Creating Value from Uncertainty: A Study of Ocean Transportation Contracting

by

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Abstract

How can financial tools like real options and hedging mitigate and create value from uncertainty in transportation? This paper describes these concepts and identifies research on them that has relevance to transportation. It then gives historical background of the containerized ocean transportation industry, uses Porter's five forces to explain its dynamics, and explains how contracts are set up and managed. It identifies areas within containerized ocean transportation that could benefit from real options and hedging, claiming that recent deregulation is creating opportunities for innovative thought. It gives examples of how real options are already being used in the industry to create flexibility without having any price attached to them and then comes up with new ideas of using them. It concludes by, first, stating that both shippers and carriers can benefit from managing uncertainty together and, second, suggesting future areas of research.

Thesis Supervisor: Dr. Chris Caplice
Title: Executive Director, Master of Engineering in Logistics Program

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1 Introduction

Everyday uncertainty in the transportation industry complicates the management of contracts and operations, and has made it difficult for the service providers (carriers) to operate efficiently. In the current environment shippers are faced with uncertain costs due to changing surcharges that are added to the negotiated base rate for the shipment. These surcharges can be due to changes in fuel prices, congestion at ports, or transportation at peak season, etc.

These uncertainties are usually thought of as being negative. Real options, counter intuitively, see value in uncertainty. Real options are a right but not an obligation to take an action and the more the uncertainty the higher is the value of the option. Another important aspect of real options is that they can put a price on flexibility, such as the flexibility that is necessary in an industry where demand is uncertain.

Change is driven by incentives (Byrnes & Shapiro, 1991) and knowing where the value is, creates an opportunity for change. If a producer of a product can solve any operational problem he has by charging the customer more without worrying that the customer will leave, he lacks the incentive to solve his problems and remove the extra cost from the system. This is a powerful concept when dealing with uncertainty that is industry specific, because instead of taking the uncertainty for granted, it may be possible to eliminate it.

Some uncertainties come from the outside and cannot be managed within the industry. These are for examples fluctuations in fuel prices and currencies. There are advanced hedging tools within the finance industry which may be applicable to the industry of containerized ocean transportation.

The thesis focuses on contracting in containerized ocean transportation. It identifies the major competitive forces, the interaction between carriers and shippers, its uncertainties, and examines its recent trends.

The transportation of containers, which has its origins in the late 1950s and took off in the 1960s, has seen considerable and continuing deregulation in the USA since 1998. The European Commission is now, in 2005, working towards the same goal, albeit with different methods. The industry is fragmented – the largest carrier has 10% of the world capacity. It is undergoing a transition from point to point transportation services to more inclusive logistics contracts that seek to add value to the shippers business. This development is also being pushed by shippers, whose focus is shifting from seeking the lowest transportation price to seeking a reliable service that minimizes the cost of stock-outs. The shippers are also growing in size and their leverage is increasing. A decision of one shipper – Wal-Mart -- to concentrate its shipments for the peak season on two months instead of spreading it over four or more months, had effects on the whole industry (Mongelluzzo, 2004, September 6).

The uncertainty that characterizes the industry of containerized ocean transportation and has so far been regarded as problematic and devaluating is, for example, demand volatility over lanes, transit time volatility, fuel price volatility, currency fluctuations, capacity constraints, port capacity, and the business cycle. The objective of this thesis is to determine if real options can be used to create value from this uncertainty.

Chapter 2 describes the main attributes of real options and summarizes a discussion on their use and applicability. The chapter focuses on aspects of real options that are specifically interesting in the context of contracts. Chapter 3 describes containerized ocean transportation in detail amongst other things through the use of Porter's five forces (Porter, 1980). It explains why the customary way of doing things might be coming to an end, and leads the discussion into chapter 4, which explains contracts within the industry and identifies real options within it. It claims that the industry's incentive system creates a barrier to change. Chapter 5 suggests future areas of research as well as claiming that it is not only a good idea, but a necessary idea, to start using new tools to increase cooperation not only between shippers and ocean carriers, but also between ocean carriers and their suppliers, such as those who offer services in the ports.

2 Real Options and Management of Uncertainty

Uncertainty that traditionally is considered a problem has a value when looked at from the perspective of real options. Understanding the variables that determine the value of real options can also help to manage uncertainty. Real options theory is however still under development. There are opposing views regarding where they are applicable, how their value should be calculated, and even if they have use outside their theoretical application. This chapter identifies the main issues regarding real options, and describes the aspects that may have relevance to containerized ocean transportation.

2.1 What Is a Real Option?

A real option is "a right, but not an obligation, to take some action now, or in the future, for a pre-determined price." (de Neufville, 2004). The concept of option comes from the world of finance, where in the simplest case, the owner of an option can decide at or up to a certain time to buy or sell the underlying asset of the option. The underlying asset can for example be a stock in a company where future price is uncertain. An option that can be exercised only at a specific point in time is called a European option, whereas an option that can be exercised anytime up to a specific point in time is called an American option. An option that gives the owner the right to buy the underlying asset is a call option, and the option that gives the owner the right to sell an underlying asset is a put option. The term real option extends the use of options from financial assets to something tangible as opposed to purely financial.

Using real options in the design of a system is a way to build flexibility into a system that is designed for an environment that has future uncertain states. There are different types of real options, the main ones being the option to defer, the option to expand, the option to shrink, the option to abandon, and the option to switch. Compound real options are yet another type, where a project is built in phases and each phase is dependent on the phase before (Copeland & Antikarov, 2003). When thinking in terms of real options a call option becomes an option to seize an opportunity and a put option becomes an option to get out of a bad situation. Examples of real options are given below.

Zhao and Tseng (2003) describes the construction of a parking garage, in which the demand for parking spaces is uncertain. Instead of assuming a deterministic demand and designing to that assumption, real options are introduced. The garage is built with a certain number of floors, but the columns are over-dimensioned, thus creating an option to add extra floors later if needed. This means that a real option to expand has been designed into the project.

Weck, de Neufville and Chaize (2004) discusses the case of a communication satellite system that went bankrupt. The system was designed according to fixed requirements and was built in one stage. The paper argues that designing flexibility into the system and building it in stages would have made the project profitable. Building in stages would have allowed the designers to incorporate better information into their design requirements. Designing flexibility into the system would have allowed the system to be changed to meet market demand. This is a description of a compound real option that allows the owner to defer the decision to go ahead with the next stage. It can also be seen as an option to expand.

Reykjavík Energy, which operates the water distribution system for the capital city of Iceland, has kept operational a small water reservoir that is only intended for use during extreme peak water consumption (Hjartarson, 1994). This is a switch option: the pumps at the small water reservoir are switched on during extreme demand, but are otherwise switched off. Copeland and Antikarov (2003) gives the option to open or close a mine as an example of a switching option: if the price of the material being mined are unfavorable the mine can be closed, and vice versa opened if prices are favorable.

Copeland and Antikarov (2003) go on to give an example of a jet engine producer that offers customers the option to cancel orders. This gives the customers a real option to shrink their order if the market situation changes.

In the case of an airport expansion in South America, De Neufville (2004) explains how the whole project can be segmented into phases, where each phase is designed so as to minimize the cost of abandoning the project if demand doesn't support the expansion. The first phase in such a project could, for example, be to secure land for an airport, a process that can take years. This first phase can be started without spending too much money on design, for example. This means that the project is set up in such a way that the owner of it has a real option to abandon it.

A type of a real option that clearly creates flexibility is postponement, a concept familiar to supply chain specialists. The classic example is from Benetton where the product and the supply chain is designed to allow the company to decide the color of sweaters right before their sold, instead of deciding it early on in the production. This is achieved by producing a greige sweater that can be colored just before it is sold, when it is possible to forecast more accurately the demand for specific colors. (Signorelli & Heskett, 1984). This is a real option in the sense that you can prevent lost sales by deferring the decision of the color.

What postponement, and in general real options are doing, is delaying the need for decision making until some of the uncertainty has been resolved, i.e. they create flexibility and this flexibility has value.

2.2 Valuing Real Options

There are six variables used to define the value of a real option: the value of the underlying asset, the strike price, the duration of the option, the underlying asset's volatility, the risk-free interest rate, and dividends (Copeland & Antikarov, 2003). The case of the parking garage described in Section 2.1 can illustrate these variables. In this case the columns in a parking garage were built thicker than necessary, so that it would be possible to build extra floors on top of it in case of a high demand for parking spaces. The value of the underlying asset is the value of cash-flows of the parking garage itself. The strike price is the cost of building the extra floors. The duration of the option is undetermined, since it is there during the lifetime of the garage. The volatility is based on the volatility in demand. The dividends would be the cash inflows and outflows from the parking garage investment after it became operational. The value of the option that is calculated from the above variables is the increase in the value of the total project, from what it would have been without the over-dimensioning. Finally, the price of the real option is the cost of building thicker columns and should therefore be less than the option's value.

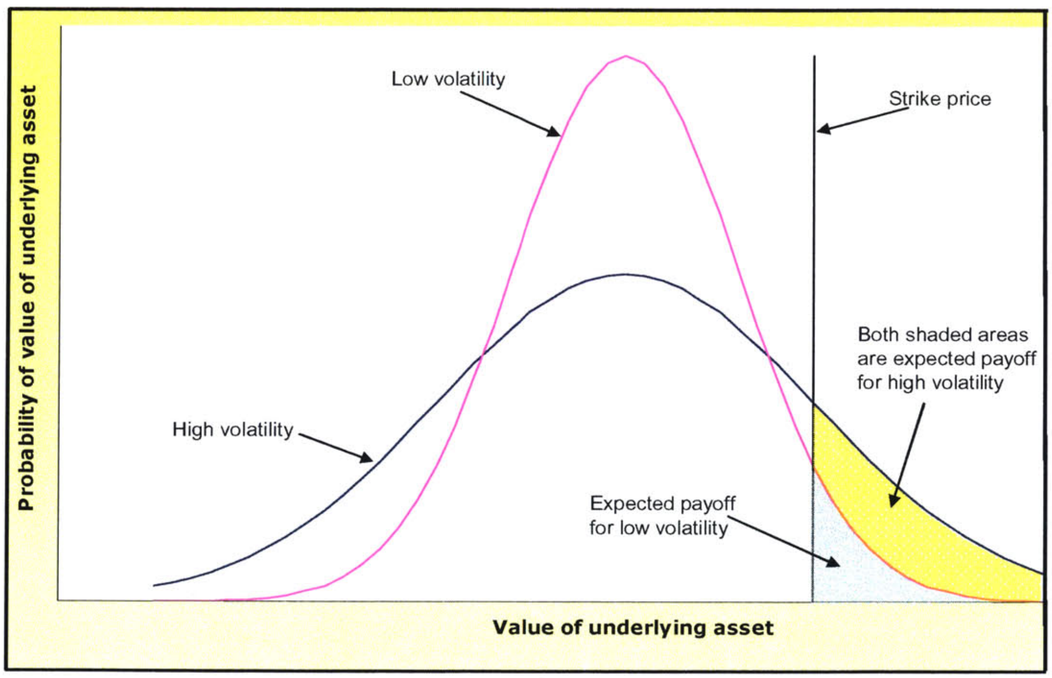
An important aspect of options is that they have the counter-intuitive properties of having a higher value, the more the uncertainty is. This is because an option allows you to reap all the benefits of a good situation, while allowing you to get rid of the risk of the bad situation.

Let's consider an opportunity X where the volatility of the payoff stretches uniformly from -3 to 3. Anything below 0 is a bad situation and everything above 0 is a good situation.

