4.3.3.3



Source: author based on elaboration of the data

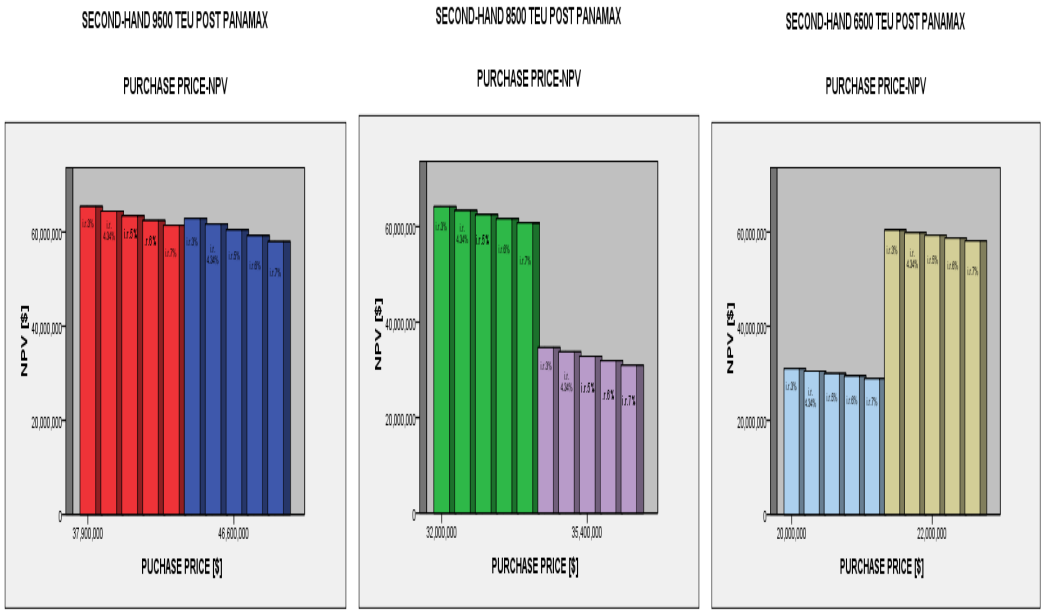
In the most positive scenario, 50% increase of the value of the freight rates, it is clearly observed in all three graphs, figure 4.2.3.1, figure 4.2.3.2 and figure 4.2.3.3 that the NPV price for second hand containers (5 year old) reaches extremely high values; above $100,000,000 for the case of 9,500 TEU ship. With this significant increase in freight rates it is monitored, for the 8,500 TEU ship that the NPV reaches $80,000,000; $20,000,000 more than the case of a new built acquisition. Comparing the levels of the NPV for the 6,500 TEU ships with the newly builds in case study 1 we conclude that they don't differ much, as the NPV is between $25,000,000 - $35,000,000.

4.4 Case 3 results – Second-hand Post-Panamax Container Vessels (10 year old)

4.4.1 Scenario 1 – 2010 Actual Freight Rates

The following graphs present the relationship between NPV and purchase price for second hand ten years old Post-Panamax container vessels. The purchase price of the 9,500 TEU vessels is based on prices according to SIN(2010) The charter party's are based on the speculation that are transferred with the vessels to the new owners apart for the model in figure 4.3.1.2 displayed with purple bar and the model in figure 4.3.1.3 shown in light blue colour.

Figure: 4.4.1.1 Figure: 4.4.1.2 Figure: 4.4.1.3



Source: author based on elaboration of the data

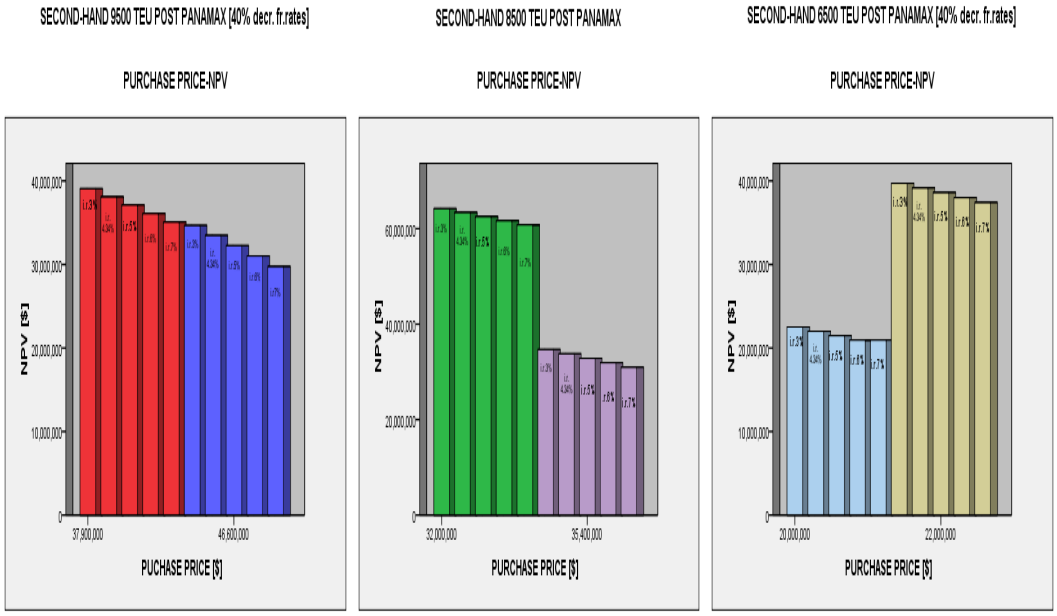
The purchase costs of the 9500 TEU vessels in figure 4.4.1.1 are $37,900,000 and $46,600,000. The earnings are $28,000 and $30,000 respectively and the expenses for each vessel around $9,500. The price of the NPV of both vessels in comparison to case 1 with the newly built vessels is higher and reaches the value of $60,000,000. On the other hand, the value is lower than the NPV level of the 5 year old second hand vessels.

Figure 4.4.1.2 displays the position of the NPV for different values of interest rates of two 8,500 TEU vessels. The NPV price for the vessel presented with green bars varies around $60,000,000 with purchase price of $32,000,000. Compared to the five year old second hand and newly built vessel, this model of the same category, has the highest NPV value and is considered as the most feasible investment. The earnings reach $26,000 daily and expenses cost around $9,500 per day. On the other hand the model displayed with the purple bars although it has a significant lower NPV price than its sister vessel is considered as a more profitable investment in comparison to the new built scenarios. The purchase price is $35,400,000, the earnings $15,000 and the expenses cost around $9,000.

Figure 4.4.1.3, displaying the light blue and brown bars relates to 6,500 TEU container vessels and reflects the price of the NPV for different interest rates compared to the purchase price. The purchase price of the first model is equal to $20,000,000 and the price for the second model is $22,000,000. The considerable difference of the NPV level is due to the low freight rates of the first model, $9,000 compared to $22,000. The expenses for both ships are around $8,500. It is noteworthy that the purchase prices of such investments are so low in contrast with new built and five year old second hand, resulting ten year old second hand Post-Panamax container vessels to gain more profits after the repayment of the 10 year debt.

4.4.2 Scenario 2 – 40% Decreased Freight Rates

Figure: 4.4.2.1 Figure: 4.4.2.2 Figure: 4.4.2.3



Source: author based on elaboration of the data

The above graphs expose the high prices of NPV for all cases, 9,500 TEU, 8,500 TEU and 6,500 TEU although the evaluation is done based on the worst case scenario of 40% decreased freight rates.

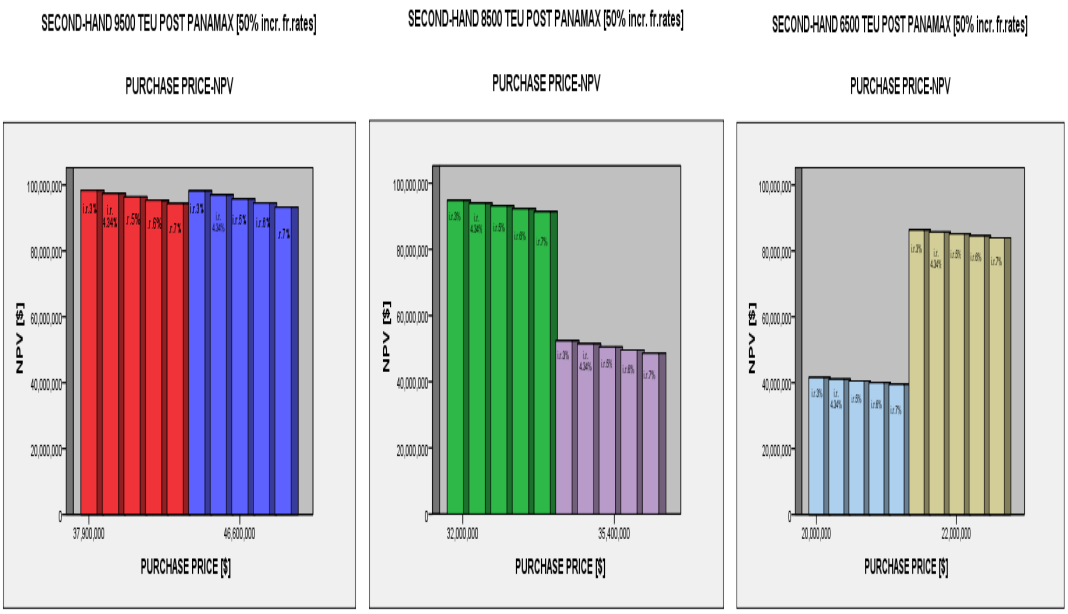
According to figure 4.4.2.1 the investments in 9,500 TEU ships could be considered to formulate more profits than the new built vessels as the NPV is higher, but less than the five year old second hand 9,500 TEU vessels.

Figure 4.4.2.2 and figure 4.4.2.3 picture NPV prices between $20,000,000 - $40,000,000 for both sizes, 8,500 and 6,500 and compared to the same scenario of the other cases (new-built and five year old second hand), the described investments appear to have higher profits by examining the NPV levels.

4.4.3 Scenario 3 – 50% Increased Freight Rates

The following graphs express the relationship between NPV - purchase price for second hand ten year old Post-Panamax vessels of all TEU major categories with 50% increase in freight rates compared to case 3 scenario 1. In all three figures it is clearly observed the high price the NPV creates in all categories. The majority of them reach the price of $100,000,000 considering these investments beneficial and advantageous compared to the cases discussed in other sections of this chapter.

Figure: 4.4.3.1 Figure: 4.4.3.2 Figure: 4.4.3.3



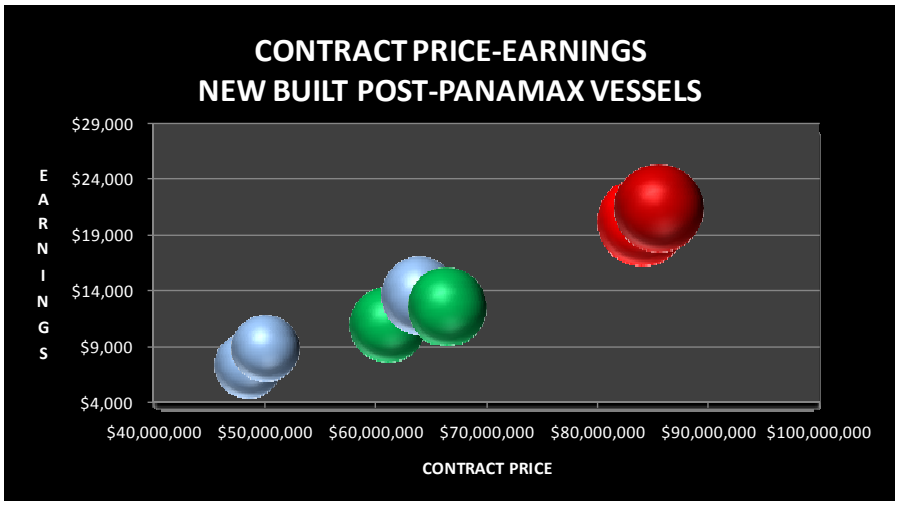
Source: author based on elaboration of the data

4.5 Break-Even Analysis

This section describes the results obtained from the break-even analysis applied to all the sample of vessels. The results will be presented in 3 graphs, one for each case as analyzed previously. Bubble charts will express the average earning price corresponding to the purchase price of each vessel. Each bubble refers to an individual case covering the average earning price, resulting from the different combination of interest rates used in the cash flow models. The results were acquired with the use of solver function applied to all cash flow models searching the price of the freight rate in order the NPV to be equal to zero after the repayment of the loan.

The below figure illustrates the relationship between earning price and contract price for newly built Post-Panamax container vessels.

Figure: 4.5.1

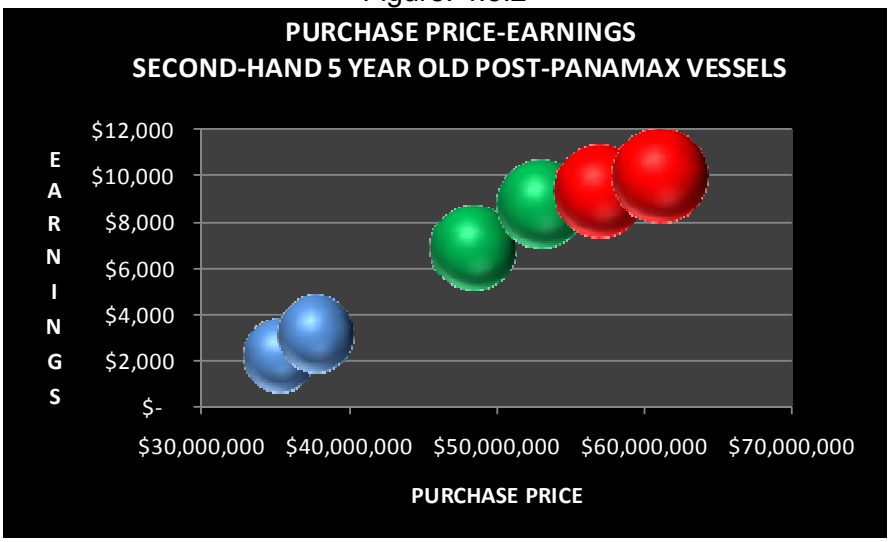


Source: author based on elaboration of the data

The red bubbles represent 9,500 TEU vessels, the green 8,500 TEU vessels and the light blue 6,500 TEU Post-Panamax containerships. It is observed that the 9,500 TEU capacity vessels reach a NPV of zero after ten years of $22,000 per day constant earnings, based on the delivery price of the vessels. On the contrary the 8,500 TEU containerships necessitate approximately $12,000 daily. In addition the smaller size of this generation of ships, require roughly $8,000 per day, constantly for ten years. According to the above graph it is noticeable that the 9,500 TEU vessels can be considered extra risky.

Figure 4.5.2 displays the average price of earnings per day for 5 year old Post-Panamax container vessels in order the NPV to be equal to zero after a ten year period.