Now let's consider an opportunity Y where the payoff stretches uniformly from -4 to 4. The volatility of Y is higher than that of X. Since the option is only exercised if the payoff is above 0, the value of the option Y is higher than that of A.

Figure 1 shows the payoff for two normally distributed assets with the same mean but different volatility for a call option. The asset with the higher volatility has the higher payoff.

Figure 1
The higher the volatility the higher the potential pay-off since the downside can always be ignored.



Based on Copeland and Antikarov (2003)

In certain cases of real options it is possible to attach an exact value to the option being created. This is possible when the uncertainty is known and the option is simple, you either use the option or not. The calculations soon become overly complicated when more dimensions are added to the equation. (Kalligeros, 2004).

Copeland and Antikarov (2003) recommend four steps to calculate the value of real options. The first step is to calculate the net present value without taking uncertainty into account. The second step is to combine all the uncertainties into one uncertainty, for example using the Monte Carlo simulation. The combined uncertainty is then used to build an event tree that describes all possible outcomes. The third step is to identify the responses management will have under different outcomes in the event tree, and add them to the tree, creating a decision tree. The fourth and final step is to calculate the payoffs in the decision tree.

This method shows that in order to put a value on a real option it is not only necessary to understand the uncertainty affecting the value of the real option, but also to take into account different management responses as events unfold. This is the largest difference between the evaluation of a real option versus a financial option. The variables used for the evaluation of a financial options are fixed, whereas the variables of the real option can be influenced by its owner.

2.3 Strategic Use of Real Options

Leslie and Michaels (1997) identifies two kinds of flexibility that come with real options: reactive and proactive. This is an important distinction. With financial options the owner of the option is reacting to exogenous factors, such as the price of the stock, thus the flexibility is reactive. When the owner influences factors in order to increase the value of the option, the flexibility is proactive.

The paper identifies six ways for the owner to proactively increase the value of the option: increase future revenues, decrease future costs, increase the volatility of the future net income, increase the duration of the option, limit the loss that waiting to exercise the option causes, and to increase the risk-free interest rate. The price of the option is most sensitive to the first three ways. The largest value of real options as a strategic tool is that it changes the perception of uncertainty from something to fear to an opportunity.

"The real power of real options lies in strategic application," (Leslie & Michels, 1997). Just by applying the way of thinking that real options entail, such that there is value in uncertainty, may lead to beneficial management approaches. It may not be necessary to go to extreme details to get the value out of the real options philosophy. McGrath et al. (2004) states that the value of real options is amongst other things in keeping costs in check while there is still high uncertainty, and allowing a company to go after possibilities with the potential for high payoff. Mittendorf (2004) describes how the value of a real option can be increased by controlling the flow of information as a decision to take action is delayed.

Kogut and Kulatilaka (2001) states that options have value because of uncertainty, duration, and the owner's choice. It then describes how a multinational company is creating options by its presence in different countries. It can react to currency fluctuations by shifting production from one country to another. The company has in effect a real option to switch production from one country to another. The paper values the option by looking only at the volatility in the currency, stating that looking at only one of the volatilities gives a minimum value of an option. The paper then mentions the possibility of writing short-term contracts that give the company the real option to switch suppliers, if the currency rate favors it.

A related way of thinking is presented by Chi (2000), where joint ventures are described as options and a mathematical framework to value these options is described. In this case, two companies might form a joint venture around a project and they would then have the option to buy the other company's stakes in the joint venture. It is perceivable that a shipper and carrier might want to form such a joint venture when going in with a production in a new area. The shippers and the carriers could by doing so cooperate to maximize the profit of the joint venture, thus maximizing their own profit. As the business matured the carrier could buy the shipper out of the joint venture.

Pochard (2003) describes how a manufacturer can diversify away his risks by using a dual sourcing policy. It concludes that this is a viable possibility and uses the real options theory to assign a value for the policy. Billington (2002) describes how Hewlett-Packard used a dual sourcing policy in practice. What Hewlett-Packard did was to create a portfolio of different contracts for the sourcing of a part. One type of the contract was a long-term contract focusing on meeting the bulk of the demand (for example 90%) for the low price such a contract offers. The other type of contract in the portfolio was a short-term contract, that had a higher price, but a guaranteed supply of parts to meet demand volatility. In effect, Hewlett-Packard had the option to expand or shrink their parts supply without losing much of the benefits of a long-term contract.

Real Options are used to take uncertainty into account when a decision is made. There are different types of real options but the common attribute is that real options allow managers to calculate the value of being able to change the direction of a project or cancel a project after the initial investments have been made.

2.4 Limits to Real Options

The science of real options is evolving and what exactly is meant by the term real options has not been established on a common basis for all (McGrath, Ferrier, & Mendelow, 2004). Where they are applicable and what constitutes a real option as opposed to a series of decisions is taken up by Adner and Levinthal (2004). Since the real option allows managers to abandon a project, the paper argues that a company that uses real options in its decision making process should have a higher percentage of initiated projects that are cancelled. Although it doesn't answer the question, whether this is so, it points out that it is easier to initiate an investment than to cancel it, and if this tendency is allowed to go unchecked, the value of the real options might be forfeited. A company using real options should therefore have a clear set of guidelines and built in incentives that guide the decision makers.

Figure 2 is an overview of the "traps" that management can fall into when using real options for strategic purposes. "Technical agenda fixed" means that the product cannot be changed to meet the market's reaction, whereas "Technical agenda flexible" means that the product can be changed. "Target market fixed" means that the product is only meant for one specific target market and cannot be launched in another market if the original market doesn't respond favorably to it, whereas "Target market flexible" means that the product can be tried out in another market if the first one responds unfavorably.

Figure 2
"Option Traps".

	Target market fixed	**Target market flexible**
Technical agenda fixed	Option trap: in the absence of expiration, the firm can maintain the option indefinitely until conditions improve "Things will get better"	Option trap: negative market signals may lead to a search for new potential markets or market interventions rather than abandonment "We can try it somewhere else"
Technical agenda flexible	Option trap: further development efforts always hold the potential for overcoming any negative market signal "We can try harder"	Option trap: too many degrees of freedom for ruling out success "We can make this work"

Source: Adner and Levinthal (2004)

McGrath et al. (2004) disagrees with this approach and says that deciding beforehand under what circumstances an option will be abandoned ignores the potential of the real option that is specifically designed so that decisions can be made under new information. It also underlines that real options are about more than canceling a project; they are about switching between choices, scaling a project up or down. Kogut and Kulatilaka (2004) further state that a company invents heuristics to counter the tendencies presented in Figure 2. Adner and Levinthal (2004, pp. 120-126) says that although heuristics created through real options can be helpful, the company needs to be careful regarding which context the heuristics are used in. It states that just as deterministic methods can lead to foregone opportunities, the use of real options heuristics can lead to over investment.

The following chapters explore how the containerized ocean transportation industry looks like and how real options can be used within it. The "Option Traps" (Figure 2) are a figure that can help the real options practitioner avoid mistakes.

2.5 The Power of Real Options

This chapter has described the concept of real options and explained how they are valued. There are three points from this chapter that are good to keep in mind, before moving on to explore containerized ocean transportation. The first item is that real options are a way to create value from uncertainty – uncertainty is not necessarily bad. The second point is that real options can be used for strategic purposes – they are not only applicable to one-off investment projects. The third is that use of real options may have limits – using real options strategy to initiate a project without using it to abandon the project can lead to unprofitable decisions. Chapter 4 will tie real options with ocean transportation contracting, but first, Chapter 3 describes the industry of containerized ocean transportation.

3 Forces and Uncertainty in Containerized Ocean Transportation

This chapter uses Michael Porter's five forces model to analyze the industry of containerized ocean transportation. The five forces are rivalry between industry players, supplier power, customer power, threat of substitutes, and barriers to entry. Understanding how strong the forces are and how they interact can help a company position itself strategically within a segment of the industry that will give it the maximum success (Porter, 1980). Using the five forces here is a way to understand how the companies in the industry are positioned and why the industry is as it is.

In the case of this industry the customers are the shippers, suppliers are those who provide the industry with ships, containers, ports, terminals, and sometimes transportation from port to the end customer, the substitutes would be other modes of transportation, barriers to entry are anything that works against newcomers in the industry, and the players are the ocean carriers, which vary in size and services.

P. Keller (Presentation at MIT, 2005, March 7) describes three main groups of ocean carriers: First, second, and third tier. First-tier carriers can offer full supply chain services integrated into the shippers operations. Second-tier carriers offer door-to-door services, where the shipper still looks at the transportation link as independent from other operations. Third-tier carriers offer only port-to-port services. In many cases, instead of dealing directly with the shippers, the carriers are dealing with intermediaries.

These intermediaries are Freight Forwarders (FF) and Non-Vessel Operating Common Carriers (NVOCC). FFs arrange shipments for shippers and take care of the paperwork involved. They can be either individuals or companies. NVOCCs take this service a step further, both operating as a Common Carrier towards the shipper, with its own bill of ladings (see Section 4.1). They may also consolidate shipments, even within containers. They do however not operate their own vessels, and to the ocean carriers the NVOCCs function as shippers. The NVOCCs enable smaller shippers through the consolidation of shipments to enjoy prices and services closer to those of a large shipper with high leverage, as is discussed in section 3.3.

This chapter provides an understanding of the industry needed in order to generate ideas about how real options and derivatives trading can be applied. Section 3.1 describes the industry in general terms. Section 3.2 explains how the industry's environment is changing through deregulation thus increasing competition between carriers. Section 3.3 uses Porter's five forces to analyze the industry. Section 3.4 introduces the uncertainties that are predominant in the industry, and section 3.5 ties the results to chapter 4.

3.1 Industry Background

The first shipment of containers sailed from New York to Houston on April 26, 1956. Ten years later the first international shipment left USA for Europe. (Carr, 1998). Containerization had a dramatic effect on liner shipping. Liners are common carriers that publish time tables for specific lanes that are followed whether the ship is full or not and that publish tariffs, which dictate the terms of the contract with the shipper. Tramps are the opposite of liners and are usually chartered by a shipper for a one-off full load shipment. Liner shipping has its origin in the late 1860s when the steamship entered the market offering reliable ocean transportation that was mostly weather independent. (Sjostrom, 2004).

In the 1860s governments protected the liner shipping industry through regulations as they considered it to be central to their countries well being. The regulation prevented amongst other things international mergers, forced liners to publish their rates and tariffs forbidding them to negotiate confidential contracts, as well as later exempting them from anti-trust laws (Carr, 1998).

This exemption from anti-trust laws has enabled ocean carriers to operate conferences, which are discussed in section 3.2, where the carriers over a specific route agree on common tariffs for the type of cargo to be shipped. They can also agree on how demand for transportation is distributed between the carriers (Sjostrom, 2004).

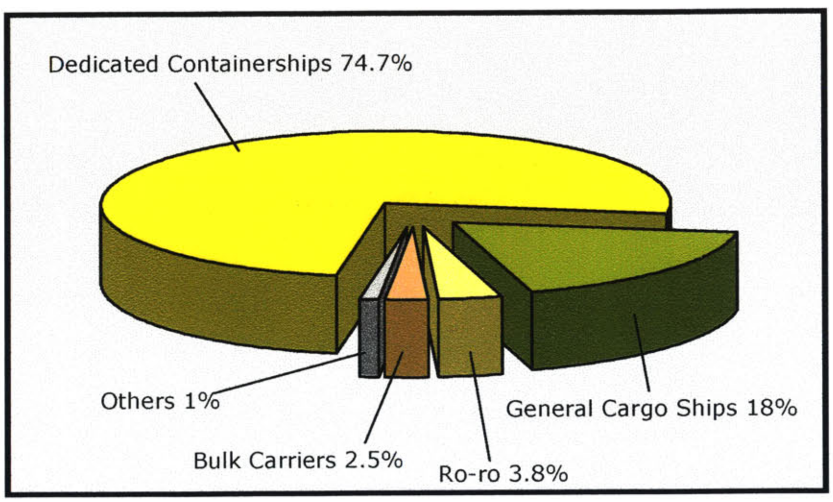
The containers brought with them efficiency that has undermined the premise for the government regulations. Using containers instead of pallets cut the time a ship spends in a port from 3 weeks to around 24 hours enabling and supporting the recent globalization of business (Carr, 1998).

A standard container is 8 feet wide and 8,5 feet high. Its length varies with the most common being 20, 40, and 45 feet. The standard measurement when discussing capacity is a 20 feet container, or a twenty foot equivalent unit, TEU. The world capacity for containerized ocean transportation in 2003 was 8.5 million TEUs, and grew by 8.3% from the year before (United Nations, 2004). This trend fits with the overall 8.5% average annual containerized freight trade growth since 1998 (Department of Transportation, 2005).

From the annual reports of the largest carriers it can be estimated that annual revenues per 1 TEU of capacity in the year 2003 were around USD 18,000. The total revenues of the containership industry were therefore around USD 150 billion.

Ships that are completely dedicated to containers represented 74.7% of the total world capacity for transportation of containers in 2004, up from around 73.7% the year before (United Nations, 2004). This percentage has been rising every year; in 1985 it was around 40% (Stopford, 2001). The rest of the capacity is provided by general cargo ships (single-deck and multi-deck), roll on – roll off (ro-ro) cargo, and bulk carriers as Figure 3 depicts.

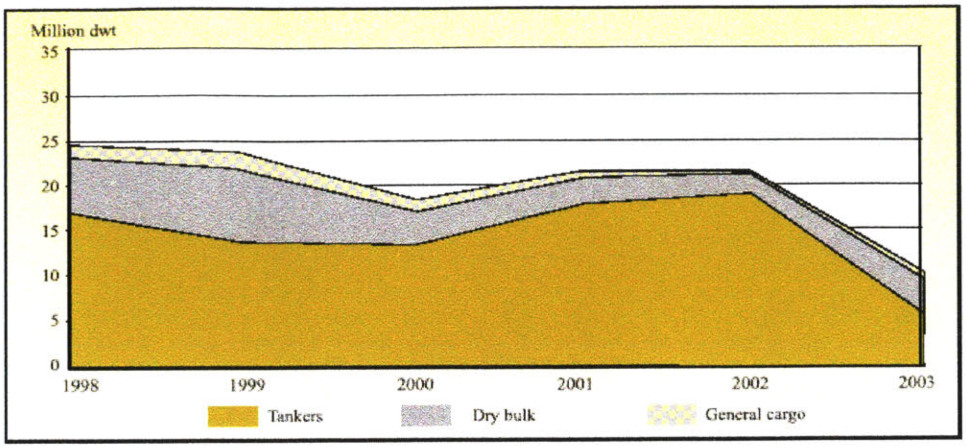
Figure 3
Container capacity by group of ships.



Source: United Nations (2004).

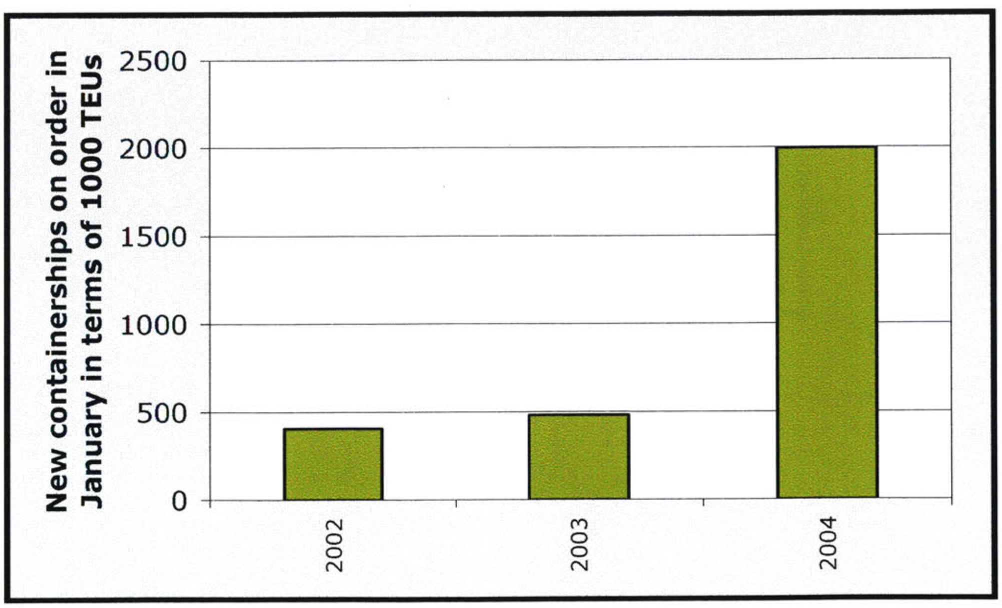
Overcapacity is decreasing for all types of cargo ships as can be seen from Figure 4. This has lead to a huge demand for new ships, not least for containerships, as can be seen from Figure 5. Figure 6 then shows two things: how the fleet of dedicated containerships has been growing steadily and how the proportion of TEU capacity against number of ships has been getting lower, indicating that containerships are getting larger.

Figure 4
Trends in overcapacity for Tankers, Dry Bulk, and General Cargo (including containers).



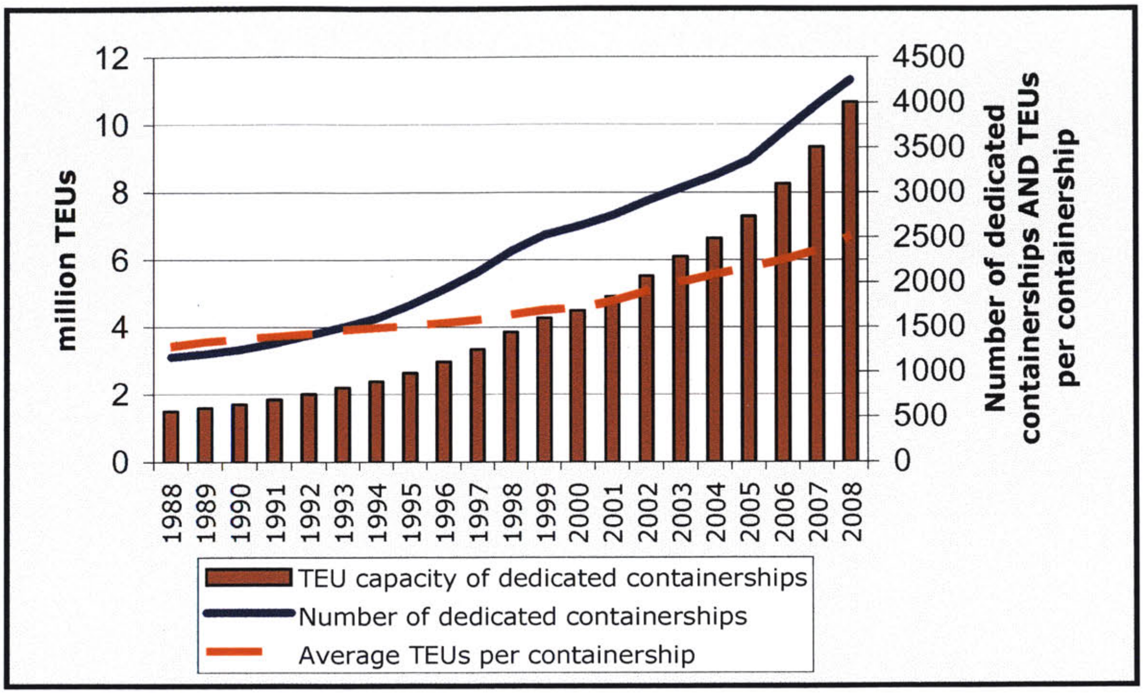
Source: United Nations (2004)

Figure 5
Orders on hand for new containerships in January of 2002, 2003, and 2004 in terms of 1000 TEUs.



Source: United Nations (2004)

Figure 6
Trends in the world of dedicated containership fleet from 1988 to 2008. The year 2006 to 2008 are based on orders on hand.

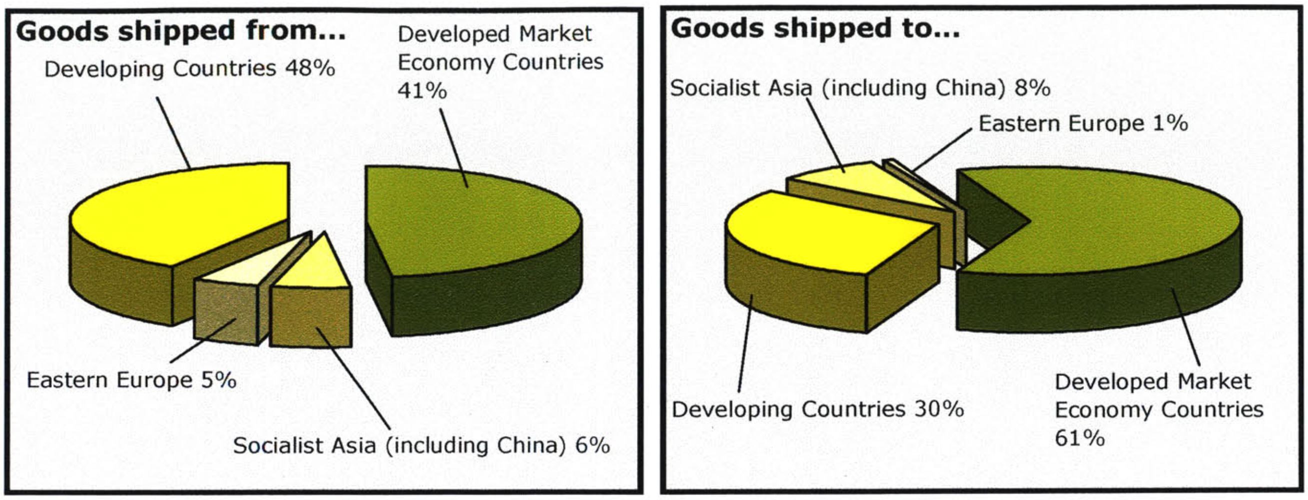


Source: Barry Rogliano Salles (2005)

The size of the business, capacity development, demand development, and the effect this is having on the price to customers underline the relevance of finding opportunities for increased efficiency within the industry.