Figure: 4.5.2

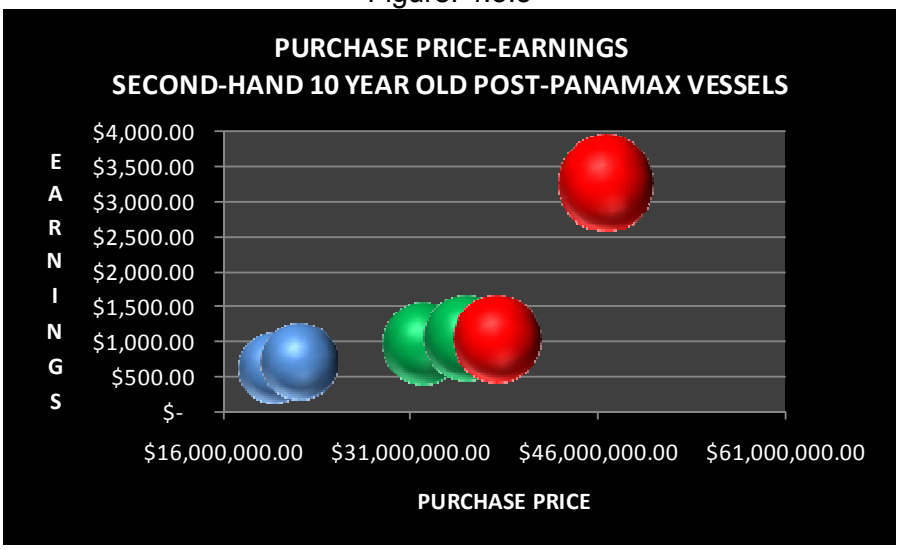


Source: author based on elaboration of the data

In contrast with the previous case, the 8,500 and 9,500 TEU capacity vessels appear to have a more balanced price between $7,500 and $10,000 daily depending on the price of the investment. In comparison to the newly built vessels, the freight

rates of the 9,500 TEU vessels are obvious that are lower in order the financial outcome of the investments to be considered as borderline, justifying the investments as less risky. The category referring to the 8,500 TEU ships appear to have minor differences with the sample examined in the new building case. The 6,500 TEU ships appear to satisfy the ten year demands with extremely low earnings around $3,000 daily, approximately $5,000 less than the equivalent investments relating to the first case.

Figure: 4.5.3



Source: author based on elaboration of the data

In figure 4.5.3, which represents the case of the ten year old second hand container vessels, it is observed that the 9,500 TEU vessel with the $46,000,000 purchase price requires higher constant earning compared to the other cases, assuring it as the less feasible. The other investments appear to require lower freight rates between $500 and $1,500 daily due to the low purchase costs relating to these investments. Although the maintenance costs for these ships are higher affecting the overall operating expenses, the above investments entail to require lower earnings in order the NPV to be equal to zero, in contrast to the newly built and five year old cases.

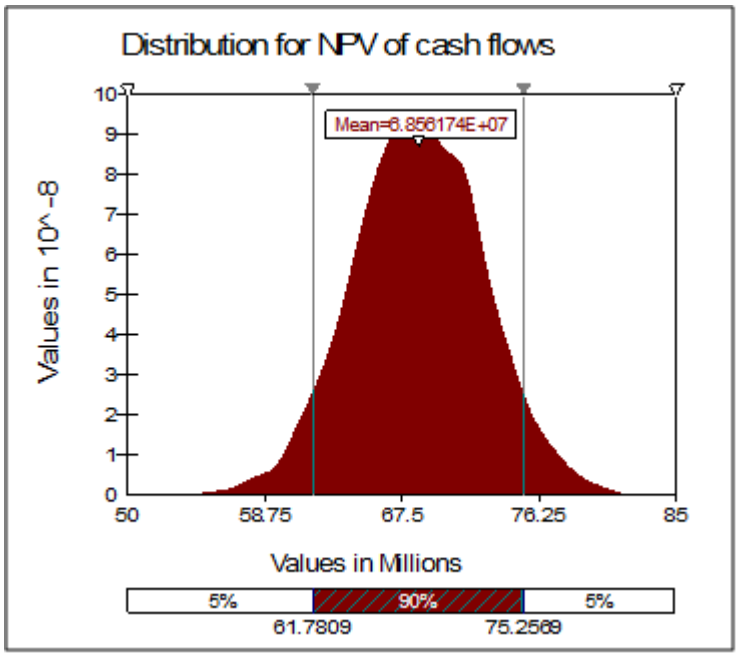
Chapter 5. Sensitivity-Risk Analysis

In this chapter a sensitivity analysis will be analyzed referring to the correlation between the NPV of each project and the combination of interest rates and freight rates. The risk analysis will be analyzed with the use of @Risk by producing graphs relating to the case studies presented in chapter four. The chapter composed of three sections, one for each of the following cases: new built vessels, five year old second hand vessels and ten year old Post-Panamax container carriers. In this case due limit constraints only one model of each size of vessel will be presented; created by calculating the average purchase price and earnings of each category. In order to measure the risk of each investment, the normal distribution curves examining the freight rates of the last 20 years, presented in the previous chapter are used in order to get an accurate simulation with @Risk regarding the NPV of each investment. Simultaneously the model toggles different values of interest rates to express the influence they have on the NPV of each investment. The graphs illustrated below derive from 10,000 iterations in order to produce as more precise results as possible.

5.1 Case 1: Newly Built Post-Panamax Container Vessels

The below graph illustrates how the NPV changes according to the fluctuation of the freight rates and interest rates for the 9,500 TEU Post-Panamax “investments” in a ten year period. It is noticeable that the mean price of the NPV is equal approximately to $68,000,000. The maximum NPV for such investments reaches $82,000,000 and the minimum $53,000,000. The following results identify that although the freight rates the last year have been very low, in a long-run period the NPV is not influenced in such a high level, resulting with high profits for the investors.

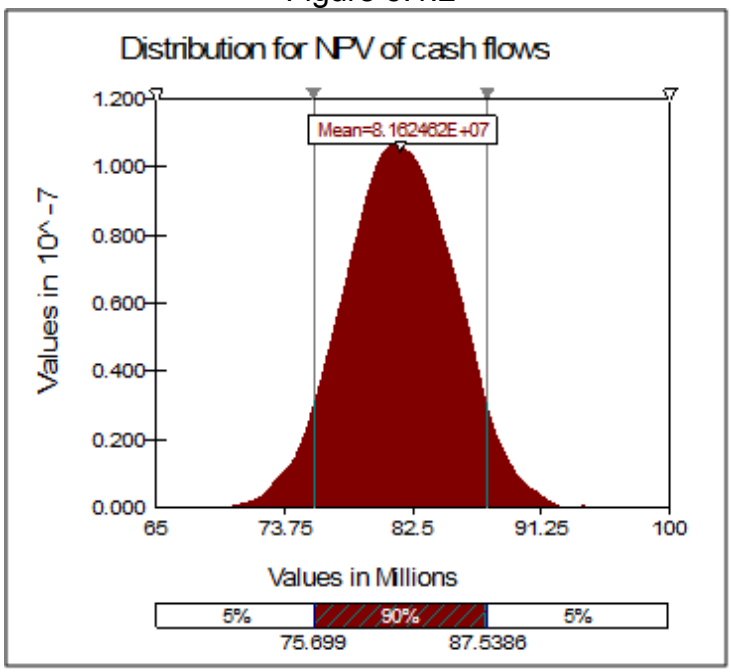
Figure 5.1.1



Source: author based on elaboration of the data

Figure 5.1.2 presents the risk analysis for newly built 8,500 TEU containerships.

Figure 5.1.2

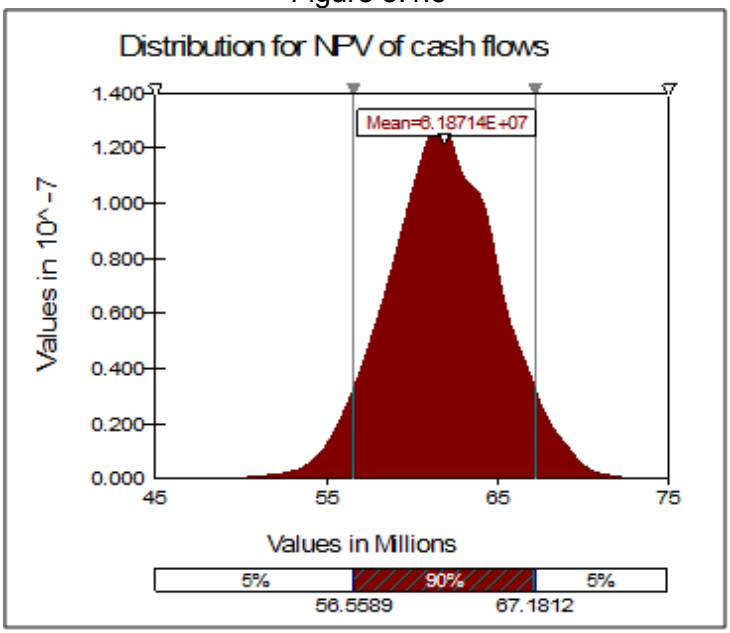


Source: author based on elaboration of the data

For this size of vessels the average price of the NPV is equal to $81,000,000 based on the results obtained from @Risk. It is noticeable that the NPV in this case is higher than the 9,500 vessels, although the freight rates are lower. The risk in this case is less due to the lower delivery price of such investments. The maximum value the NPV can reach is $95,000,000, almost a nine digit value and the minimum $69,000,000 with a standard deviation of $3,500,000 according to the obtained results.

Figure 5.1.3 displays the results of the simulation of NPV for 6,500 TEU container vessels.

Figure 5.1.3



Source: author based on elaboration of the data

The above figure in comparison to the other two scenarios has a much lower average NPV, equal to $61,000,000. The maximum price in this case is $74,000,000 and the minimum $48,000,000. Although the value of the NPV is lower compared to newly built 8,500 and 9,500 TEU vessels, it is noteworthy that even with lower freight rates, the results support the argument to serve high profits to investors interested in purchasing this size of vessels.

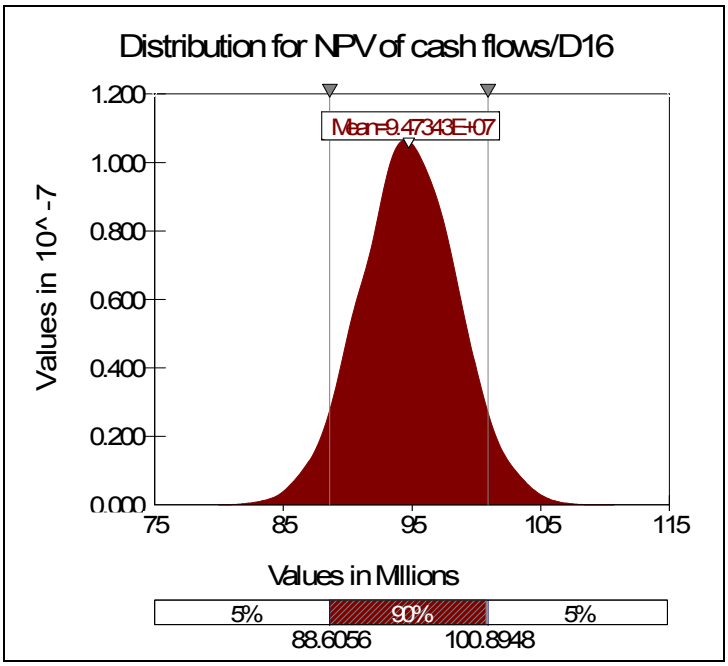
By comparing the above three cases, the investment with the smaller amount of risk, that generate the highest profits is the 8,500 TEU container vessel.

5.2 Case 2: Second-Hand 5 Year Old Post-Panamax Container Vessels

This section examines the risk and sensitivity analysis between NPV, interest rate and freight rate for five year old second hand Post-Panamax container vessels.

Figure 5.2.1 represents a 9,500 TEU vessel.

Figure 5.2.1

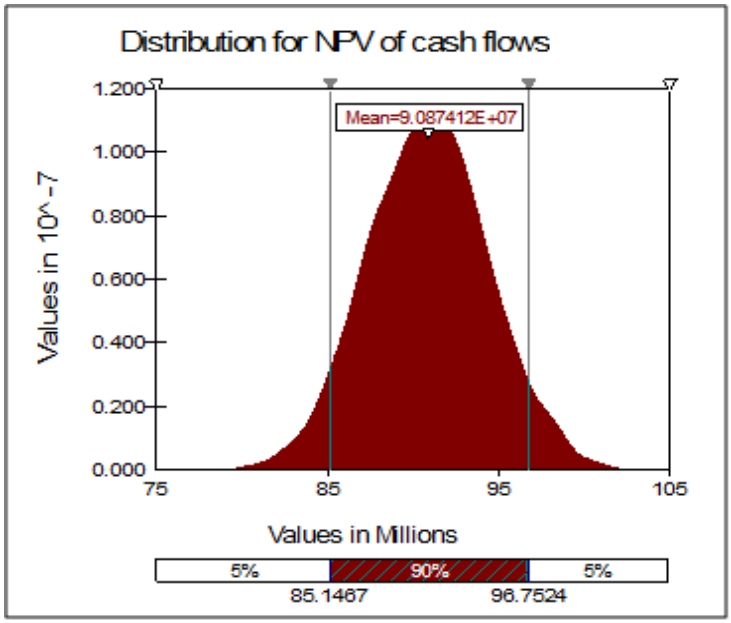


Source: author based on elaboration of the data

The mean NPV for this investment is equal to $94,000,000, revealing in this case as well, that the historical freight rates are much higher than the current rates considering this investment high profitable. By comparing the results obtained from the software with the 9,500 TEU vessels in case 1, it is observed that it is more feasible to invest in a five year old second hand vessel than in a new built, as the purchase price is 20% lower allowing the NPV value to reach such a high level. The maximum value the NPV can reach in this scenario is $110,000,000 and the minimum approximately $80,000,000, which is $10,000,000 higher than the average NPV of the newly built 9,500 TEU vessel. Not taking into account the age of the ship, which is significantly small and the effects it could have in maintaining the vessel, this scenario is considered by far more feasible.

The below chart describes the sensitivity that appears between the volatile factors (interest rate and freight rate) and the NPV for 8,500 TEU vessels.

Figure 5.2.2

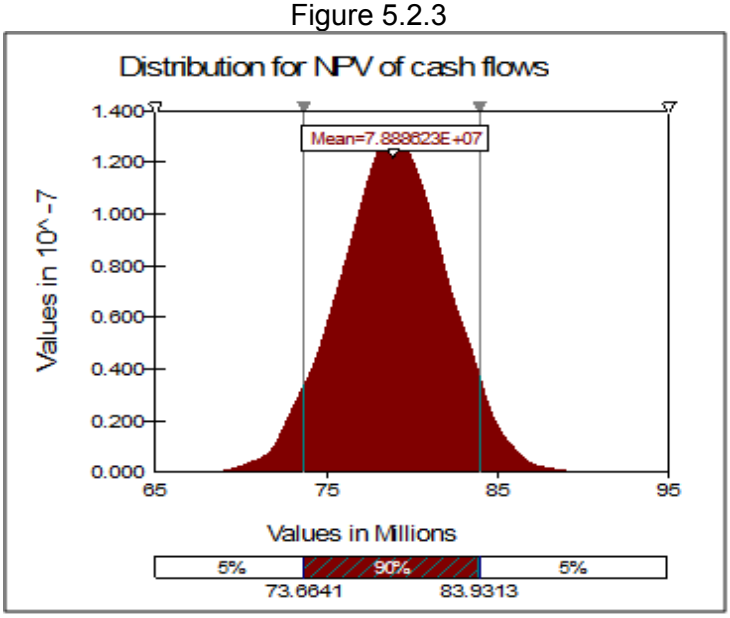


Source: author based on elaboration of the data

The mean NPV in this scenario is roughly $91,000,000, a crumb less than the 9,500 TEU vessel. In contrast with the same category of the newly built vessel, this investment reflects to have higher profits based on the mean value of the normal distribution produced in chapter four for the freight rates. The maximum NPV this investment may acquire with the best possible freight rates is $105,000,000 and the minimum $78,000,000 which serves the reasoning of a less risky investment compared to the new cases.