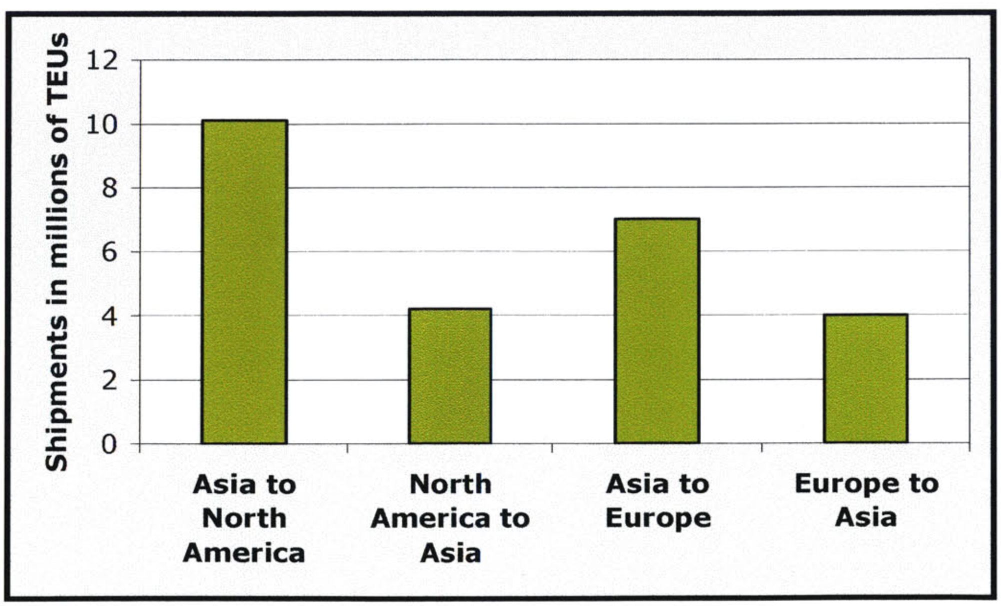
The following three graphs explain how supply and demand are having an effect on the price over the major trade lanes. First, Figure 7 shows how there is an imbalance in the flow of products for all ocean transportation, from the developing countries to the developed market economies. Second, Figure 8 shows how this is also true for containerized ocean transportation. Third, Figure 9 shows how this imbalance affects the prices, that are much higher to North America than from North America. Furthermore, Figure 9 shows how prices over the major lanes have been increasing over the eight quarters from the start of 2002 to the middle of 2004.

Figure 7
All ocean transportation by areas as a percentage of weight.



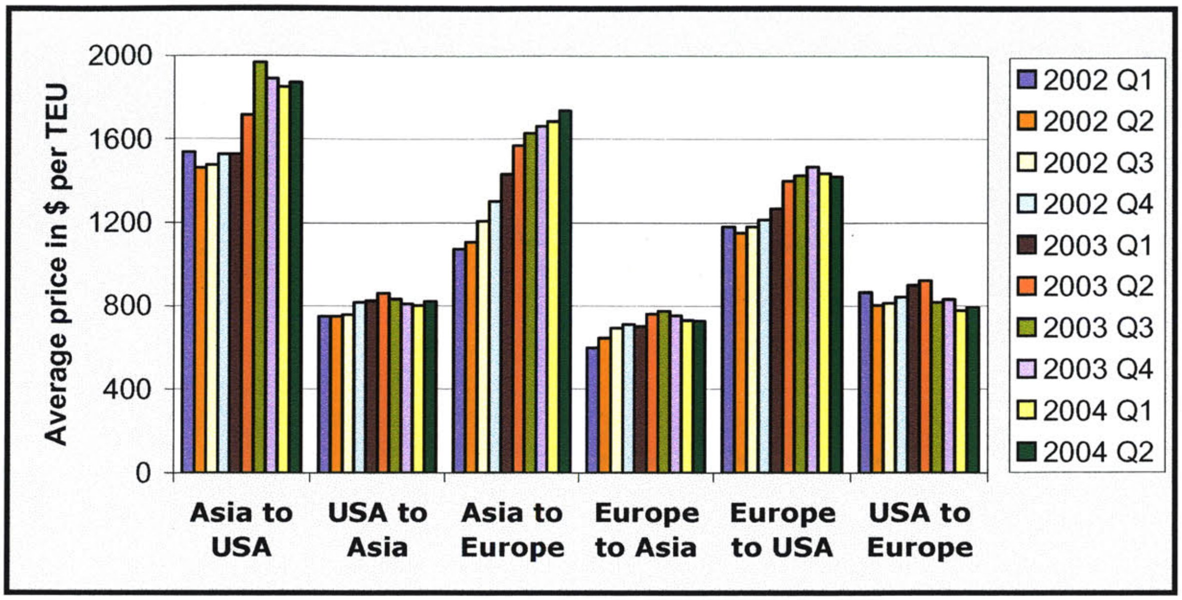
Source: United Nations (2004)

Figure 8
Volume imbalance in the shipments of containers.



Source: United Nations (2004)

Figure 9
Imbalance in volume over lanes leads to large price differences. The figure shows the price development from the first quarter in 2002 to the second quarter in 2004 for both directions on the three major lanes.



Source: United Nations (2004).

This section has described the industry in general terms, given insight into how much it costs to ship a container, how large the industry is, and how surplus capacity has decreased substantially. It was pointed out that the industry has been exempt from anti-trust laws enabling cooperation amongst competitors, which deserves more explanation.

3.2 Deregulation Is Changing the Market Dynamics

The first modern version of a conference was the U.K.-Calcutta conference formed in 1875. Conferences are a cooperation platform for ocean carriers shipping on a specific route. The conferences establish common rates, called freight tariffs, and timetables over specific routes, thereby coordinating the supply of capacity. The supply of capacity is also controlled through cargo quotas and sailing quotas (Sjostrom, 2004). Carriers within a conference traditionally could not deviate from the freight tariffs issued by the conference.

Sjostrom (2004) describes that the reason for the first conferences was perceived to be to cope with excess capacity, although the real reason had probably more to do with perceived failure of the competition. Today there are about 150 conferences in the world. Some of the larger ones are Transpacific Westbound Freight Agreement, the Trans Atlantic Conference Agreement, and Far East Freight Conference. Although there have always been carriers outside the conferences that keep up the competition on a trade route their power has recently been undermined through government deregulation.

The Ocean Shipping Reform Act of 1998 (OSRA) passed by the American Senate allowed carriers to establish confidential one-on-one contracts with shippers. This was aimed at increasing competition and reducing the influence of conferences. In 1998 there were 35 conferences on file at the Federal Maritime Commission (FMC), in 2001 there were 19. This may however not be the work of OSRA as the number of conferences in the US in 1982 was 90 (Sjostrom, 2004). OSRA has led to an increase in service contracts within the ocean liner industry (Federal Maritime Commission, 2001). Deregulation is continuing with the most recent one being on January 15, 2005, when NVOCCs (see section 3.1) were for the first time allowed to enter into confidential contracts with shippers (FMC, 2004). The focus on deregulation in the industry is, however, not confined to the United States.

The European Commission issued a White Paper on conferences in 2003, where it discusses abolishing the liners rights to operate conferences on trade routes to and from the European Union. The European Liners Affairs Association (ELAA) is open towards the suggestion but wants to keep possibilities for discussions and information sharing between carriers, in order to facilitate estimations of market size, data for demand and supply by commodity, and to operate a public price index (European Commission, 2004). The American

Institute for Shippers' Associations (AISA) supports abolishing the conference system and opposes the ELAA suggestions. Generally speaking the AISA does not see any difference between the ocean carrier industry and other industries and opposes any exceptions from anti-trust laws (American Institute for Shippers' Association, 2004). European Shippers' Council (ESC) is of the same opinion (ESC, 2004).

The changes described above show that the traditional way of doing business within the industry is changing. In a time of high demand and low capacity, as the case is now in the beginning of 2005, the ocean carriers have the opportunity to use their leverage to keep the old system going or to lead changes that can benefit the industry as a whole. These are changes that could affect the relationship along the whole transportation chain, stretching from inland transportation through the ports and the carriers to the shippers. The next section describes how the industry looks like today.

3.3 Porter's Five Forces Analysis

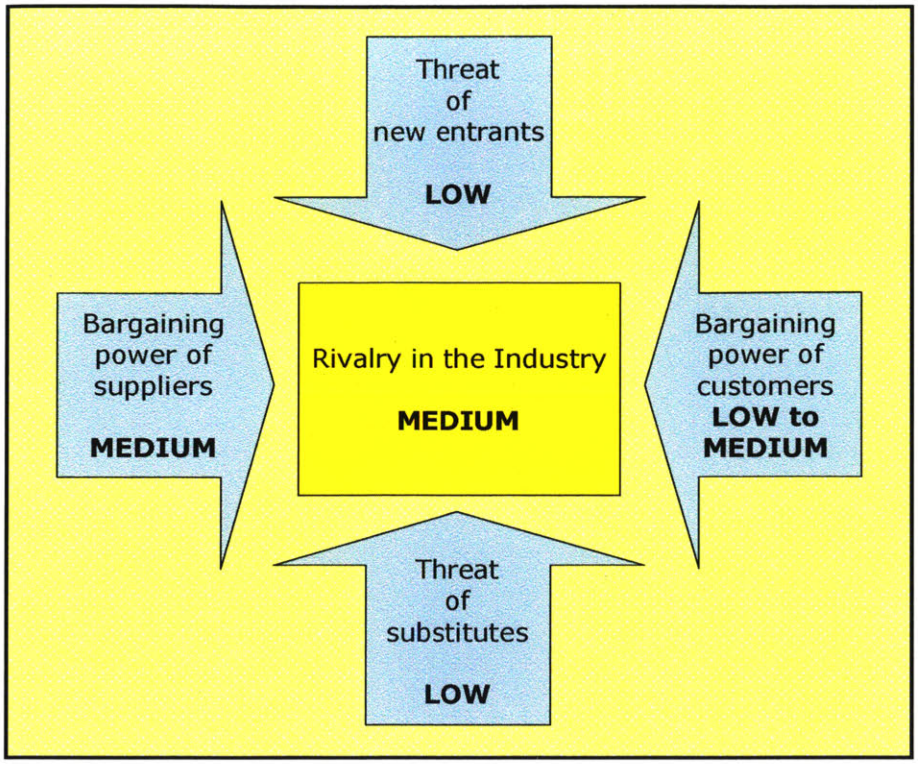
The containerized ocean transportation should be a good industry to be in. First, the rivalry between carriers has been relatively little, as they have been able to allocate volume between themselves and set prices over specific lanes through conferences. Although this is changing as section 3.2 describes, it has not completely gone away, and the same surcharges are still being used industry wide. Second, Threat of substitute products, such as air cargo, is low as the price difference and capacity make it unattractive. Third, bargaining power of customers has traditionally been fairly low, although that is changing with the possibility for confidential contracts between shippers and ocean carriers on the one hand and between NVOCCs and shippers on the other hand. Finally, there are high capital barriers to entry as well as market barriers in the form of cooperation between existing players on the market. The only drawback is that suppliers of the ocean carriers have high leverage.

It is therefore counter-intuitive that carriers traditionally have low operating margins. One explanation is that until 2004 there was much overcapacity (see Figure 4) and the carriers couldn't afford to be selective of customers. In 2004 there was under-capacity which pushed up prices and allowed carriers to be more selective of customers. Given the high number of new containerships being built (see Figure 5) this is likely to change again in the future, thus creating a pattern where every few years it is the shipper's world and the next few years it is the carrier's world, a concern voiced by both shippers and carriers at an industry conference (CTL, 2005).

Another thing to keep in mind when going through the five forces analysis is that the industry is not homogenous. It has different kinds of ocean carriers as described in the beginning of this chapter. There may be fierce competition over one lane while another lane is lacking in competition. There is a wide variety of lane compositions possible and although it may be difficult to differentiate the service from port to port, it is possible for a carrier to differentiate in which ports it offers. However, there are three main trade routes that are dominating the demand for containerized ocean transportation: Asia – USA, Asia – Europe, and Europe – USA. The shift of manufacturing from Europe and USA to Asia is driving a huge surge in demand over the routes to Asia that has lead to under-capacity in an industry that is used to excess capacity as well as leading to congestion in ports.