Figure 5.2.3 displays the relationship between NPV and freight rates for a five year old second hand Post-Panamax vessel.

Figure 5.2.3



Source: author based on elaboration of the data

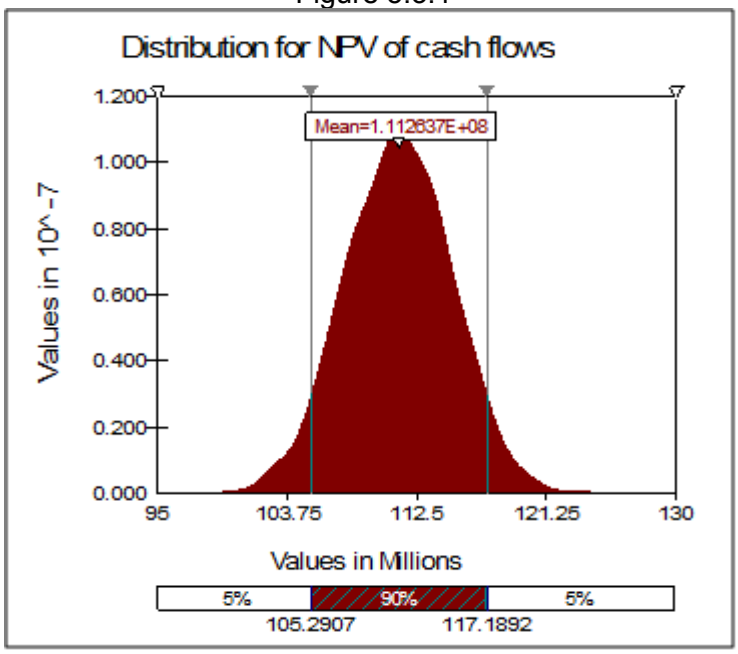
The average NPV in this case is around $78,000,000, roughly higher than any scenario referring to the newly built carriers. The maximum level the NPV can reach is $93,000,000 and the smallest amount $68,000,000 revealing high profits even though the other second hand carriers attain higher NPV prices.

5.3 Case 3: Second-Hand 10 Year Old Post-Panamax Container Vessels

The final section of this chapter describes the connection and influence the earnings and interest rates have on the NPV price of ten year old second hand Post-Panamax container carriers.

The below figure illustrates the sensitivity of the NPV for 9,500 TEU vessels.

Figure 5.3.1

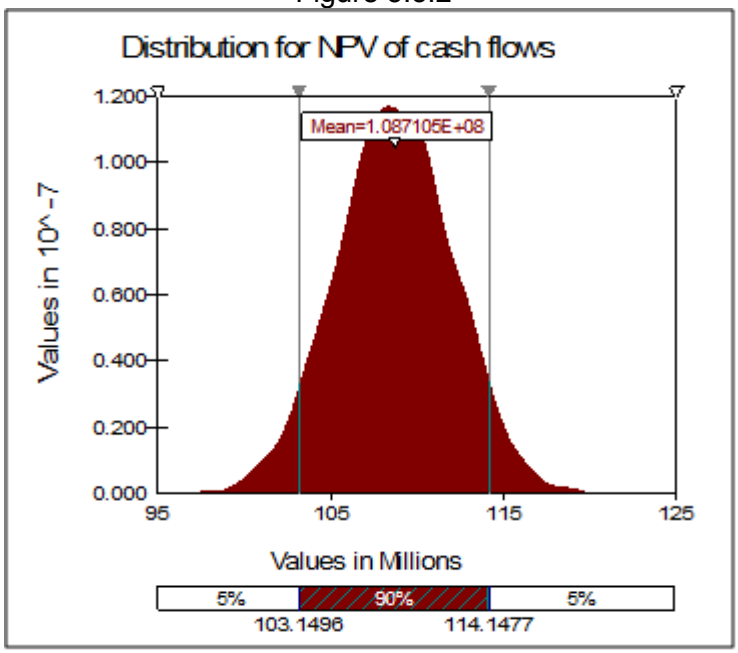


Source: author based on elaboration of the data

It is observed that the average NPV value in this case is much higher than the other cases, as the purchase price of second hand Post-Panamax is 40% lower than new built vessels. The average NPV price for this investment is $111,000, the maximum and minimum $126,000,000 and $96,000,000 respectively.

Figure 5.3.2 presents the distribution of NPV of cash flows for case relating to a 8,500 second hand Post-Panamax vessels.

Figure 5.3.2



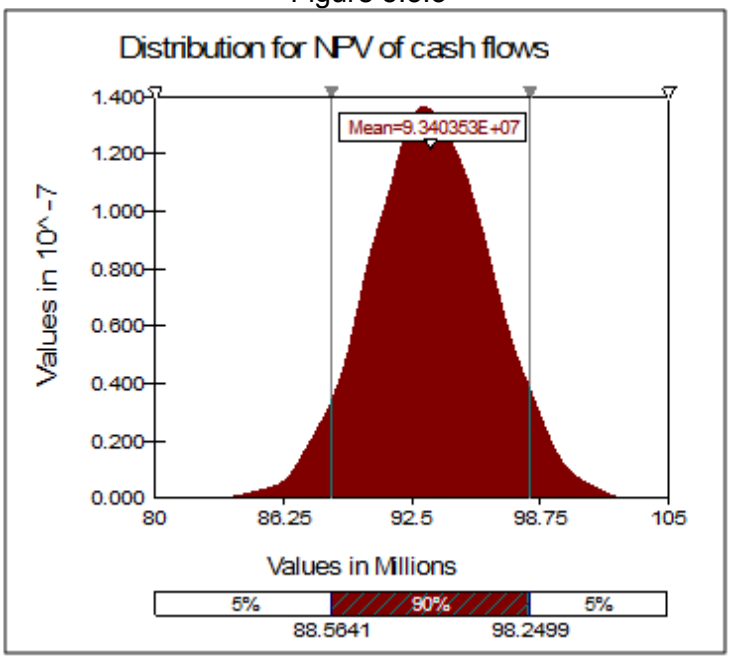
Source: author based on elaboration of the data

The average NPV for the above graph is approximately $108,000,000, a “hair” lower than the previous category. Bearing in mind that the age of these ships has increased and the maintenance costs grow significantly, the profitability of such investments is levels higher than the new built cases, although freight rates are lower. The maximum price the NPV can reach is $121,000,000 and minimum $95,000,000. The results don’t appear to be influenced in a high level from the recession of 2009. In addition, even the minimum possible NPV remains relatively high.

Figure 5.3.3 presents the sensitivity analyzed by @Risk for 6,500 TEU ten year old second hand Post-Panamax container vessels.

The mean NPV in this scenario is equal to $93,000,000. The maximum price is $104,000,000 and the minimum $82,000,000 with a standard deviation of $2,000,000 describing how small is the percentage of risk for such investments. In comparison to the other two cases, second hand five year old and newly built 6,500 TEU capacity container vessels, this case appears to generate the highest profits resulting as more feasible to invest in.

Figure 5.3.3



Source: author based on elaboration of the data

In conclusion, by investigating the feasibility of each case individually, the 8,500 TEU capacity vessel in the first case appears to have higher profits. In regards to the second and third case, higher profits reflect to the 9,500 TEU investments. By comparing the feasibility of each case in general, based on the results obtained from the risk analysis, the third case referring to the ten year old second hand Post-Panamax container vessels appear to generate more profits.

Chapter 6. Conclusions-Suggestions for Further Research

6.1 Introduction

In this chapter we will be commenting on the results we got after the application of the mathematical models regarding the cash flows, presented in detail in chapter four. The goal is to formulate significant conclusions regarding the evaluation of the investments made before the economic downturn and beyond, while commenting on the results of the cash flow models.

The models used, were based on fixed funding data, as known at this time. The capital funding of the vessels is 50% of the purchase price. The balloon percentage is equal to 10% of the loan amount. This figure represents the residual value beyond the ship at the end of the decade. The spread rate at the time the thesis was conducted was 3% and the libor rate 1.41 according to A.B. Shipping Bank. Hence, the total interest rate was calculated 4.41%. Therefore, due to the high volatility the interest rate appears to have the past years, different cash flow models were conducted with different0 values of interest rate in order to obtain more precise results. The discount rate (WACC) was calculated for each investment and varied between 7.5% and 8.7%.

The duration of the loan is twenty equal installments and the balloon payment is done by paying the balloon interest per period and the principal payment at the end of the decade.

Applying the cash-flow models to all concerned samples we reached significant results which were presented in graphs displaying the relationship between purchase price and NPV, based on historical prices of current and previous years. Therefore, we drawn reliable conclusions regarding the image an investor must have before purchasing a Post-Panamax container vessel.

6.2 Comments on Obtained Results

By observing the results obtained from the mathematical models in chapter four, the obtain outputs were as expected. Noticing that the high purchase price of vessels requires high freight rates throughout the whole repayment period in order to qualify a cost-effective investment. It is noteworthy that the current tariffs are the lowest of recent years, so an investment must be purchased at low cost to generate high profits. It is assumed that the vessels will operate under the same conditions, because if the purchased vessels are forced to remain tied up due to lack of demand, it is understandable the investments will not be feasible.

Regarding the loan and the considered fixed data, it is understood that they directly affect the investment, and hence the required freight rate for each Post-Panamax container vessel. Specifically, the data used to finance such vessels, debt (50%), balloon rate (10%) and the interest rate affect the amount of each instalment, thus affecting the final results of the cash flow model. Also other factors, such as the method to repay the loan and the balloon percentage affect the results of the cash flow model. In this thesis the data used to create the cash flows overlap with the ones the banks use for granting a loan. This data may not apply in some months or years, but this is a risk the individual investors require to take.

The results presented in chapter four are composed of three cases referring to the year of built of the vessels. The first case illustrates figures concerning newly built Post-Panamax container vessels. By observing the graphs it is noticeable that all sizes of ships produce high return of capitals when the time charter rates are stable for a ten year period, based on the data provided from the shipping companies. Thus, in the worst case scenario where the freights rates are extremely low, the only size of vessels that can be considered as a more reliable investment is the category of the 6,500 TEU capacity containerships, when the delivery price of the vessel is between $45,000,000 and $50,000,000. On the other hand, in the best case scenario, all categories appear to reach high NPV prices with the size of the 9,500 TEU capacity vessels dominating the rest of the fleet.

On the contrary with the first case, the second case, which relates to five year old second hand Post-Panamax container vessels, consists of more productive and reliable investments, reducing efficiently the risk barrier, as in all scenarios the NPV remains positive. The category of the 9,500 TEU vessels appears to lead in comparison to other Post-Panamax sizes.

The third case, presents the results referring to ten year old Post-Panamax containerships. The results from this section reveal that all ship models produce enormously high financial outcomes in all three scenarios. The NPV of the 9,500 TEU capacity vessels varies between different prices; $30,000,000 in the worst scenario and can reach the price of $100,000,000 in the best scenario. The 8,500 and 6,500 TEU vessels have similar NPV results (between $20,000,000 and $80,000,000), depending on the time-charter rates and operating procedures shipping firms follow.

In addition, the break-even analysis in the third section of chapter four exposes that ten year old Post-Panamax container vessels are capable of surviving with tremendously low freight rates (e.g. $1000 daily freight rates for 6,500 TEU vessels, in order the financial outcome of the mathematical models to be considered as borderline).

According to the results obtained from chapter 4 and 5 relating to the first two research questions discussed in chapter 1, by comparing the feasibility of each case in general and based on the above conclusions, the ten year old second hand Post-Panamax container vessels appear to generate more profits. Investigating the feasibility of each size of ship individually, the 9,500 TEU capacity vessels referring to the second hand ten year old Post-Panamax containerships produce higher return of capital, regardless higher operating expenses compared to younger vessels.

Moreover it is proven, under the market conditions as they are configured now, investors are in favour to proceed with the purchase of Post-Panamax container vessels. As revealed from historical freight rate data, investors who are interested to purchase such vessels at the current period have all the future potential to generate enough profits in the upcoming years even with time-charter rates from the past decade. In contrast, investments made just before the recession with high purchase contracts, while not able to take advantage of the high freight rates that existed for a long time, will have feasibility problems.

6.3 Suggestions for Further Research

In the previous section we presented the results of our study to evaluate the feasibility of purchasing Post-Panamax vessels before and after the economic downturn on the basis of cash flows generated by the model constructed. In the cash flow models conducted some elements remained constant.

Subject for further investigation would be to examine several parameters and variable by conducting various combinations with different numerical data, referring to the following:

- Loan period
- The number of loan instalments per year
- Lending rate
- Balloon lending rate
- Applying the model to different categories of containerships; comparing the feasibility of each investment with ULCC, vessels that reach up to 15,000 TEU capacity, which entered the market the past six years and most of them are laid-up as effect of the financial crisis.

Application of the models in other markets outside the time-charter and spot-market, where fares and operation procedures differ.

Further study will lead to more reliable conclusion for the investors and measure precisely the allocation of risk, in order to gain maximum returns from such investments.

Finally, it is possible to implement a user friendly computer application, making decision planning as simple as possible for commercial reasons. Of particular interest would be to integrate the results of this study with other studies relating to freight market analysis that have either been completed or are under preparation, creating a plan, to easily evaluate a shipping investment.

Bibliography

Alizadeh, A. H., and Nomikos, N. K. (2009) *Shipping Derivatives and Risk Management*. Basingstoke: Palgrave McMillan.

Brealey, R. A., and Myers, S. C. (2000) *Principles of Corporate Finance*. 9th edn. New York: McGraw Hill Education.

Chzanowski, I., and Wiater, S. J. (1989) *An Introduction to Shipping Economics*. London: Fairplay Publications.

Currie E., and Velandia, A. (2002) Risk Management of Contingent Liabilities within a Sovereign Asset-Liability Framework [online]. Available: http://treasury.worldbank.org/bdm/pdf/7_RiskMgt_Conting_Liab_Frmwk_Currie_Velandia_.pdf [Accessed: 27 July 2010].

Economic and Social Commission for the Asia Pacific Transport Division (2007) *Regional Shipping and Port Development: Container Traffic Forecast 2007 Update.* ST/ESCAP/2484.

Fan, L., Low, M. Y. H., Ying, H. S., Jing, H. W., Min, Z., and Aye, W.C. (2010) Stowage Planning of Large Containership with Tradeoff between Crane Workload Balance and Ship Stability. *Proceedings of the International Multiconference of Engineers and Computer Scientists,* March 17-19, Hong Kong.

Feyrer, J. (2009) Distance, Trade and Income – The 1967 to 1975 Closing of the Suez Canal as a Natural Experiment'. NBER Working Paper No. 15557.

Grammenos, K., and Xylas, E. (1998) *Shipping Investment and Finance.* London: City University.

Gwilliam, K. M. (1993) *Current Issues in Maritime Economics.* Dordrecht: Kluwer Academic Publishers.

Hagel, J., Brown, J. S., and Davison, L. (2008) Shaping Strategy in a World of Constant Disruption. *Harvard Business Review,* **October 2008**.

Harisson, R., and Figliozzi, M. (2001) Impacts of Containership Size, Service Rates and Demand on Texas Gulf Ports [online]. Available: http://www.utexas.edu/research/ctr/pdf_reports/1833_3.pdf [Accessed: 18 July 2010].

Heideloff, C., Stockmann, D., and Monden, R. (2004) General Cargo and Container Shipping [online]. Available: http://www.isl.org/products_services/publications/pdf/COMM_6-04_short.pdf [Accessed: 18 July 2010].