Figure 10 shows the five forces diagram for the industry. It is discussed in more detail in the following sections.

Figure 10
Five forces for first-tier and second-tier carriers



3.3.1 Rivalry

The industry is fragmented. Table 1 shows the 20 largest carriers in the world for the year 2002 and 2003. The largest carrier has 10.1% of the TEU capacity in 2003, 4 percentage points more than the next largest carrier. The Herfindahl index is used to measure concentration within an industry. The index is calculated by summing up the squares of the market share of the companies within the industry (Caplice, 1996). Thus and industry with two companies, each with a 50% market share, has a Herfindahl index of $50^2 + 50^2 = 5000$. According to the Department of Justice (1997) an industry with a Herfindahl index of over 1800 is highly concentrated. An index between 1000 and 1800 means a moderately concentrated industry, and an industry with an index below 1000 is fragmented. The Herfindahl index for the industry of containerized ocean transportation is below 350. It cannot be calculated accurately since the market shares of all carriers within it are not available. However, the 20 largest carriers have a market share of 64.5% and add 292 to the index. The 20th largest carrier has 1.3% market share measured in capacity so the maximum the carriers below that can add to the index is 47. The industry in the world market area is therefore fragmented.

Table 1
The 20 largest carriers, their ranking and capacity for 2003 and 2002.

Ranking	Carrier	# of ships	Change in ranking	TEU 2003	% of total	TEU 2002	% of total
1	A.P. Möller Group Denmark	328	No Change	844,626	10.1%	773,931	10.0%
2	MSC Switzerland	217	No Change	516,876	6.2%	413,814	5.4%
3	Evergreen Group Taiwan	152	UP 1	442,310	5.3%	403,932	5.2%
4	P&O Nedlloyd UK/Netherlands	157	DOWN 1	419,527	5.0%	406,654	5.3%
5	CMA-CGM Group France	150	UP 3	299,174	3.6%	225,436	2.9%
6	Hanjin/DSR-Senator Republic of Korea/Germa	76	DOWN 1	290,677	3.5%	304,409	3.9%
7	COSCO China	148	DOWN 1	274,128	3.3%	255,937	3.3%
8	NOL/APL Singapore	82	DOWN 1	273,573	3.3%	227,749	3.0%
9	NYK Japan	91	UP 2	233,934	2.8%	177,700	2.3%
10	MOL Japan	72	DOWN 1	222,533	2.7%	188,326	2.4%
11	CP Ships Group Canada	85	DOWN 1	201,706	2.4%	187,890	2.4%
12	K Line Japan	63	No Change	186,017	2.2%	168,413	2.2%
13	OOCL Hong Kong	55	UP 1	185,502	2.2%	157,493	2.0%
14	Zim Israel	79	DOWN 1	174,480	2.1%	164,350	2.1%
15	Hapag Lloyd Germany	41	UP 1	154,850	1.9%	135,953	1.8%
16	Yang Ming Taiwan	55	UP 2	153,783	1.8%	120,319	1.6%
17	China Shipping China	94	DOWN 2	143,655	1.7%	148,212	1.9%
18	Hyundai Republic of Korea	35	DOWN 2	136,548	1.6%	122,713	1.6%
19	CSAV Chile	55	UP 1	123,378	1.5%	90,625	1.2%
20	PIL Group Singapore	92	DOWN 1	106,508	1.3%	97,827	1.3%
	Total top 20			5,383,785	64.5%	4,771,683	61.8%
	World fleet estimate			8,354,000	100.0%	7,713,000	100.0%

Source: United Nations (2004)

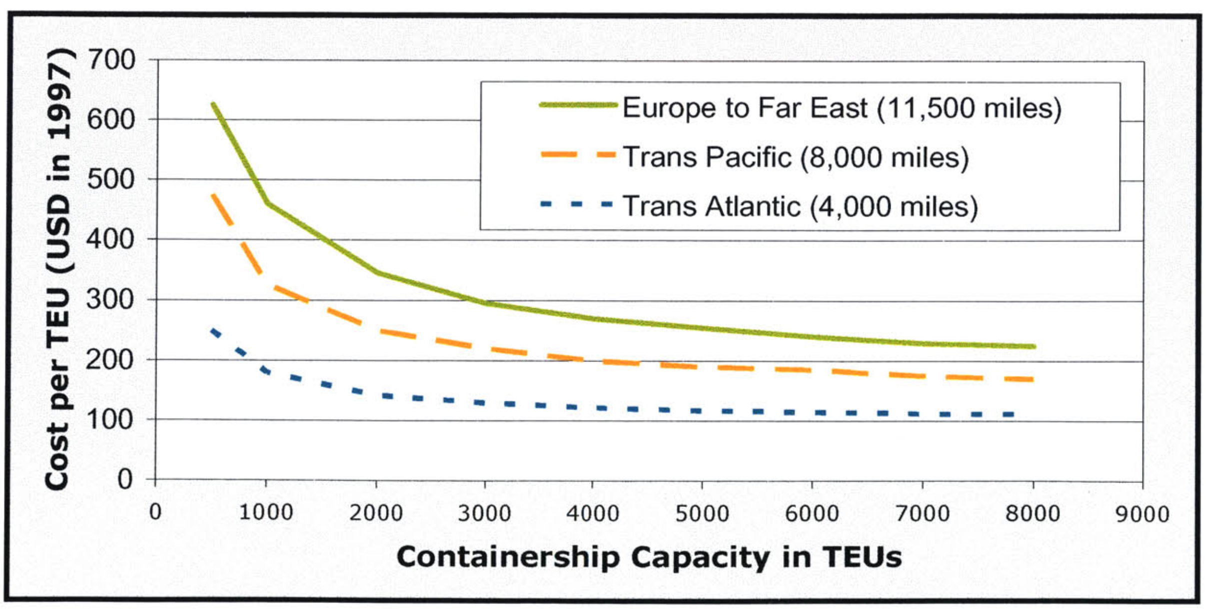
Porter (1980) explains why an industry is fragmented. Many of his reasons fit the industry of containerized ocean transportation. First, an industry is likely to be fragmented if there is little advantage for competitors to be large when dealing with customers. For the industry of containerized ocean transportation the published rates, the ban on confidential contracts, and demand allocation between carriers within a conference did exactly that. Second, if exit barriers are high, poor performers stay on in the industry. Containerships both demand heavy investment and can only be used for one thing: transporting containers. So even if an ocean carrier goes bankrupt, its TEU capacity is likely to be bought or chartered by someone, even cheaply during a bust-period. Third, local presence, local connections, and local regulations can give local rivals an advantage. The ocean carriers come from different areas of the world and have different cultures, fulfilling this criterion for a fragmented market.

Although the first reason for fragmentation, the lack of benefits for being large, has now been removed, that is not necessarily enough to overcome fragmentation, since companies may get stuck in the traditional way of doing things and don't see the opportunity presented to them (Porter, 1980). In this industry, however, there has been consolidation of ocean carriers for example the merger between Maersk and Sealand and between NOL and APL. It is also noteworthy that between the years 2002 and 2003 there were no new entrants to the top 20 list presented in Table 1 and the top 20 carriers increased there market share from 61.8% to 64.5% indicating consolidation within the industry.

Until high demand eliminated the overcapacity in the industry in 2004, overcapacity and the high barriers of exit were the reason for the low operating margins, as explained by Porter (1980): "Exit barriers ... keep companies competing even though they may be earning low or even negative returns on investment. Excess capacity remains functioning, and the profitability of the healthy competitors suffers as the sick ones hang on. If the entire industry suffers from overcapacity, it may seek government help...". This description fits the containerized ocean transportation industry before 2004 perfectly. Until then, the carriers had a low operating margin. The industry average operating profit as a percentage of income for 1994 to 2002 was highest 7.0% in 2000 and lowest 3.5% in 2002 (H. S. Marcus, Lecture at MIT, 2005, March 2). In 2002 the highest single shipping line had a margin of 9.5% (American Shipper, 2003). In 2004, due to high demand resulting in capacity constraints, the operating margin is much higher than before for rivals in the shipping industry. This continued into the first quarter of 2003 and is not likely to recede in the close future. Capacity expansion is however one of the most critical strategic decision a company can make according to Porter (1980), and the great capacity expansion shown in Figure 5 can bring problems with it that may lead to yet another bust in this industry.

Porter (1980) names many reasons that can lead to overinvestment in capacity that fit this industry well. First there are technological reasons for overinvestment. Capacity can only be added in large lumps, which is a description that applies to the containership capacity. There are large economies of scale as Figure 11 shows. United Nations (2004) reports that containerships on order are getting much larger. There are long lead times to delivery as it takes around two years to deliver a new containership.

Figure 11
Economies of scale for containerships by route



Source: Cullinane and Khanna (1999)

Second, there are structural reasons for overinvestment in capacity. The largest reason in this category are the before mentioned high exit barriers. Another structural reason is that capacity leaders that want to take as much of the surging demand as possible are highly motivated to increase their capacity.

Third, there are competitive reasons for overinvestment. Porter (1980) says that if there are many companies in an industry without a clear market leader that are vying for a leadership position they are likely to want to be the first to increase their capacity. Finally, there are other reasons such as overestimation of future trends, tendency of managers to err on the side of more capacity, and confusion due to structural changes in the industry.

The structural changes through deregulation coincide with the, at least temporary, reduction of overcapacity. The industry shows many of the behaviors as described by Porter (1980) that can lead to another period of overcapacity, although it may not be right around the corner. However, this change in the market forces is also leading to new industry practices, such as customer selection, and forcing carriers to think up new ideas to run their business. If there is room for real options within the industry, this might therefore a good time to introduce them.

3.3.2 Threat of Substitutes

There is little threat of substitute services. Air cargo is still much more expensive, and is used to solve a crisis or transport highly valuable products, but 90% of cargo in the world is transported by ocean carriers (United Nations, 2004). Certain industries that have high value goods, such as the high tech industry, use air for transportation of certain goods, but ocean transportation is the most efficient mode of transportation for majority of goods, that need to be shipped.

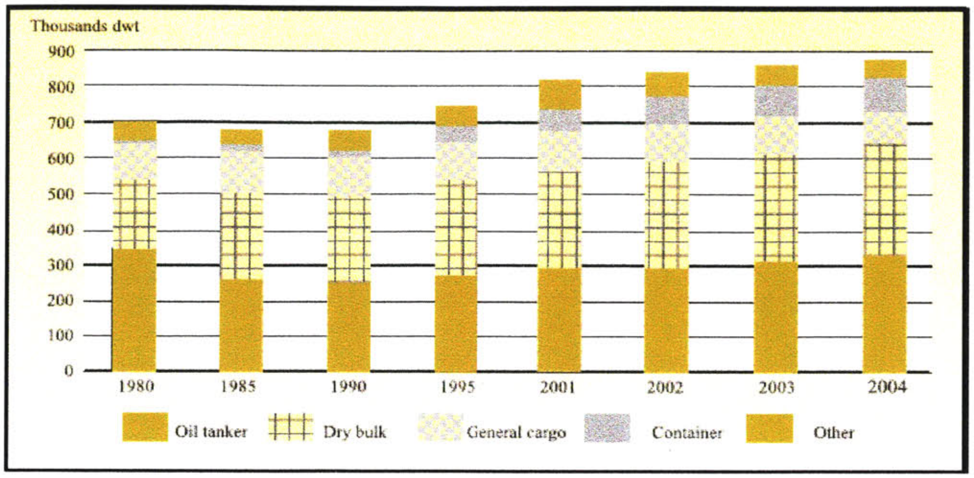
The largest threat of substitutes would probably be the shifting of manufacturing from one area to another. It is however more likely that such a shift would just shift business from one segment of the industry to another. The largest threat of substitutes would probably be if manufacturing would start shifting back from Asia to the European and American continents.

3.3.3 Supplier Power

There are four main kinds of supplies that the industry depends on: Shipyard services for both new buildings and repairs, ports and terminals, labor, and containers.

At the start of 2004 there were 3,054 fully cellular containerships in the world (United Nations, 2004). This, however, represents a small percentage of the total world fleet for all types of ships used for transportation, although the containerized portion has been rising as can be seen from Figure 12. This small portion of the total ships being used means that when there is a shortage of containerships, getting new ones might be affected by the demand for other types of ships also. The price of a new 100,000 dwt afromax (see appendix for definition) tanker is 71 million USD today compared with 36 million USD two years ago (R. duMoulin, Presentation at MIT, April 11, 2005). In light of high demand for new ship buildings, shipyards are using their leverage by taking 25% to 50% of the price of the ship upfront and being less flexible in the configuration of the ships. Shipyards have also become more selective in the projects they take on. They prefer to build a Liquefied Natural Gas (LNG) carrier, because it gives high margins due to its advanced technology specifications. Containerships are number two on their list, tankers are number three, and bulk carriers are the least preferred. The containership industry is therefore not affected by shipyards account management. They are however affected by the overall high demand that stretches upstream to diesel engines and other parts for the ship. Furthermore, the shipyards can only hedge steel one year out and are therefore reluctant to take orders too far into the future (R. duMoulin, Presentation at MIT, April 11, 2005).

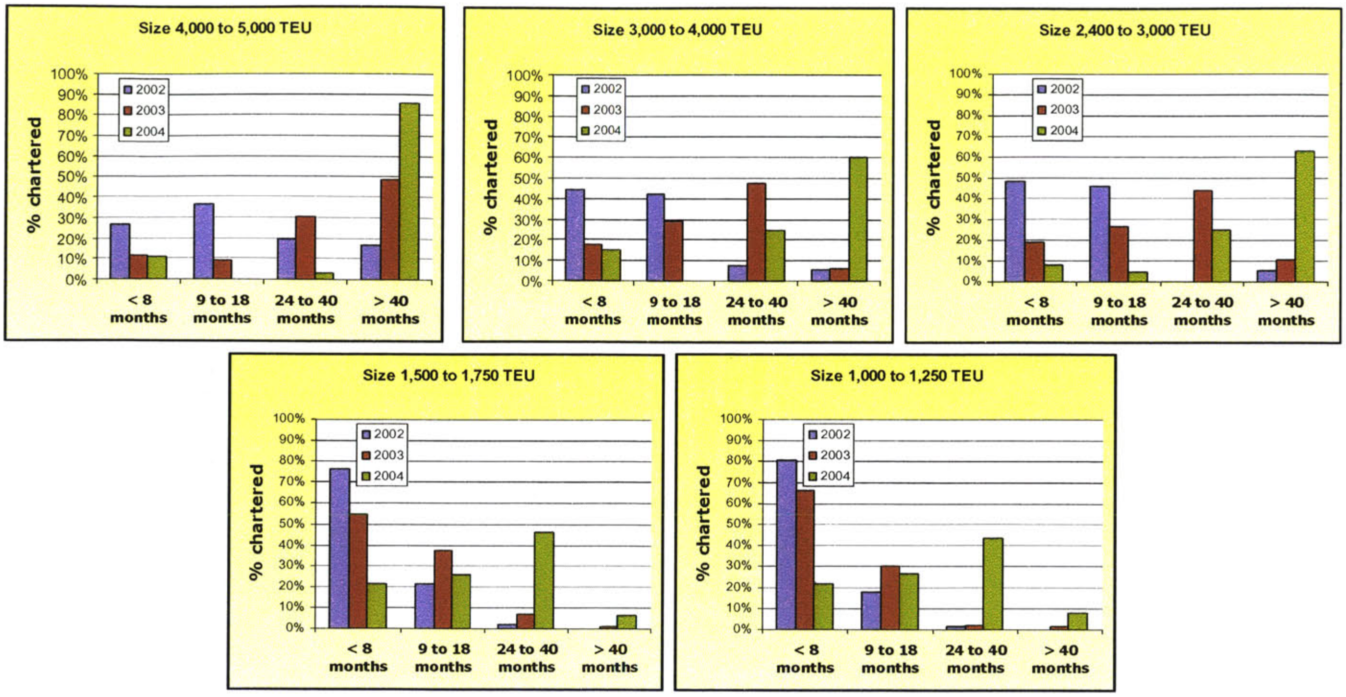
Figure 12
The world shipping fleet by categories.



Source: United Nations (2004)

The high demand for ships is reflected in the cost of chartering a containership. Chartering means that an ocean carrier enters into a contract with a ship owner to rent his ship for a specific period of time, usually at a fixed price per day. Around half of the containerships, less than half of the capacity, are chartered. Since 2004 it has been difficult and expensive to charter a ship. Another evident trend is that carriers are chartering the ships for a longer period of time as Figure 13 shows. Chartering long-term can be considered an investment, and shows that the carrier is relying on the current situation to continue. But the duration of the chartering is not only getting longer, every day is also getting more expensive.

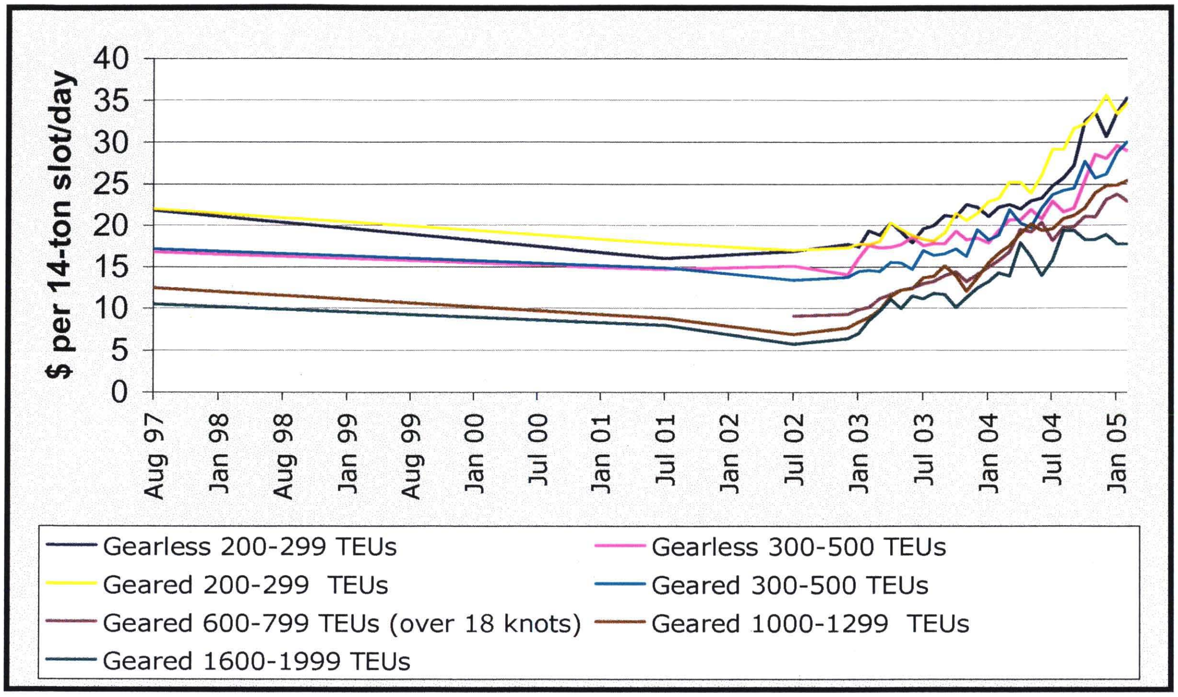
Figure 13
Trends in duration of chartering



Source: Barry Rogliano Salles (2005)

The Hamburg Shipbroker's Association, VHSS, is by far the largest broker of chartered containerships with 75% of the market (United Nations, 2004). Figure 14 shows how the price has been steadily rising over the past two years.

Figure 14
The Hamburg Index for Rates for chartered containerships for three months chartering. Based on yearly averages for 1997, 2001, and 2002 and monthly numbers for January 2003 to March 2005. Geared means that the vessel is with loading gear. Gearless means that the vessel is without loading gear.



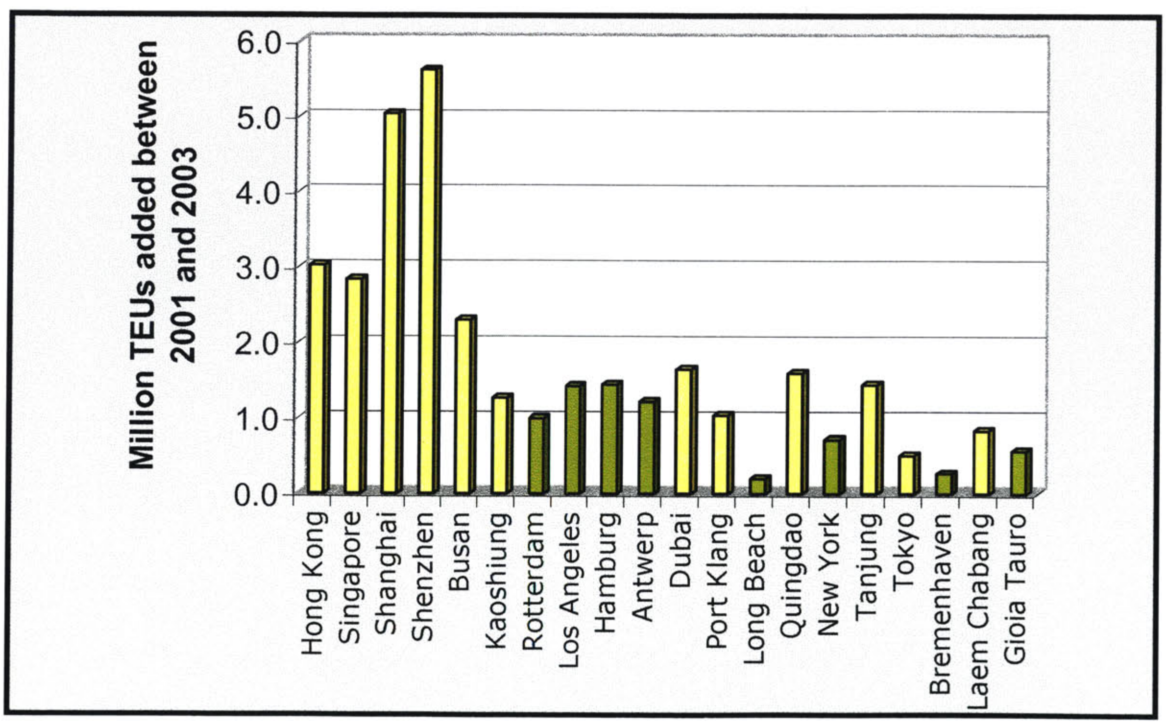
Source: Combination from United Nations (2004) and Hamburg Shipbroker's Association (2005)

To grow, the industry needs more capacity. Although shipyards are inflexible in the short term its capacity is influenced by the carrier's demand for new ships, i.e. shipyards can relatively easily expand their operations to meet demand in the long run (Høegh, 1998). The apparent gap between supply and demand that has increased the lead time to 3 years from 2 years for a new ship might therefore be reduced over the next few years. The price for a new ship is also dictated by the demand for new ships (Høegh, 1998).