Hong Kong Marine Department (2006) Study on the Next Generation of Containerships and its Potential Implications for the Port of Hong Kong [online]. Available: http://www.mardep.gov.hk/en/publication/pdf/pocp4_06.pdf [Accessed: 2 August 2010].

Hummels, D. (1999) Have International Costs Declined? [online]. Available: http://www.aerohabitat.eu/uploads/media/11-01-2006_-_D_Hummels__Transportation_cost_declines.pdf [Accessed: 1 August 2010].

Klovland, J. T. (2002) Business Cycles, Commodity Prices and Freight Rates: Some Evidence from the Pre-WWI Period'. SNF Report No 48/02, SNF Project no. 1312.

Mankiw, N. G. (2007) *Principles of Economics.* 5th edn. Mason: South West Cengage Learning.

McConville, J. (1999) *Economics of Maritime Transport: Theory and Practice*. London: Witherby Publishers.

McConville, J., Leggate, H., and Morvillo, A. (2005) *International Maritime Transport. Perspectives*. Oxon: Routledge.

Mercator Transport Group (2005) Container Vessel Specifications and Port Calls within San Pedro Bay [online]. Available: http://www.portoflosangeles.org/DOC/REPORT_SPB_Vessel_Forecast.pdf [Accessed: 10 July 2010].

Merge Global Value Creation Initiative (2008) Insomnia: Why Challenges Facing the World Container Shipping Industry Make for More Nightmares than they should [online]. Available: http://www.docstoc.com/docs/24167444/Why-challenges-facing-the-world-container-shipping-industry-make [Accessed: 18 July 2010].

Mercogliano, S. R. (2006) The Container Revolution. *Sea History*, **vol. 114**, pp. 8-11.

Mintz, B., and Schwatz, M. (1985) *The Power Structure of American Business.* London: The University of Chicago Press.

Notteboom, T. E. (2010) Concentration and Formation of Multi-Port Gateway Regions in the European Container Port System: an update. *International Journal of Shipping And Transport Logistics*, **2** (2) pp. 224-245.

Panama Canal Authority (2006) Proposal for the Expansion of the Panama Canal. Third Set Of Lock Projects [online]. Available: http://www.pancanal.com/eng/plan/documentos/propuesta/acp-expansion-proposal.pdf [Accessed: 10 July 2010].

Peterson, W. L. (1989) *Principles of Economics*. Chicago: Irwin Publishing Co.

Prayer, H. G. (1999) Containership Development in the Past Decade and Prospects for the Future. *Proceedings of the IUMI Conference,* 12-16 September, Berlin.

Prayer, H. G. (2005) Adequacy of Selected Lock Size Parameters for Expanded Panama Canal. Post-Panamax Lock Size Review Study [online]. Available: http://www.pancanal.com/esp/plan/estudios/0286.pdf [Accessed: 14 July 2010].

Rodrigue, J. P., Comptois, C., and Slack, B. (2004) *The Geography of Transport Systems.* New York: Routledge.

Rodrigue, J. P., Slack, B., and Comptois, C. (1997) Transportation and Spatial Cycles: Evidence from Maritime Systems. *Journal of Transport Geography,* **5** (2), pp.87-98.

Samson, D. (1998) *Managerial Decision Analysis*. Chicago: Irwin Publishing Co.

Shipping Intelligence Network (2009) *Shipping Sector Reports*. Clarkson Research Services Limited, Spring 2009.

Shipping Intelligence Network (2010) *Shipping Intelligence Weekly.* Clarkson Research Services Limited, 16 April 2010.

Shipping Intelligence Network (2010) *Shipping Sector Reports*. Clarkson Research Services Limited, Spring 2010.

Song, D. W., and Panayides, P.M. (2008) Global Supply Chain and Port/Terminal: Integration and Competitiveness. *Maritime Policy and Management,* **35** (1), pp. 75-89.

Stopford, M. (2008) Shipping Cycles and the World Economy - A Quick Update. Clarkson Research Department, 12 September 2008.

Svendsen, J., and Tiedemann, J. (2006) The Container Shipping Newsletter. The Weekly Container Shipping Newsletter [online]. Available: http://www.containership-info.com/newsletter_2006_49.pdf [Accessed: 20 July 2010].

The Center of Supply Chain Research (2008) Containerized Freight Rate Trends [online]. Available: http://www.vics.org/docs/home/pdf/Container-Freight-Rate-Trend_April15_2008.pdf [Accessed: 20 July 2010].

Ting, E. (2007) The Containerships and Containers [online]. Available: http://ind.ntou.edu.tw/~ericting/download/Container%20Transport/03%20The%20Containerships%20and%20Containers.pdf [Accessed: 20 July 2010].

UNCTAD (1998) Concentration in Liner Shipping: Its Causes and Impacts for Ports and Shipping Services in Developing Regions [online]. Available:

http://www.eclac.org/publicaciones/xml/5/5175/LC_G.2027.pdf [Accessed: 24 July 2010].

UNCTAD (2001) Review of Maritime Transport [online]. Available: http://www.unctad.org/en/docs/rmt2001ch1_en.pdf [Accessed: 24 July 2010].

UNCTAD (2004) Transport Newsletter. **No.25**, 3rd quarter 2004.

Vose, D. (2000) *Risk Analysis: A Quantitative Guide*. 2nd edn. Chichester: John Wiley and Sons, ltd.

Williams, E. C., and Denton, L. T., (1993) Merchant Vessel Chartering and Operation in International Trade: Ethical and Safety Issues. *International Journal of Commerce and Management*, **6** (1/2), pp.71 - 96

Zei, D. A. (2006) Estimating the Costs of Maritime Shipping [online]. Available: http://wupcenter.mtu.edu/education/great_lakes_maritime/teaching_units/Zei_Lesson_2_Shipping_Costs.pdf [Accessed: 24 July 2010].

Appendices

Appendix A: Cash-Flow Model

CASH FLOW PROJECTIONS

ASSUMPTIONS

Contract Price	*$48,400,000*	*8500 TEU*
Equity Capital	*$19,360,000*	
Term Loan (% of contract price)	*$24,200,000*	
Balloon	*$4,840,000*	
Residual Ship Value	*$4,840,000*	
# of Loans	*20*	
Loan %	*60%*	
Balloon %	*10.00%*	
Interest rate (per year)	*4.00%*	
Loan Payment	*-$1,479,993*	
Balloon Payment	*-$96,800*	
Discount rate/Return of equity(per year)	*8.00%*	
NPV of cash flows	*$12,235,381*	
IRR of cash flows (per period)	*9.95%*	

	Income per day	*Operating days*	*Total Income (per month)*	*Opex per day*	*Operating days*	*Total Running Expenses*	*Operating Cash Flow per month*		*Operating Cash flow per 6 months*		*Interest Expenses*	*Principal Payments*	*Loan Payment*	*BalloonPayment*	*Net Cash Flow per 6 months*	*Remaining investment outlay*	*Loan O/S*
															-$19,360,000	**-$19,360,000**	
Jan-09	$11,500	30	**$345,000**	$8,025	30	**$240,750**	**$585,750**										**$24,200,000**
Feb-09	$11,500	30	**$345,000**	$8,025	30	**$240,750**	**$585,750**										**$24,200,000**
Mar-09	$11,500	30	**$345,000**	$8,025	30	**$240,750**	**$585,750**										**$24,200,000**
Apr-09	$11,500	30	**$345,000**	$8,025	30	**$240,750**	**$585,750**										**$24,200,000**
May-09	$11,500	30	**$345,000**	$8,025	30	**$240,750**	**$585,750**										**$24,200,000**
Jun-09	$11,500	30	**$345,000**	$8,025	30	**$240,750**	**$585,750**		**$3,514,500**		-$484,000	-$995,993	**-$1,479,993**	-$96,800	**$1,937,707**	**-$17,422,293**	**$23,204,007**
Jul-09	$11,500	30	**$345,000**	$8,266	30	**$247,973**	**$592,973**										**$23,204,007**
Aug-09	$11,500	30	**$345,000**	$8,266	30	**$247,973**	**$592,973**										**$23,204,007**
Sep-09	$11,500	30	**$345,000**	$8,266	30	**$247,973**	**$592,973**										**$23,204,007**
Oct-09	$11,500	30	**$345,000**	$8,266	30	**$247,973**	**$592,973**										**$23,204,007**
Nov-09	$11,500	30	**$345,000**	$8,266	30	**$247,973**	**$592,973**										**$23,204,007**
Dec-09	$11,500	30	**$345,000**	$8,266	30	**$247,973**	**$592,973**		**$3,557,835**		-$464,080	-$1,015,912	**-$1,479,993**	-$96,800	**$1,981,042**	**-$15,441,250**	**$22,188,095**
Jan-10	$11,500	30	**$345,000**	$8,514	30	**$255,412**	**$600,412**										**$22,188,095**
Feb-10	$11,500	30	**$345,000**	$8,514	30	**$255,412**	**$600,412**										**$22,188,095**
Mar-10	$11,500	30	**$345,000**	$8,514	30	**$255,412**	**$600,412**										**$22,188,095**
Apr-10	$11,500	30	**$345,000**	$8,514	30	**$255,412**	**$600,412**										**$22,188,095**
May-10	$11,500	30	**$345,000**	$8,514	30	**$255,412**	**$600,412**										**$22,188,095**
Jun-10	$11,500	30	**$345,000**	$8,514	30	**$255,412**	**$600,412**		**$3,602,470**		-$443,762	-$1,036,231	**-$1,479,993**	-$96,800	**$2,025,677**	**-$13,415,573**	**$21,151,864**

Jul-10	$11,500	30	**$345,000**	$8,769	30	**$263,074**	**$608,074**									**$21,151,864**
Aug-10	$11,500	30	**$345,000**	$8,769	30	**$263,074**	**$608,074**									**$21,151,864**
Sep-10	$11,500	30	**$345,000**	$8,769	30	**$263,074**	**$608,074**									**$21,151,864**
Oct-10	$11,500	30	**$345,000**	$8,769	30	**$263,074**	**$608,074**									**$21,151,864**
Nov-10	$11,500	30	**$345,000**	$8,769	30	**$263,074**	**$608,074**									**$21,151,864**
Dec-10	$11,500	30	**$345,000**	$8,769	30	**$263,074**	**$608,074**		**$3,648,444**		-$423,037	-$1,056,955	**-$1,479,993**	-$96,800	**$2,071,652**	**-$11,343,921**	**$20,094,909**
Jan-11	$11,500	30	**$345,000**	$9,032	30	**$270,966**	**$615,966**										**$20,094,909**
Feb-11	$11,500	30	**$345,000**	$9,032	30	**$270,966**	**$615,966**										**$20,094,909**
Mar-11	$11,500	30	**$345,000**	$9,032	30	**$270,966**	**$615,966**										**$20,094,909**
Apr-11	$11,500	30	**$345,000**	$9,032	30	**$270,966**	**$615,966**										**$20,094,909**
May-11	$11,500	30	**$345,000**	$9,032	30	**$270,966**	**$615,966**										**$20,094,909**
Jun-11	$11,500	30	**$345,000**	$9,032	30	**$270,966**	**$615,966**		**$3,695,797**		-$401,898	-$1,078,094	**-$1,479,993**	-$96,800	**$2,119,005**	**-$9,224,916**	**$19,016,815**
Jul-11	$11,500	30	**$345,000**	$9,303	30	**$279,095**	**$624,095**										**$19,016,815**
Aug-11	$11,500	30	**$345,000**	$9,303	30	**$279,095**	**$624,095**										**$19,016,815**
Sep-11	$11,500	30	**$345,000**	$9,303	30	**$279,095**	**$624,095**										**$19,016,815**
Oct-11	$11,500	30	**$345,000**	$9,303	30	**$279,095**	**$624,095**										**$19,016,815**
Nov-11	$11,500	30	**$345,000**	$9,303	30	**$279,095**	**$624,095**										**$19,016,815**
Dec-11	$11,500	30	**$345,000**	$9,303	30	**$279,095**	**$624,095**		**$3,744,571**		-$380,336	-$1,099,656	**-$1,479,993**	-$96,800	**$2,167,779**	**-$7,057,137**	**$17,917,158**
Jan-12	$11,500	30	**$345,000**	$9,582	30	**$287,468**	**$632,468**										**$17,917,158**
Feb-12	$11,500	30	**$345,000**	$9,582	30	**$287,468**	**$632,468**										**$17,917,158**
Mar-12	$11,500	30	**$345,000**	$9,582	30	**$287,468**	**$632,468**										**$17,917,158**

Apr-12	$11,500	30	**$345,000**	$9,582	30	**$287,468**	**$632,468**									**$17,917,158**
May-12	$11,500	30	**$345,000**	$9,582	30	**$287,468**	**$632,468**									**$17,917,158**
Jun-12	$11,500	30	**$345,000**	$9,582	30	**$287,468**	**$632,468**		**$3,794,809**		-$358,343	-$1,121,649	**-$1,479,993**	-$96,800	**$2,218,016**	**-$4,839,121**	**$16,795,509**
Jul-12	$11,500	30	**$345,000**	$9,870	30	**$296,092**	**$641,092**										**$16,795,509**
Aug-12	$11,500	30	**$345,000**	$9,870	30	**$296,092**	**$641,092**										**$16,795,509**
Sep-12	$11,500	30	**$345,000**	$9,870	30	**$296,092**	**$641,092**										**$16,795,509**
Oct-12	$11,500	30	**$345,000**	$9,870	30	**$296,092**	**$641,092**										**$16,795,509**
Nov-12	$11,500	30	**$345,000**	$9,870	30	**$296,092**	**$641,092**										**$16,795,509**
Dec-12	$11,500	30	**$345,000**	$9,870	30	**$296,092**	**$641,092**		**$3,846,553**		-$335,910	-$1,144,082	**-$1,479,993**	-$96,800	**$2,269,760**	**-$2,569,361**	**$15,651,427**
Jan-13	$11,500	30	**$345,000**	$10,166	30	**$304,975**	**$649,975**										**$15,651,427**
Feb-13	$11,500	30	**$345,000**	$10,166	30	**$304,975**	**$649,975**										**$15,651,427**
Mar-13	$11,500	30	**$345,000**	$10,166	30	**$304,975**	**$649,975**										**$15,651,427**
Apr-13	$11,500	30	**$345,000**	$10,166	30	**$304,975**	**$649,975**										**$15,651,427**
May-13	$11,500	30	**$345,000**	$10,166	30	**$304,975**	**$649,975**										**$15,651,427**
Jun-13	$11,500	30	**$345,000**	$10,166	30	**$304,975**	**$649,975**		**$3,899,849**		-$313,029	-$1,166,964	**-$1,479,993**	-$96,800	**$2,323,057**	**-$246,304**	**$14,484,462**
Jul-13	$11,500	30	**$345,000**	$10,471	30	**$314,124**	**$659,124**										**$14,484,462**
Aug-13	$11,500	30	**$345,000**	$10,471	30	**$314,124**	**$659,124**										**$14,484,462**
Sep-13	$11,500	30	**$345,000**	$10,471	30	**$314,124**	**$659,124**										**$14,484,462**
Oct-13	$11,500	30	**$345,000**	$10,471	30	**$314,124**	**$659,124**										**$14,484,462**
Nov-13	$11,500	30	**$345,000**	$10,471	30	**$314,124**	**$659,124**										**$14,484,462**
Dec-13	$11,500	30	**$345,000**	$10,471	30	**$314,124**	**$659,124**		**$3,954,745**		-$289,689	-$1,190,303	**-$1,479,993**	-$96,800	**$2,377,952**	**$2,131,648**	**$13,294,159**