The combination of a difficult chartering market and a capacity constrained shipyards gives these suppliers a high leverage that can influence the margins of the carriers. But ships are not the only supply the industry of containerized ocean transportation relies on. Ports are another important supply.

As Figure 15 shows, the largest ports in North America and Europe are lagging far behind in terms of increased throughput between the years 2001 and 2003. This is a trend that has caused worries in the industry, as the gap will continue to increase. The large ports in the United States do not have plans for expansions comparable to the ports in Asia although they have opportunities in increasing productivity, which is up to 4 times poorer than some ports in Asia (J. Vickerman, Presentation at MIT, 2005, May 5). The ports will therefore have more leverage and access to them could become a competitive advantage in the industry. Control over container terminals at the ports is also critical.

Figure 15
TEU increase in throughput from 2001 to 2003 for the top twenty container terminals in the world. Ranked in size from left to right, the largest on the left. Terminals in Europe and North America are darkened.



Source: United Nations (2004)

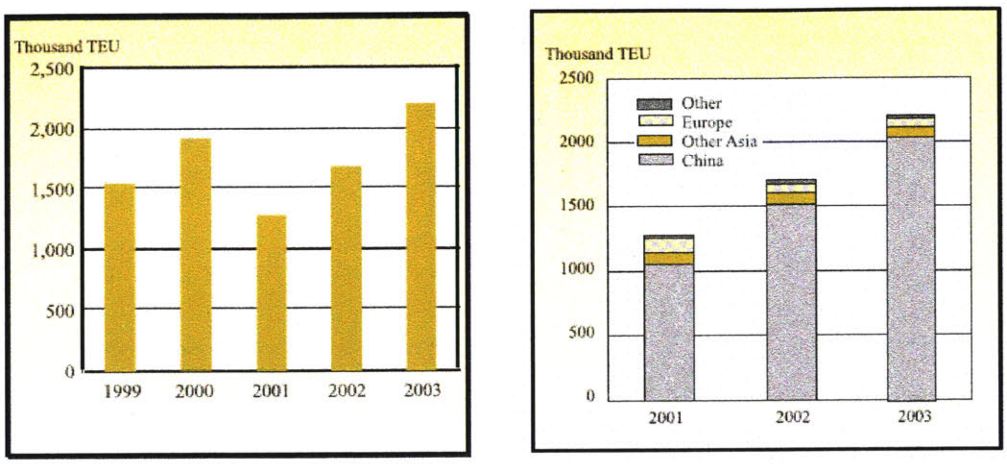
The difference between a port and a terminal is that one port can have many terminals. The terminals can be owned and operated by companies that are customers of the port authority.

Sometimes the carriers operate their own terminals, but usually they negotiate access with a terminal operator. For example, unless a vessel has a reliable access to a terminal on the large ports on the US West Coast that have become very congested, it might have to wait for days before being able to dock. This can allow the first tier carriers that are more likely to have their own terminals to take business from lower tier carriers that don't have this access. Terminal access is not the only problem at the ports.

Inland access to the port is also critical. The port of Los Angeles is a good example, where the road network to the port has huge congestion problems. The capacity to unload ships is more than the capacity to drive the containers out of the port. The same capacity constraint applies to the railway system: The average train speed at UP for the first eleven weeks of 2005 is 5% lower than for the same period of 2004 (ProgressiveRailroading.com, 2005). This is a part of a long-term overall trend in the US, and will continue as the plans for transportation infrastructure's capacity do not match the forecast growth in freight transport (Transportation Research Board, 2003). In addition, ports need to secure more than one way of transportation to and from them. There is the risk of single point of failure to have only one vendor to take care of transportation from a port, e.g. Canadian national railroad in Halifax (P. Keller, Presentation at MIT, 2005, March 7). Adding to the problem are unresolved issues with unions at the ports, such as the fact that the gates for the trailers are open 8 to 10 hours per day while containers are being unloaded around the clock.

Containers are an important supply factor, since the container is the prerequisite for a shipment. Due to the imbalance in volumes over lanes to and from China, and due to cheaper labor and material over 90% of containers are produced in China (United Nations, 2004). Of the containers produced, 90% are of standard sizes and function, and the rest are mostly refrigerated containers, so called reefers. Production of containers does not seem to be a problem. The only reported problem is what to do with containers when they arrive from Asia. (United Nations, 2005).

Figure 16
Annual production of containters, total and by region.



Source: United Nations (2004).

The description in this section might give the immediate feeling that supplier power was high. There are however few arguments that go against that. First, the description of shipyards and charting focused on the boom part of the business cycle. Only two years ago the industry was in a bust, which is a time when shipyards are bidding low to get contracts, and when shipbrokers may be stuck with unchartered ships. Second, the description of the ports focused on the most congested ports, where their leverage is the greatest. Third, there is a difference in the leverage of three tiers of carriers. The imbalance in the power of the suppliers therefore leads it to being rated as medium.

3.3.4 Customer Power

For a typical shipper the containerized ocean transportation accounts for the 1% to 1.5% of the total cost of the product (Carr, 1998). Although the percentage of the transportation cost of the total price of product decreases the higher the value of the cargo being transported, any savings that can be achieved in the transportation are reflected in the shippers operating margins. However, transportation cost may not be the shipper's largest concern.

For many shippers, the cost of lost sales due to missed shipments outweighs the cost of the transportation itself. The shippers are also changing: they are getting larger, and therefore carry more leverage. The 80/20 rule is applicable: 80% of the cargo comes from 20% of the customers (P. Keller, Presentation at MIT, 2005, March 7). Furthermore, smaller shippers go through NVOCCs (defined at the start of this chapter) that function as a large shipper towards the carrier, having leverage of a large shipper through the consolidation of shipments. Due to potential high cost of lost sales, there is an opportunity for a carrier to offer services that add value to the shipper that is more important than marginal changes in the rates themselves.

The first-tier carriers are in a strong position to enter into a service contract that is more than shipping a container door-to-door. In such a case, a shipper that wanted out of a contract would not only need to change four or five legs, which can be very difficult (P. Keller, Presentation at MIT, 2005, March 7). It would also be losing the value added by such a contract. An example of such value adding operating ties is Just-in-time II (JIT II), so called by Bose Inc. American Presidents Line (APL) has a full time employee working from within Bose Inc. The APL employee has full access to APL's freight system and his role is to make sure that Bose Inc. gets its shipments on time, that Bose Inc. has the visibility and flexibility to change the direction or priority of shipments, both of supplies and finished products, that are already underway (Deierlein, 2000). The operations of a huge shipper can also affect the operations of other shippers.

It is forecast that in 2008 Wal-Mart will ship 2 million TEUs, Target 800 thousand, and HomeDepot 800 thousand. Wal-Mart decided in 2004 that it would have its peak season containerized cargo that goes through Southern California shipped to them in September and October instead of spreading it over more months, thereby taking up capacity smaller shippers and NVOCCs needed during these months. (Mongelluzzo, 2004, September 6). That Wal-Mart could do this, shows the leverage some large shippers have.

Another threat identified by Porter (1980) is backward integration by the customer, in this case the shipper. This became a source of debate in 2004 when the rumor spread that Wal-Mart intended to buy APL. Although the rumor proved false, the idea of a large importer taking over the ocean transportation's part of its supply chain is still cause for discussion. One view identifies it as an opportunity for a shipper (Mongelluzzo, 2004), while another view says it has been done before: The shipper R.J. Reynolds owned the carrier Sea-Land, which suffered from its ownership, because the shipper's competitors wouldn't use it, and the shipper itself used it as leverage when negotiating with other carriers. It was eventually spun off, and has now merged with A.P. Moller Group (Ferrulli, 2005).

Shipper's position on conferences offers an insight into the different leverage of larger and smaller shippers. Just as was pointed out in the section on rivalry in this chapter, being a large carrier in the conference system of fixed pricing did not offer the same strategic advantage of being large in a free pricing environment. Looking at this from the shipper's perspective the conference system was offering the same price to large and small shipper's alike. It is therefore not surprising that according to Sjostrom (2004) it seems as smaller shippers favor the conferences while the larger shippers oppose them. This does however not fit with the unequivocal opposition to the conferences that the American and European Shipper associations voiced in response to the European Commissions white paper on banning conferences.

It was suggested in the section on rivalry that carriers could either try to make the most of current boom in the industry through traditional practices or use the opportunity to lead changes in the system. Similarly, it can be claimed that during the years after deregulation started in 1998, the shippers missed an opportunity during the bust part of the business cycle, to lead value adding changes in the system, using instead the opportunity to keep ocean carriers margins down. This was a missed opportunity that they are now paying for through higher transportation costs.

3.3.5 Barriers to Entry

This industry follows a boom and bust cycle. In either case there are large capital investment barriers. In a boom, the ships are expensive to buy or charter. In a bust, even though the ships can be very cheap to buy or charter, the operating margins are also very low and make it both undesirable and hard to enter the market. The likeliest scenario of a new large competitor entering the industry is if an NVOCC (defined at the start of this chapter) manages to use confidential contracts to increase in size and offer more flexible service at a competitive price through its connections. Another possible scenario is smaller carriers merging to create more serious competitor, using its already existing network to expand. A recent merger of smaller carriers, e.g., is the takeover of the Dutch carrier Geest North Sealine by the Icelandic carrier Samskip. This takeover took place in March 2005 and created one of the largest carriers operating within Europe (Samskip, 2005).

Section 3.3.3 describes congestion at ports and in container terminals. This congestion can make it difficult for a newcomer in the industry to get access to the space he needs, thus acting as a barrier to entry.

Conferences have been used to prevent new entrants into the market. Sjostrom (2004) describes their main tool as being underbidding, use of loyalty contracts, and capacity. Price differentiation used by conferences, according to Sjostrom (2004), on the other hand lower the barrier to entry.

Underbidding is an obvious barrier to entry. If a carrier starts operating outside of a conference the conference either drops its price below what is sustainable for the new entrant, or it dispatches a ship to compete on another route where the new entrant operates. There is however no conclusive evidence that this has been the case (Sjostrom, 2004).

Loyalty contracts are another obvious barrier to entry. There are two types of such contracts in the industry: the first one punishes the shipper if it does business outside the conference, and the other one gives backward discounts, i.e. if a shipper sticks to a conference for duration B, it receives discount for the business done for duration A, where A comes before B. This might not change if the conference disappears as loyalty contracts may continue to be a strong tool for a single carrier to lock in its business (Sjostrom, 2004).

Apart from fixing prices the conferences have rules for minimum and maximum capacity for their members. In this case the maximum capacity is used to create imbalance in the supply and demand, thus keeping prices from reaching the economic optimum. On the other hand the conferences may have minimum capacity rule for new members to the conference, if the law forces them to take new entrants, which forces new entrants to have more capacity than is efficient, thus pressing them to raise their prices if they want to participate in the market (Sjostrom, 2004).