Jan-14	$11,500	30	**$345,000**	$10,785	30	**$323,548**	**$668,548**									**$13,294,159**
Feb-14	$11,500	30	**$345,000**	$10,785	30	**$323,548**	**$668,548**									**$13,294,159**
Mar-14	$11,500	30	**$345,000**	$10,785	30	**$323,548**	**$668,548**									**$13,294,159**
Apr-14	$11,500	30	**$345,000**	$10,785	30	**$323,548**	**$668,548**									**$13,294,159**
May-14	$11,500	30	**$345,000**	$10,785	30	**$323,548**	**$668,548**									**$13,294,159**
Jun-14	$11,500	30	**$345,000**	$10,785	30	**$323,548**	**$668,548**		**$4,011,287**		-$265,883	-$1,214,109	**-$1,479,993**	-$96,800	**$2,434,495**	**$4,566,143**	**$12,080,050**
Jul-14	$11,500	30	**$345,000**	$11,108	30	**$333,254**	**$678,254**										**$12,080,050**
Aug-14	$11,500	30	**$345,000**	$11,108	30	**$333,254**	**$678,254**										**$12,080,050**
Sep-14	$11,500	30	**$345,000**	$11,108	30	**$333,254**	**$678,254**										**$12,080,050**
Oct-14	$11,500	30	**$345,000**	$11,108	30	**$333,254**	**$678,254**										**$12,080,050**
Nov-14	$11,500	30	**$345,000**	$11,108	30	**$333,254**	**$678,254**										**$12,080,050**
Dec-14	$11,500	30	**$345,000**	$11,108	30	**$333,254**	**$678,254**		**$4,069,526**		-$241,601	-$1,238,392	**-$1,479,993**	-$96,800	**$2,492,733**	**$7,058,876**	**$10,841,658**
Jan-15	$11,500	30	**$345,000**	$11,442	30	**$343,252**	**$688,252**										**$10,841,658**
Feb-15	$11,500	30	**$345,000**	$11,442	30	**$343,252**	**$688,252**										**$10,841,658**
Mar-15	$11,500	30	**$345,000**	$11,442	30	**$343,252**	**$688,252**										**$10,841,658**
Apr-15	$11,500	30	**$345,000**	$11,442	30	**$343,252**	**$688,252**										**$10,841,658**
May-15	$11,500	30	**$345,000**	$11,442	30	**$343,252**	**$688,252**										**$10,841,658**
Jun-15	$11,500	30	**$345,000**	$11,442	30	**$343,252**	**$688,252**		**$4,129,512**		-$216,833	-$1,263,159	**-$1,479,993**	-$96,800	**$2,552,719**	**$9,611,595**	**$9,578,499**
Jul-15	$11,500	30	**$345,000**	$11,785	30	**$353,549**	**$698,549**										**$9,578,499**
Aug-15	$11,500	30	**$345,000**	$11,785	30	**$353,549**	**$698,549**										**$9,578,499**
Sep-15	$11,500	30	**$345,000**	$11,785	30	**$353,549**	**$698,549**										**$9,578,499**

Oct-15	$11,500	30	**$345,000**	$11,785	30	**$353,549**	**$698,549**									**$9,578,499**
Nov-15	$11,500	30	**$345,000**	$11,785	30	**$353,549**	**$698,549**									**$9,578,499**
Dec-15	$11,500	30	**$345,000**	$11,785	30	**$353,549**	**$698,549**		**$4,191,297**		-$191,570	-$1,288,423	**-$1,479,993**	-$96,800	**$2,614,504**	**$12,226,099**	**$8,290,076**
Jan-16	$11,500	30	**$345,000**	$12,139	30	**$364,156**	**$709,156**										**$8,290,076**
Feb-16	$11,500	30	**$345,000**	$12,139	30	**$364,156**	**$709,156**										**$8,290,076**
Mar-16	$11,500	30	**$345,000**	$12,139	30	**$364,156**	**$709,156**										**$8,290,076**
Apr-16	$11,500	30	**$345,000**	$12,139	30	**$364,156**	**$709,156**										**$8,290,076**
May-16	$11,500	30	**$345,000**	$12,139	30	**$364,156**	**$709,156**										**$8,290,076**
Jun-16	$11,500	30	**$345,000**	$12,139	30	**$364,156**	**$709,156**		**$4,254,936**		-$165,802	-$1,314,191	**-$1,479,993**	-$96,800	**$2,678,143**	**$14,904,242**	**$6,975,885**
Jul-16	$11,500	30	**$345,000**	$12,503	30	**$375,081**	**$720,081**										**$6,975,885**
Aug-16	$11,500	30	**$345,000**	$12,503	30	**$375,081**	**$720,081**										**$6,975,885**
Sep-16	$11,500	30	**$345,000**	$12,503	30	**$375,081**	**$720,081**										**$6,975,885**
Oct-16	$11,500	30	**$345,000**	$12,503	30	**$375,081**	**$720,081**										**$6,975,885**
Nov-16	$11,500	30	**$345,000**	$12,503	30	**$375,081**	**$720,081**										**$6,975,885**
Dec-16	$11,500	30	**$345,000**	$12,503	30	**$375,081**	**$720,081**		**$4,320,484**		-$139,518	-$1,340,475	**-$1,479,993**	-$96,800	**$2,743,691**	**$17,647,934**	**$5,635,410**
Jan-17	$11,500	30	**$345,000**	$12,878	30	**$386,333**	**$731,333**										**$5,635,410**
Feb-17	$11,500	30	**$345,000**	$12,878	30	**$386,333**	**$731,333**										**$5,635,410**
Mar-17	$11,500	30	**$345,000**	$12,878	30	**$386,333**	**$731,333**										**$5,635,410**
Apr-17	$11,500	30	**$345,000**	$12,878	30	**$386,333**	**$731,333**										**$5,635,410**
May-17	$11,500	30	**$345,000**	$12,878	30	**$386,333**	**$731,333**										**$5,635,410**
Jun-17	$11,500	30	**$345,000**	$12,878	30	**$386,333**	**$731,333**		**$4,387,998**		-$112,708	-$1,367,284	**-$1,479,993**	-$96,800	**$2,811,206**	**$20,459,140**	**$4,268,126**

Jul-17	$11,500	30	**$345,000**	$13,264	30	**$397,923**	**$742,923**									**$4,268,126**
Aug-17	$11,500	30	**$345,000**	$13,264	30	**$397,923**	**$742,923**									**$4,268,126**
Sep-17	$11,500	30	**$345,000**	$13,264	30	**$397,923**	**$742,923**									**$4,268,126**
Oct-17	$11,500	30	**$345,000**	$13,264	30	**$397,923**	**$742,923**									**$4,268,126**
Nov-17	$11,500	30	**$345,000**	$13,264	30	**$397,923**	**$742,923**									**$4,268,126**
Dec-17	$11,500	30	**$345,000**	$13,264	30	**$397,923**	**$742,923**		**$4,457,538**		-$85,363	-$1,394,630	**-$1,479,993**	-$96,800	**$2,880,746**	**$23,339,885**	**$2,873,496**
Jan-18	$11,500	30	**$345,000**	$13,662	30	**$409,861**	**$754,861**										**$2,873,496**
Feb-18	$11,500	30	**$345,000**	$13,662	30	**$409,861**	**$754,861**										**$2,873,496**
Mar-18	$11,500	30	**$345,000**	$13,662	30	**$409,861**	**$754,861**										**$2,873,496**
Apr-18	$11,500	30	**$345,000**	$13,662	30	**$409,861**	**$754,861**										**$2,873,496**
May-18	$11,500	30	**$345,000**	$13,662	30	**$409,861**	**$754,861**										**$2,873,496**
Jun-18	$11,500	30	**$345,000**	$13,662	30	**$409,861**	**$754,861**		**$4,529,165**		-$57,470	-$1,422,523	**-$1,479,993**	-$96,800	**$2,952,372**	**$26,292,257**	**$1,450,973**
Jul-18	$11,500	30	**$345,000**	$14,072	30	**$422,157**	**$767,157**										**$1,450,973**
Aug-18	$11,500	30	**$345,000**	$14,072	30	**$422,157**	**$767,157**										**$1,450,973**
Sep-18	$11,500	30	**$345,000**	$14,072	30	**$422,157**	**$767,157**										**$1,450,973**
Oct-18	$11,500	30	**$345,000**	$14,072	30	**$422,157**	**$767,157**										**$1,450,973**
Nov-18	$11,500	30	**$345,000**	$14,072	30	**$422,157**	**$767,157**										**$1,450,973**
Dec-18	$11,500	30	**$345,000**	$14,072	30	**$422,157**	**$767,157**		**$4,602,939**		-$29,019	-$1,450,973	**-$1,479,993**	-$96,800	**$3,026,147**	**$29,318,404**	**$0**

Appendix B: Cash-Flow Analysis Results

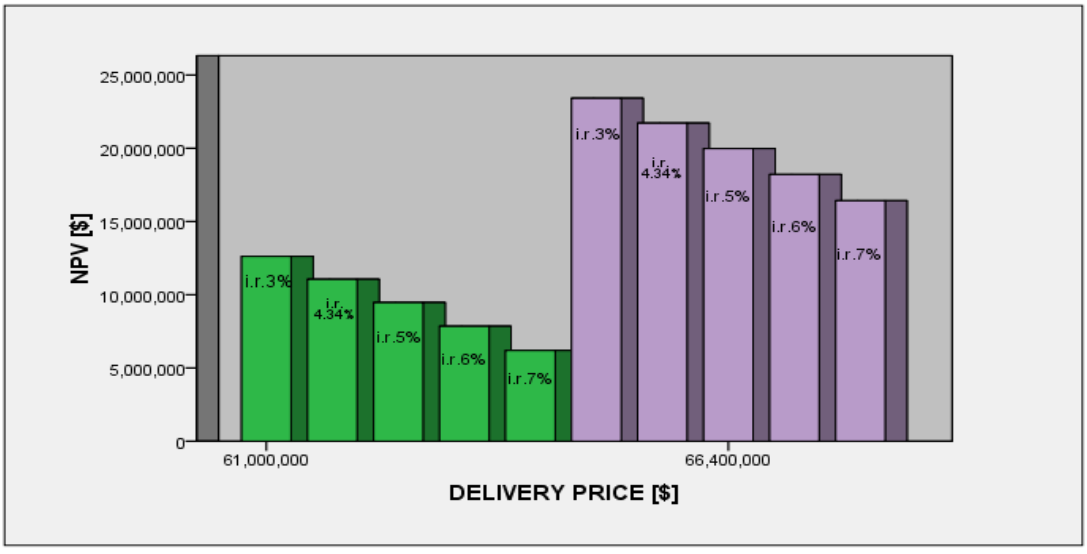
Newly built case

9500 TEU POST-PANAMAX

DELIVERY PRICE - NPV

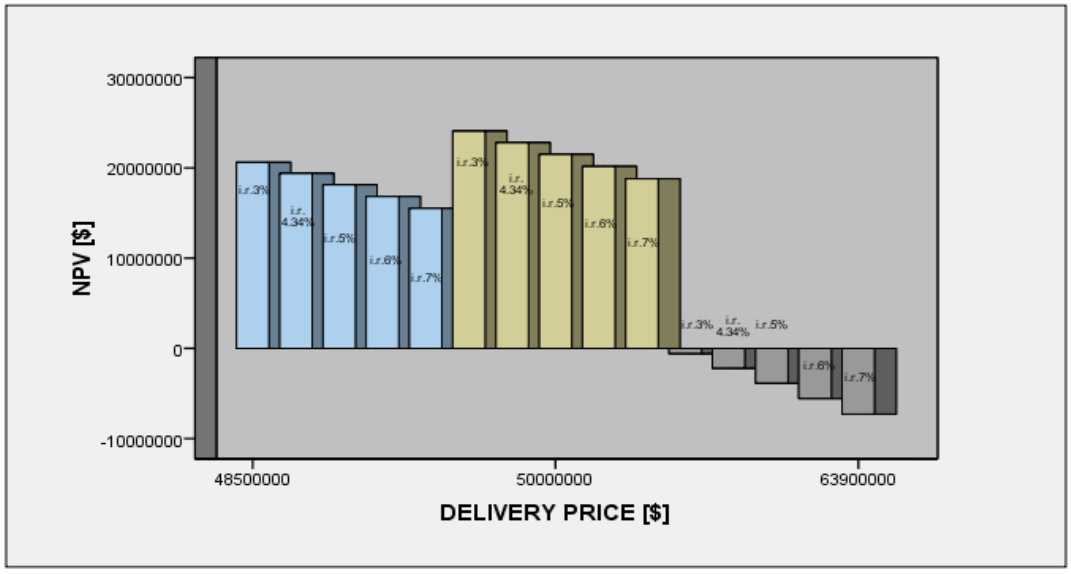
8500 TEU POST-PANAMAX

DELIVERY PRICE - NPV



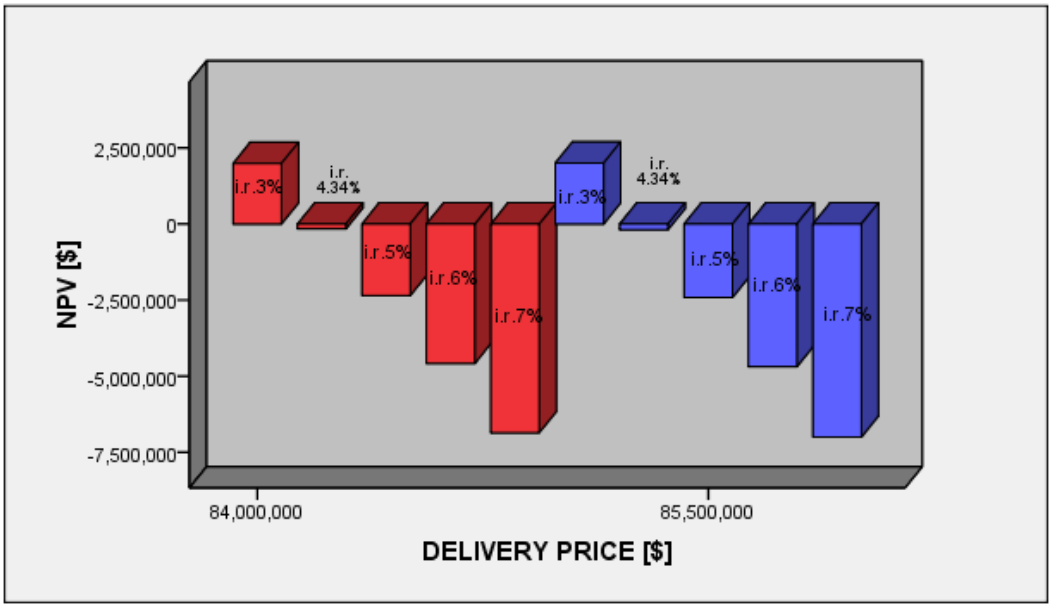
6500 TEU POST-PANAMAX

DELIVERY PRICE - NPV

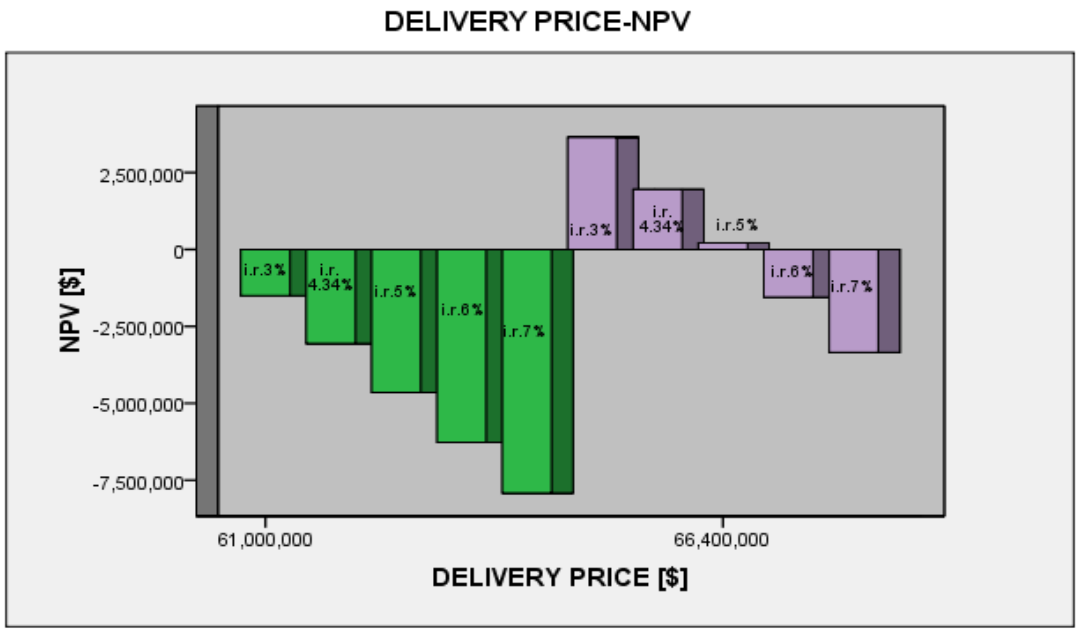


9500 TEU POST-PANAMAX [40% decr.fr.rates]

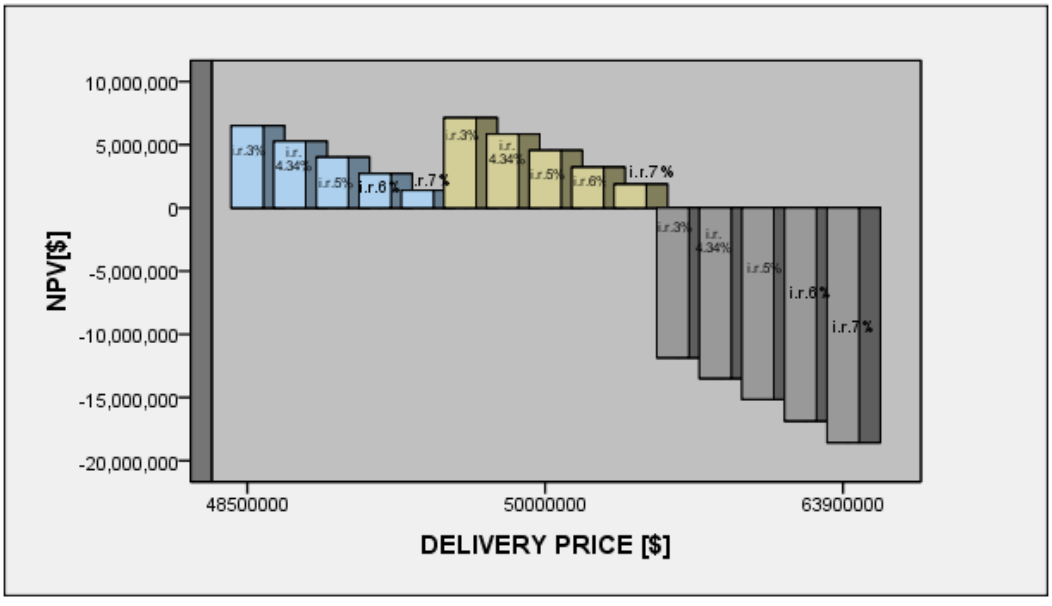
DELIVERY PRICE-NPV



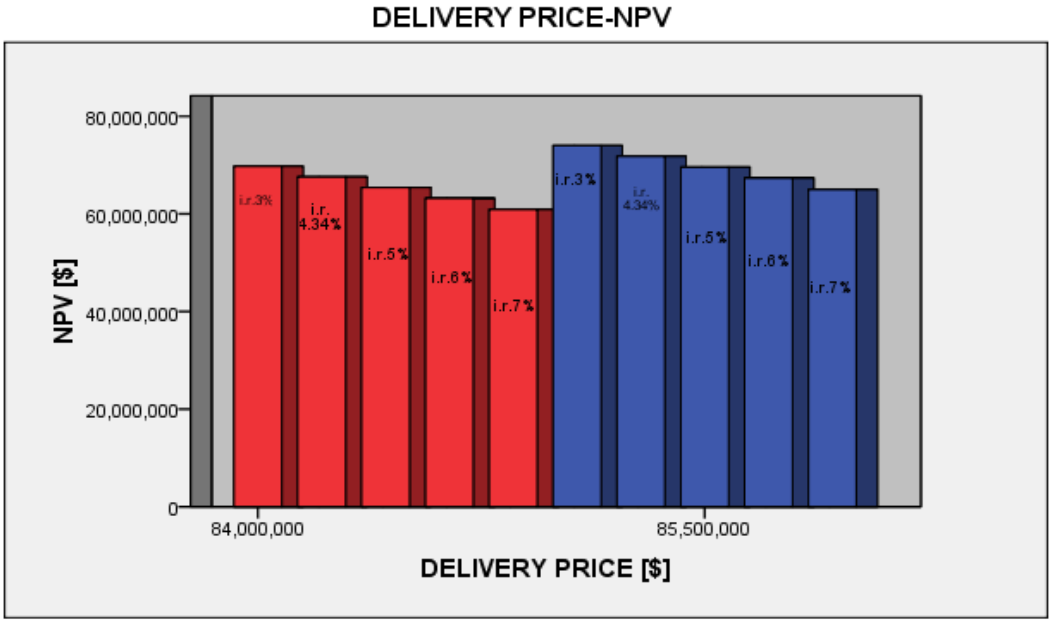
8500 TEU POST-PANAMAX [40% decr.fr.rates]



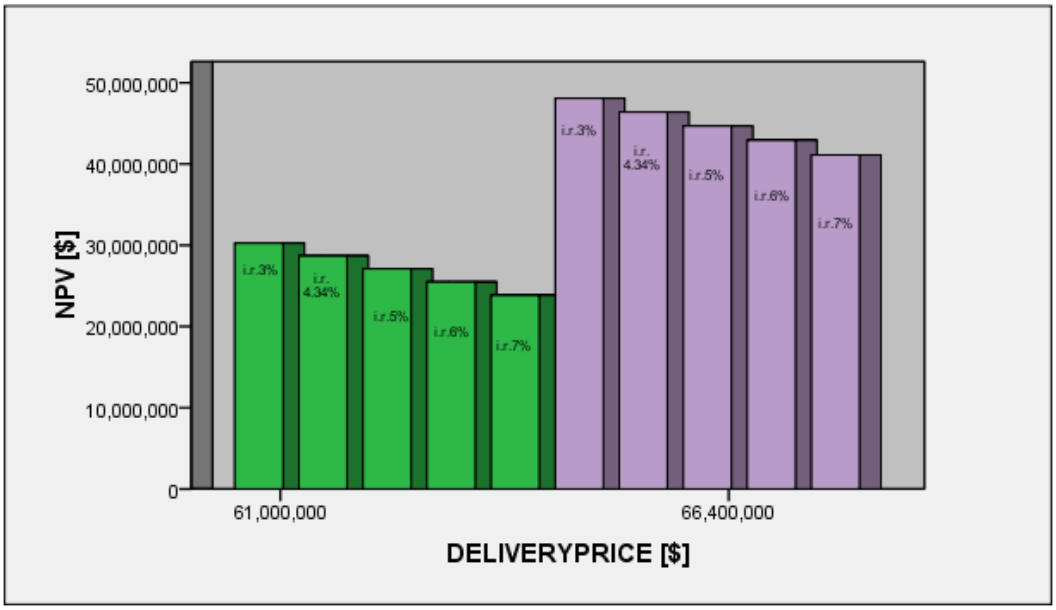
6500 TEU POST-PANAMAX [40% decr.fr.rates]



9500 TEU POST-PANAMAX [50% incr.fr.rates]

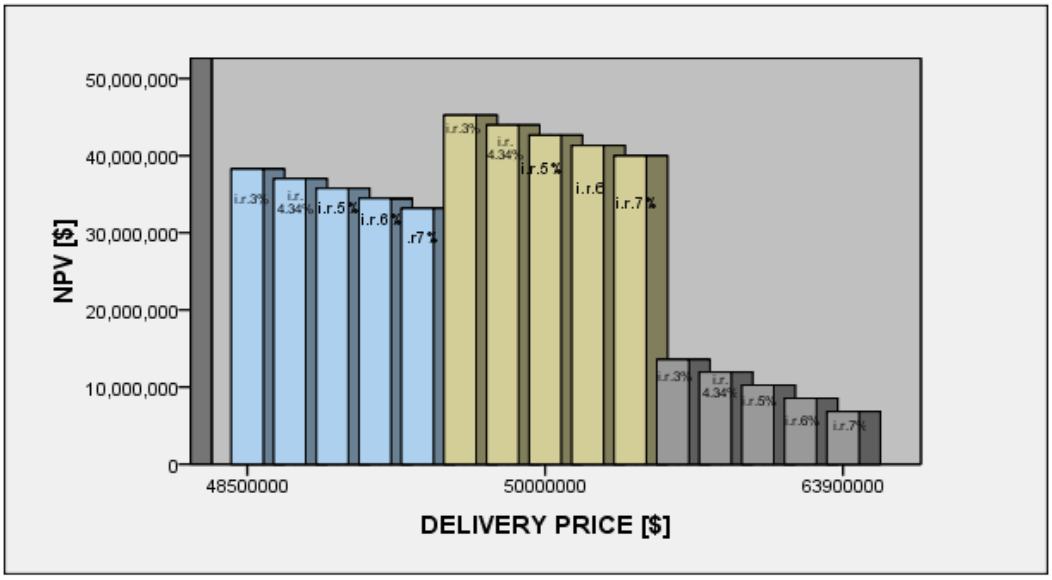


8500 TEU POST-PANAMAX [50% incr.fr.rates]



6500 TEU POST-PANAMAX [50% incr.fr.rates]

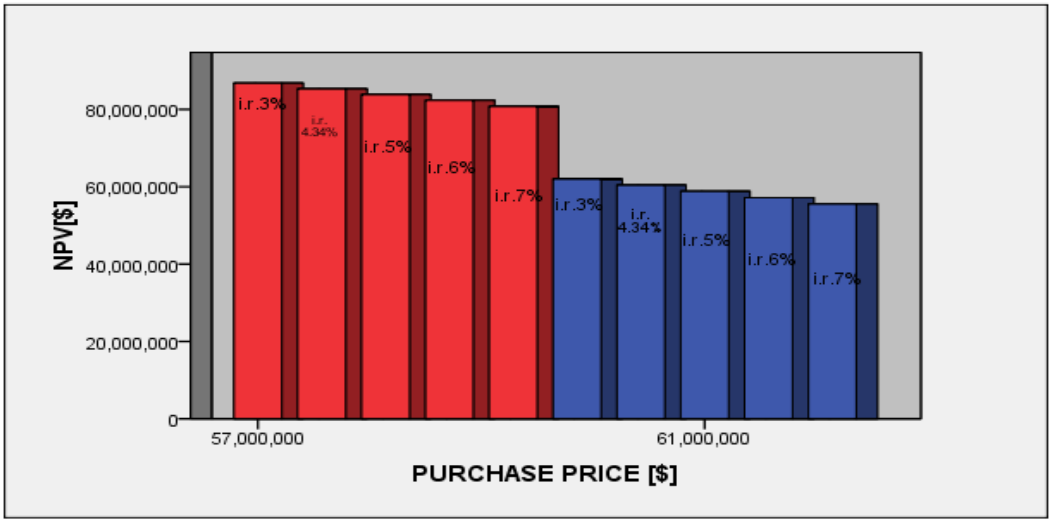
DELIVERY PRICE-NPV



Second hand 5 year old case

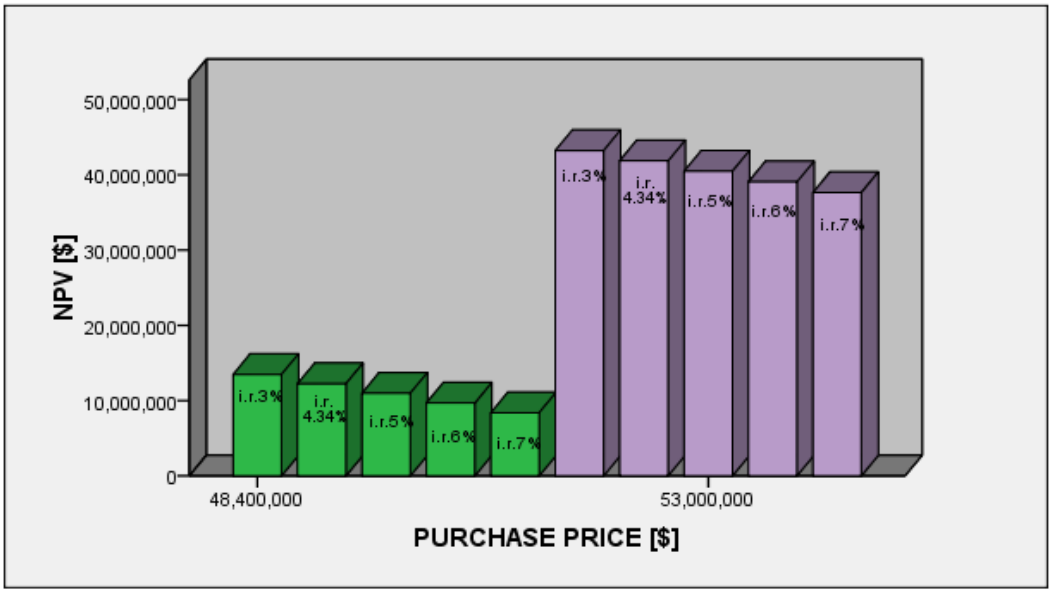
SECOND-HAND 9500 TEU POST-PANAMAX

PURCHASE PRICE-NPV



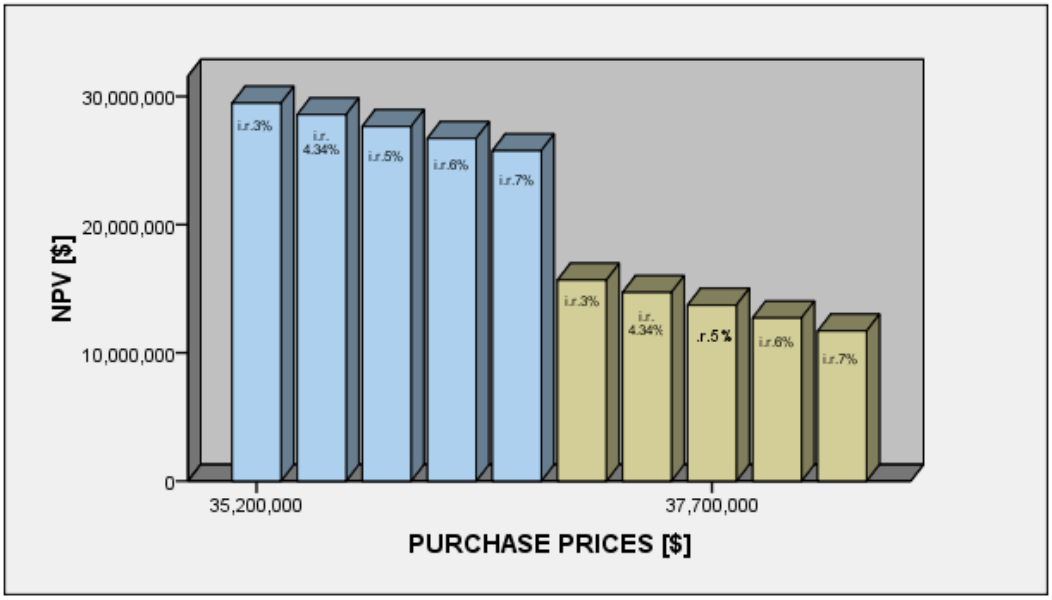
SECOND-HAND 8500 TEU POST-PANAMAX

PURCHASE PRICE-NPV



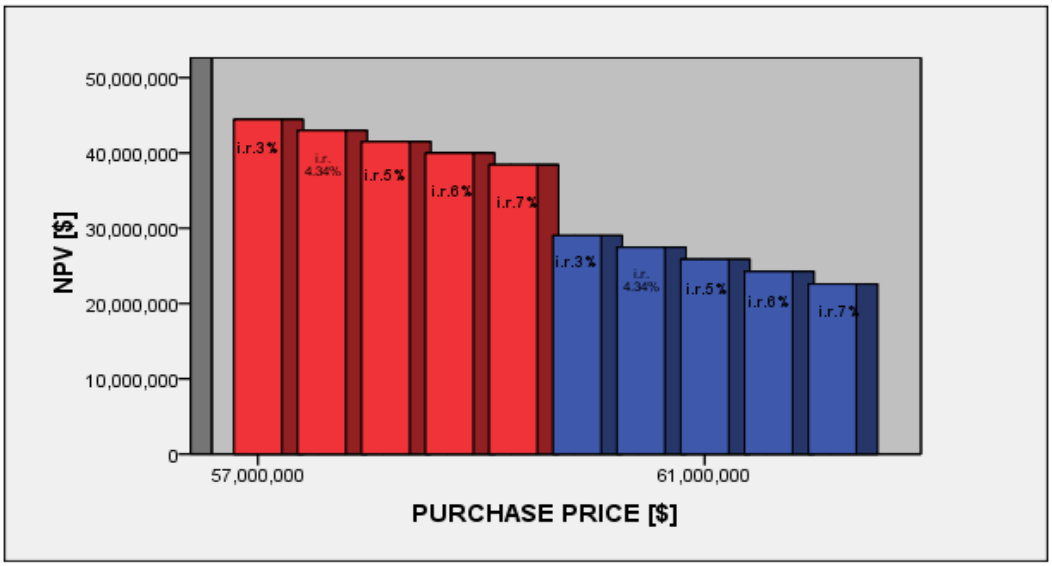
SECOND-HAND 6,500 TEU POST-PANAMAX

PURCHASE PRICE-NPV



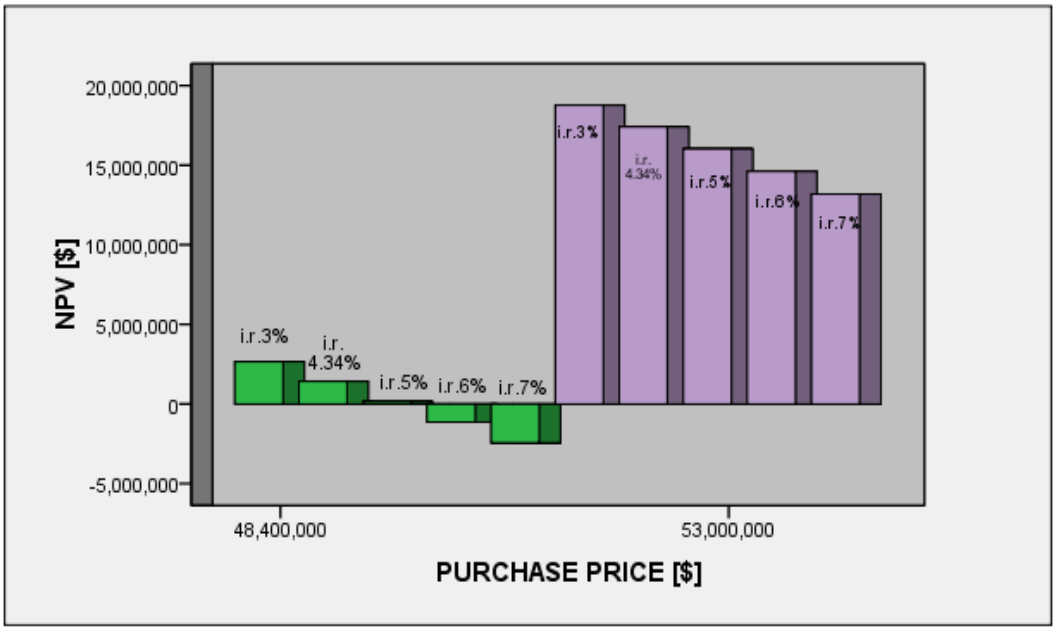
SECOND-HAND 9500 TEU POST-PANAMAX [40% decr.fr.rates]

PURCHASE PRICE-NPV



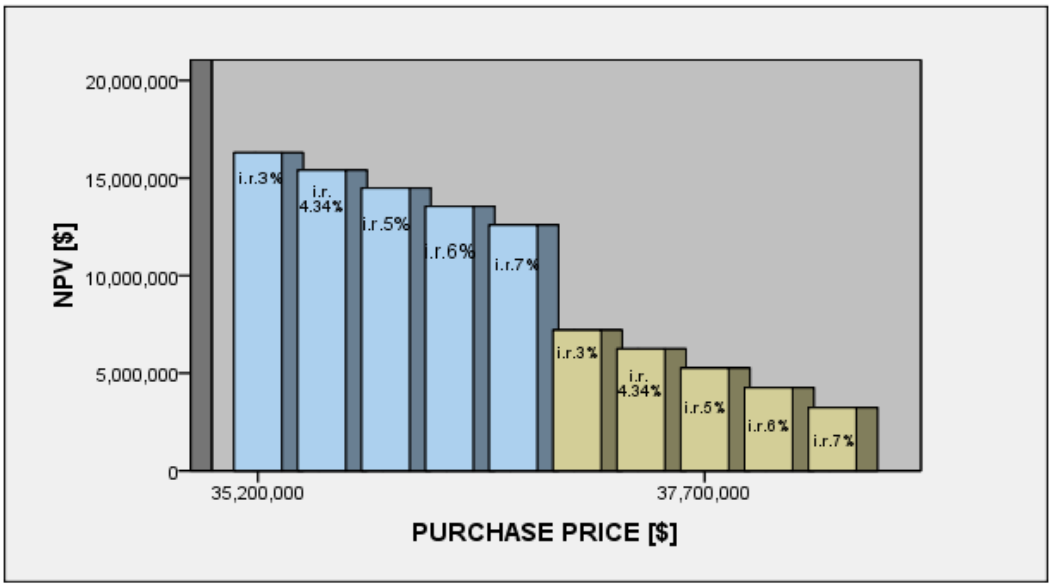
SECOND-HAND 8500 TEU POST-PANAMAX [40% decr.fr.rates]

PURCHASE PRICE-NPV



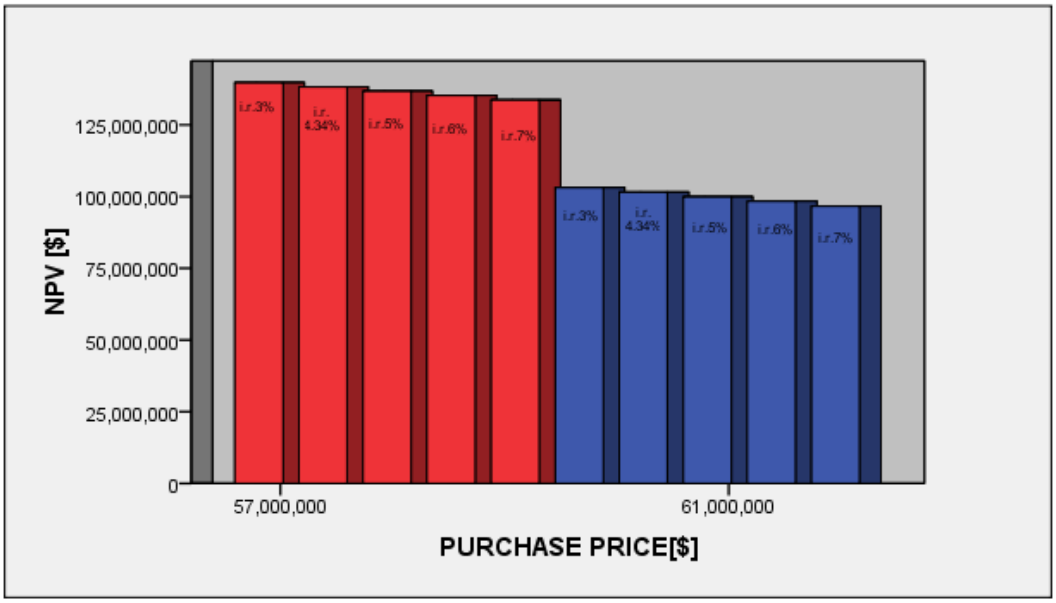
SECOND-HAND 6500 TEU POST-PANAMAX [40% decr.fr.rates]

PURCHASE PRICE-NPV



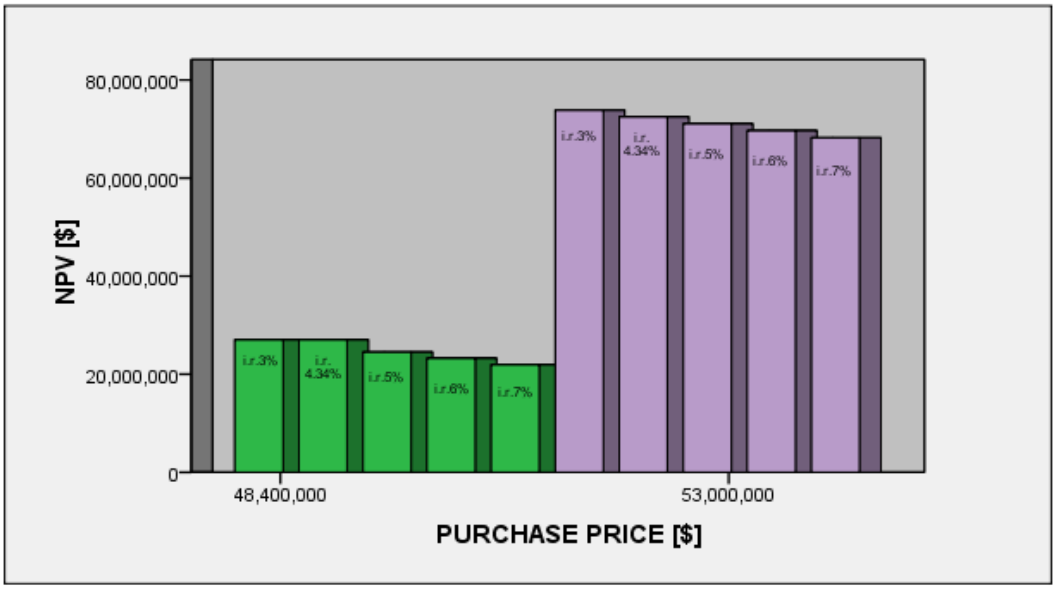
SECOND-HAND 9500 TEU POST-PANAMAX [50% incr.fr.rates]

PURCHASE PRICE-NPV



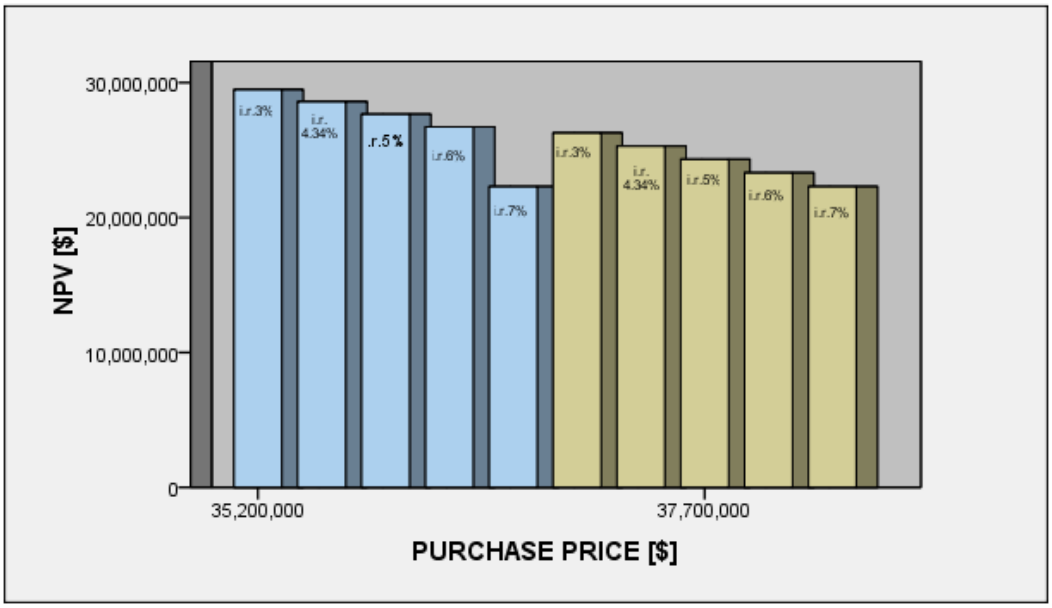
SECOND-HAND 8500 TEU POST-PANAMAX [50% incr.fr.rates]

PURCHASE PRICE-NPV



SECOND-HAND 6500 TEU POST-PANAMAX [50% incr.fr.rates]

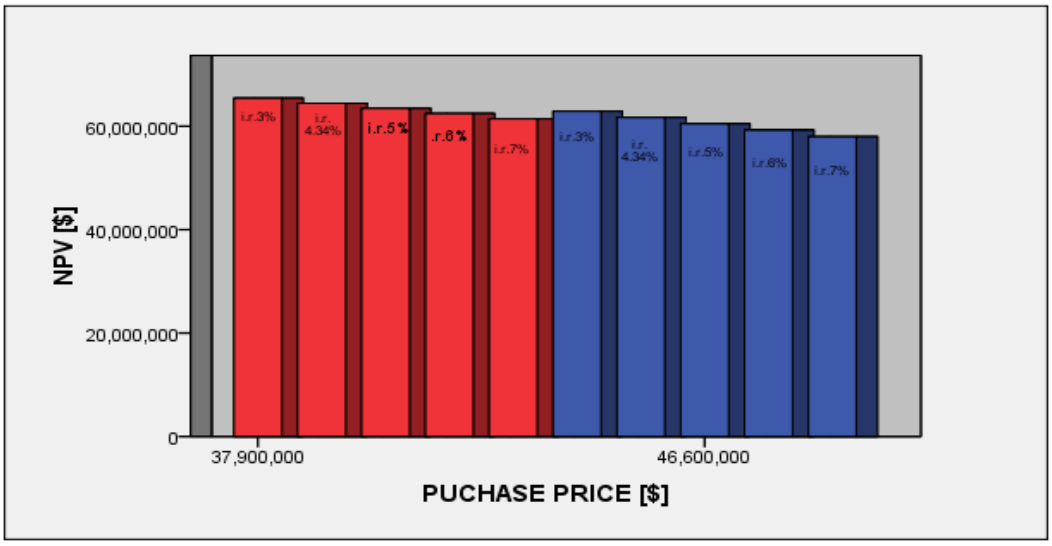
PURCHASE PRICE-NPV



Second hand 10 year old case

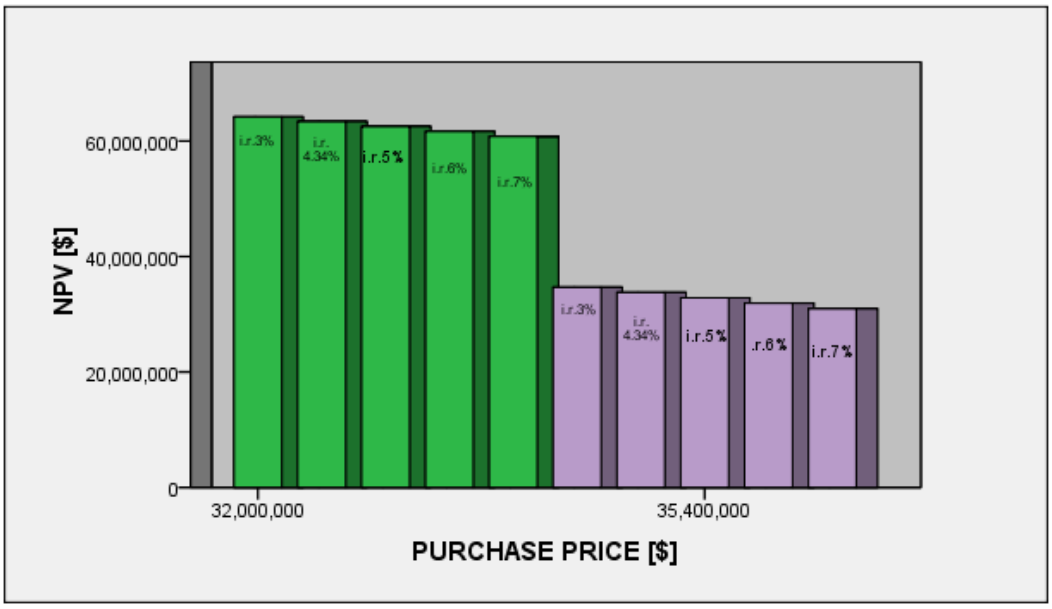
SECOND-HAND 9500 TEU POST PANAMAX

PURCHASE PRICE-NPV



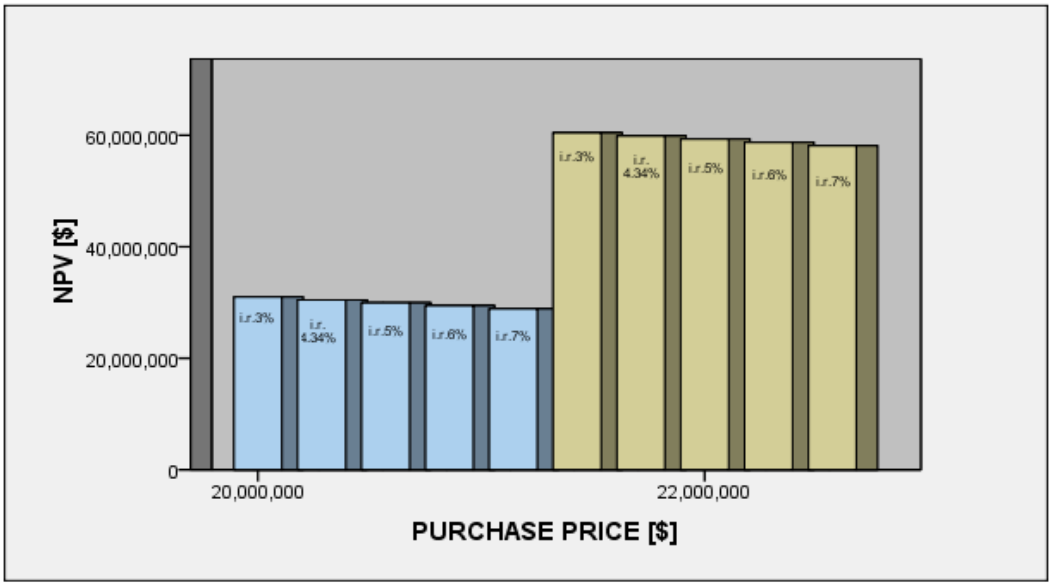
SECOND-HAND 8500 TEU POST PANAMAX

PURCHASE PRICE-NPV



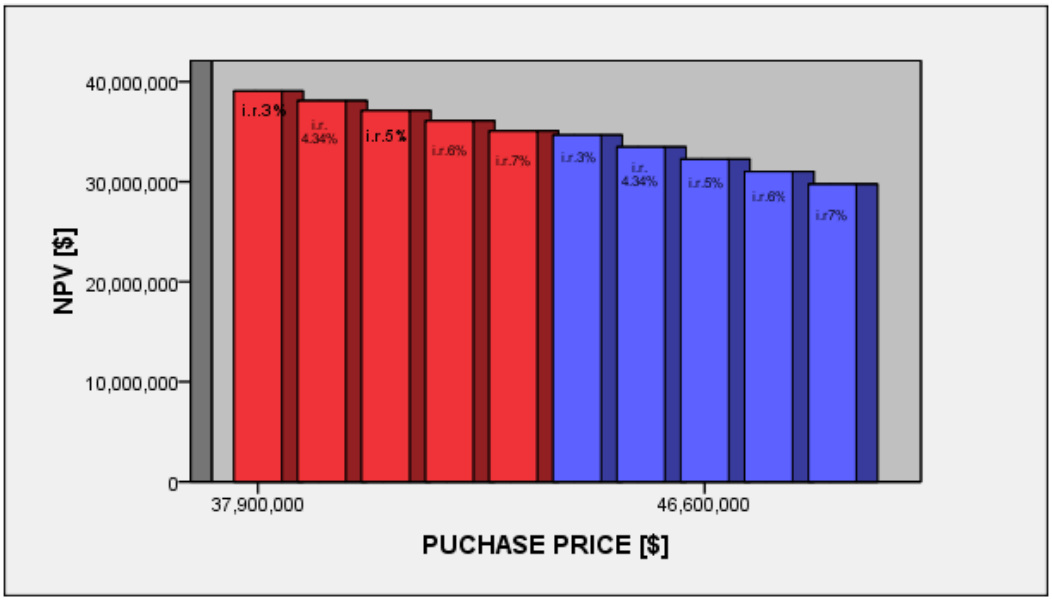
SECOND-HAND 6500 TEU POST PANAMAX

PURCHASE PRICE-NPV



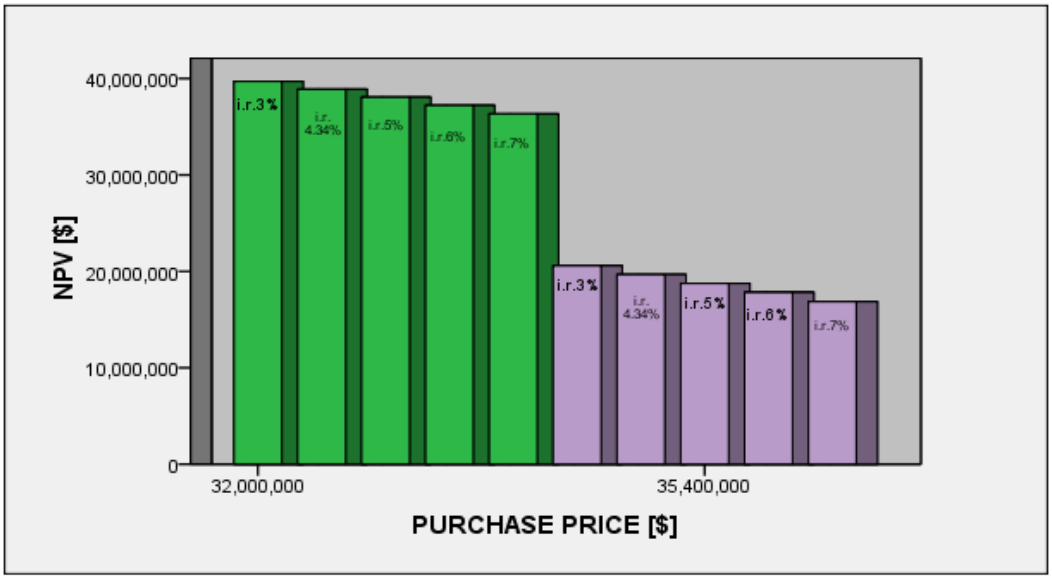
SECOND-HAND 9500 TEU POST PANAMAX [40% decr. fr.rates]

PURCHASE PRICE-NPV



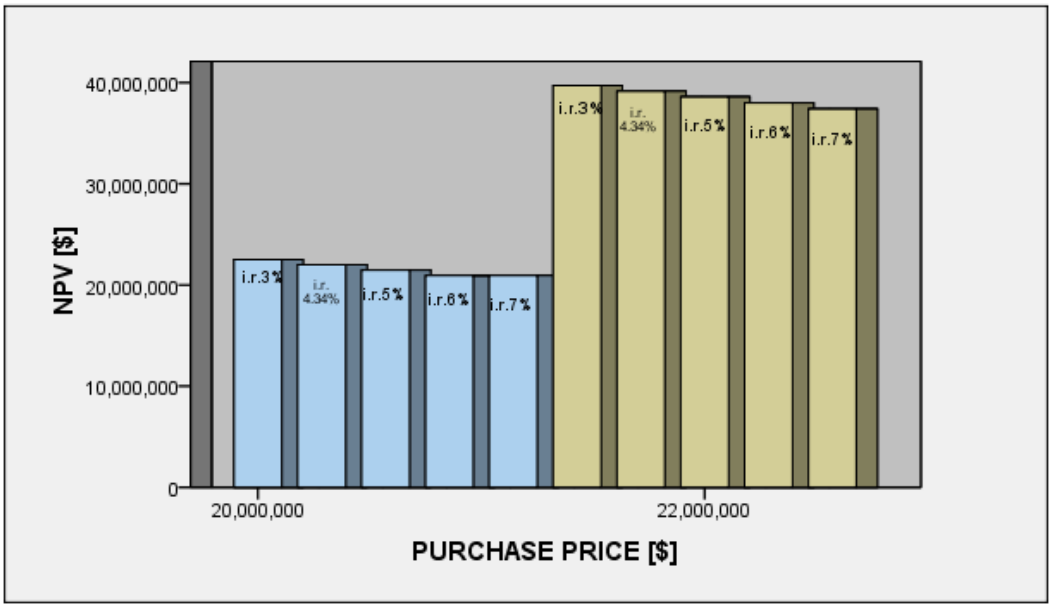
SECOND-HAND 8500 TEU POST PANAMAX [40% decr. fr.rates]

PURCHASE PRICE-NPV



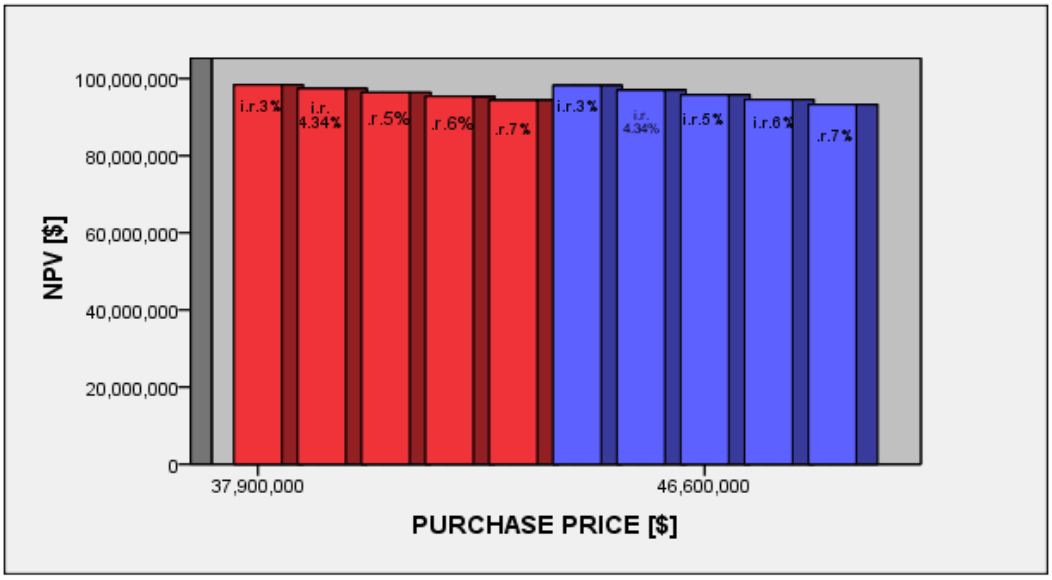
SECOND-HAND 6500 TEU POST PANAMAX [40% decr. fr.rates]

PURCHASE PRICE-NPV



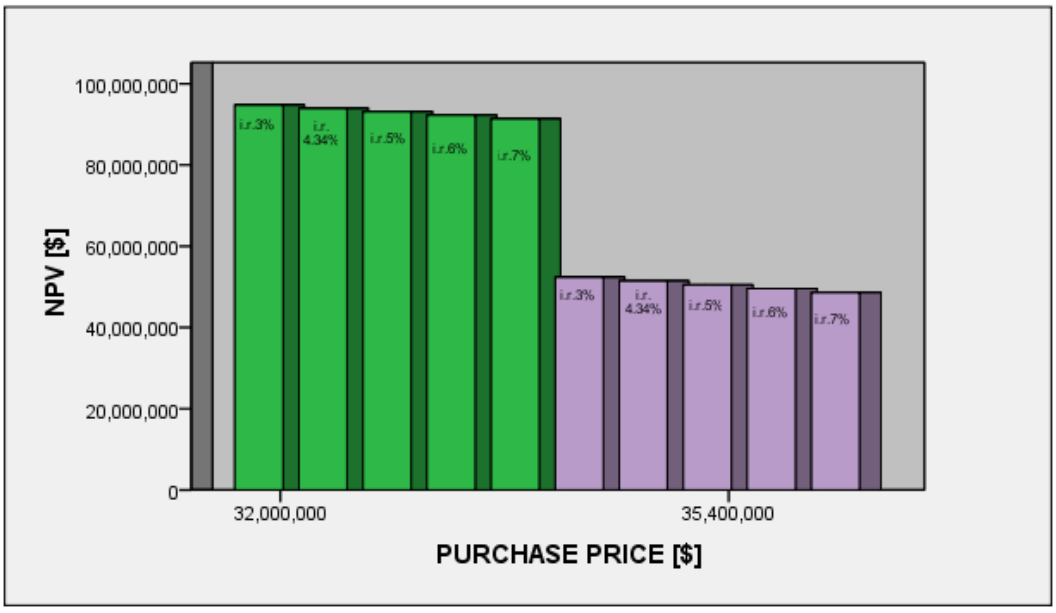
SECOND-HAND 9500 TEU POST PANAMAX [50% incr. fr.rates]

PURCHASE PRICE-NPV



SECOND-HAND 8500 TEU POST PANAMAX [50% incr. fr.rates]

PURCHASE PRICE-NPV



SECOND-HAND 6500 TEU POST PANAMAX [50% incr. fr.rates]

PURCHASE PRICE-NPV