Conferences have long been suspected of price differentiation according to the value of the product being shipped. Evidence of this has however not been conclusive. What is known, however, is that the conference tariffs price some products higher than others, which in turn makes it easier for a new entrant to offer competitive prices for certain kinds of products. This originates from the time before the containers but has not changed despite the fact that containerization decreases the difference between handling valuable shipments and cheaper shipments. In this case, the actions of the conferences act to lower the barrier of entry.

There are large barriers to entry into the first-tier carrier's market segment. The greatest threat is that smaller carriers will merge to become more serious competitors. As there is no one carrier that dominates the industry – A.P. Moller Group is the largest one with 10% of the world TEU capacity – there are likely to be mergers, especially between companies of different nationalities. The Singapore NOL acquisition of APL is an example of that (Keller, 2005, February 28). Mergers of first-tier carriers would increase the carriers' strength and diminish their need to participate in conferences. Overall, it is not complicated to charter a ship and during a boom it might be appealing to outsiders. During a boom however the price of chartering a ship increases drastically (see Figure 14) thus raising the capital barrier to entry. During a bust, it is easy to enter the market, but since the operating margins are not high then, it is not so appealing. The likeliest scenario of a newcomer in the industry is if someone identifies a need in a specific area that is not being met by existing carriers. If that proves to be successful, it may prove as a stepping stone into other markets, much as Samskip, a small Icelandic carrier, has become one of the largest carriers within Europe, after having successfully serviced the small market of Iceland.

3.4 Uncertainty in Containerized Ocean Transportation

There are many different types of uncertainty that affect the industry, some of the main ones being uncertainty in demand, fuel prices, transit time, currency, congestion, business cycle, demurrage, handling fees, and inland transportation costs.

One of the recurring themes in supply chain management literature is how difficult it is to forecast demand. This applies both to new product introduction as well as more mature markets like for clothing. The way that the carrier guards against this uncertainty is by having the shipper guarantee a minimum quantity commitment (MQC). During times of excess capacity these MQCs are a small part of the real volume shipped, but rises during times of under-capacity and in 2004 the MQC came close to the actual volume shipped. Currently, according to discussions at CTL (2005), the prevalent practice today is that of bidding and tendering. A shipper asks several carriers for a bid over specific volume over lanes, the carrier hands in the bids, the shipper optimizes the bids, and finally tenders the volume to carriers. Harding (2005) offers a good explanation of this process and looks into how the optimization matches the reality of planned and unplanned shipments. There does, however, not be much of an intertwined operating cooperation between shippers and carriers to manage the demand (see section 4.3), despite one successful attempt at this, JIT II that is described in section 3.3.4.

Fuel prices are highly volatile. Although there are advanced mechanisms in the financial markets to hedge against these fuel price fluctuations, bunker surcharges are still the norm. Figure 17 shows fuel fluctuations over a 7 year period.

Figure 17
Oil prices. The Figure shows clearly the fluctuations from day to day and also over longer periods of time.

Transit time can be sensitive for some shippers but not for others. First-tier carriers try to meet the transit time within a window of hours according to an industry practitioner. Some shippers however delay to pick up their containers. The time a container spends in a destination terminal is called a demurrage. Long demurrage can take up valuable space in an already congested terminal, which has led carriers to start charging a demurrage fee for late pickup. A fee like this shows an understanding that keeping the container in the terminal has value, and therefore provides the right incentive for the shipper to pick it up.

Currency fluctuation can severely affect the operating margins of carriers. A.P. Möller (2005) discusses this in some detail, explaining that their margins are good despite most of their income being in US dollars, which was weak during 2004, and most of their cost being in currencies that were very strong relative to the US dollar. Carriers use a Currency surcharge, CAF, to shift this uncertainty over to shippers.

Congestion in ports is now becoming a greater uncertainty leading to longer waiting times and even rerouting. A. Westhoff (Interview, 2005, March 31) explained how CSX has been receiving more traffic through the eastern ports after a strike closed down the ports on the west coast in 2002. Costs of this are handed over to the shipper in the form of a congestion surcharge. Handling fees and cost of inland transportation to ports, and changes in spot prices of feeders are also charged to the shipper in the form an extra charge (Transpacific Stabilization Agreement, 2005). United Nations (2004) cites examples where shippers are charged extra for each container that is selected for a security check.

The uncertainties described above can be split into two categories: specific to the industry and exogenous to the industry. These two types of uncertainties need to be dealt with in different ways as is discussed in chapter 4.

3.5 Times are Changing

This chapter started by introducing the industry, explaining the main historical facts, and providing an understanding of why the industry practices are the way they are. It then went on to describe the forces at work in the industry, how players interact, and what uncertainties they are facing. This discussion leads to the following conclusions.

Deregulation has created an environment that is leading to different industry practices. These changes are happening slowly because during the bust in the industry up to 2003, shippers took advantage it of it, pressing price down, forcing carriers to defend themselves through the familiar mechanism of conferences. In the boom in the industry since 2003 the tables have turned and the carriers are using their familiar mechanisms to force prices up. During times of boom the structure of the industry leads to over-investment in containership capacity, which again is likely to lead to another bust. The main ports in the US are heavily congested and their capacity expansions is lagging far behind the ports in Asia and lagging behind the capacity expansion of the containership fleet. Many of the uncertainties facing shippers and carriers stem from port operations. These uncertainties are industry specific and should therefore be manageable through behavioral change. Another group of uncertainties is exogenous to the industry and needs to be dealt with through another mechanism.

4 Managing Uncertainty through Ocean Transportation Contracting

Is it possible to manage the uncertainties through contracting? This chapter suggests ways to do so. First, it starts by describing how contracts are set up today (section 4.1). It then explains new ideas that a large ocean carrier has set forth for new types of contracts (4.2). Before moving on to concrete suggestions of what to do, the concept of "intercompany operating ties" (Byrnes & Shapiro, 1991) is introduced (section 4.3). In section 4.4 the industry specific uncertainties are addressed and a real options approach is suggested. Section 4.5 introduces how shipping derivatives for dry and wet bulk are already being used to hedge against uncertainties. The last part (section 4.6) suggests a futures market in order to hedge against uncertainty that is exogenous to the industry of containerized ocean transportation.

4.1 Contracts Today

This section is based on interviews with industry practitioners from both the carrier and shipper sides.

Most long term contracts in the containership industry have a one year cycle that starts on the first of May. They are comprised of three parts: the contract itself including line items, a bill of lading that is issued for each shipment, and tariffs that are published officially. The contracts are based on a specific route, and specify the price per container, plus various surcharges, such as a fuel surcharge (called bunker charge), customs, handling, currency adjustments factor (CAF), peak season surcharge (PSS), and a general rate increase recommended by the liner's conference (GRI). The line items include the origin of a shipment, final destination, type of container, size of shipment, quantity, the port of load (the port the ship leaves from), information on transportation from harbour to inland point, frequency of shipments, day of week it is shipped, transit time in # of days, and service.

The shippers commit to a minimum quantity commitment (MQC), but in reality the carriers generally do not seek monetary liabilities if a large customer doesn't fulfil the MQC.

The process leading up to the contract starts with the bidding. The shipper sends out data to anywhere from a handful to 50 carriers. The carriers offer a price and volume over different ports. The carriers usually provide prices according to where they want to win the business. This process creates a lot of data; for 1000 line items a shipper might receive bids from 10 carriers, which makes 10,000 records of data, each of which has different information, e.g. different ports for the same good.

Carrier performance weighs heavily when the shipper decides on volume allocation. These are usually based on a feeling of historic performance and are not necessarily hard metrics. The shipper has accurate cost information, e.g. it knows how much each day in transit costs (inventory cost). The optimization is therefore not only based on the price the carrier offers but monetary values are attached to each day in transit. This allocation of cost in the optimization process does however not enter into the contract.

The contract year starts on May 1 every year. The carrier in general has more leverage in 2004 and 2005 because of capacity constraints, which resulted in contracts being made earlier this year than before, many of them were finished in January according to industry practitioners interviewed.

Contract management on the carrier's side consists of the carrier updating its surcharges and tariffs. Known changes to demand are taken into account. Larger shippers like Wal-Mart and Proctor & Gamble can modify contracts on a daily basis while smaller shippers would do few changes per month. New lanes might be added. Amendments to a contract can consist of a term change, renegotiation of items, capacity commitments, line item changes, new equipment types (i.e. type of containers), and a carrier's change of route.

4.1.1 Contract Structure

A contract is typically comprised of three things: a standard boiler plate, notes and terms and ancilliaries.

The standard boiler plate is something that is known industry wide and protects the rights of the carriers and the shippers. The rate matrix is, however, negotiated case by case and is included in an appendix that is attached to the boiler plate. The appendix also includes specific numbers to the contract, such as the exact duration. The boiler plate then has standard clauses that define how the information in the appendix are interpreted. The boiler plate contract typically has the following items:

- Contract parties, i.e. who the shipper and carrier are.
- Governing tariffs, i.e. the carrier's freight tariffs are a part of the contract.
- Contract term, i.e. how the contract term is defined, and which shipments fall within it.
- Cargo and scope, i.e. which shipments the shipper can tender to the carrier and from where, for the rates specified in the contract.

- Minimum quantity commitment (MQC).
- Contract rates, i.e. what the rates in the appendix include and what they do not include.
- Carrier service commitment, i.e. which shipments the carrier is committed to transporting and which shipments it is not. Normally, the carrier commits to transporting the MQC and can choose to transport shipments above the MQC.
- Verification of contract carryings. This clause commits the shipper to include the contract number on all bills of ladings, which makes it possible for the carrier to manage the contract.
- Force majeure.
- Liquidated damages.
- Termination and cancellation.
- Bills of lading, i.e. the boiler plate makes sure that the bill of lading is a part of the contract.
- Contract records, i.e. which records can be used to measure the performance under the contract.

Notes and Terms are statements that affect the billing. They can exempt the shipper from some tariffs, but tariffs are automatically a part of the contract unless otherwise specified. The terms define the scope of the contract, for example free time the shipper has in the terminal. A typical term would be that the shipper has 5 days free time from the arrival of a container in the destination terminal. If it picks the container up in 7 days it incurrs 2 days demurrage payments. The contract also includes information about affiliates, i.e. companies that can ship on behalf of the shipper.

Three years ago the shippers could name affiliates and the carrier would accept them without a question. This has changed due to security reasons. Now the carriers have to know exactly who the affiliate shipping on behalf of the shipper is. Carriers require official address and proof of financial affiliation to reduce the carriers liability.

Ancilliaries are charges that come on top of the base rate. Origin side arbitraries are the most common. An example of an origin side ancilliary is the following. A shipper and a carrier make an agreement of shipping goods from Shanghai through the Hong Kong port to the US. The Transpacific Stabilization Agreement (TSA) is a forum that the main carriers on this route use to assess the ancilliary charges, which are said to represent price fluctuations that the carrier cannot control. The TSA publishes these assesments. If the TSA assesses the ancilliary handling charge at the port of Hong Kong to be USD 200, the carrier charges the shipper USD 200 for each container travelling through Hong Kong. There are some destination side ancilliaries, but they are less common.

The TSA has the following ancillary charges (Transpacific Stabilization Agreement, 2005):

- Bunker Fuel, which compensates for fuel price fluctuations,
- Congestion, which compensates for delays and rerouting of cargo due to port congestion,
- Currency, which compensates for currency fluctuations in a local currency relative to the contract currency,
- Feeder, which compensates for spot price increases of feeder services,
- War Risk, which compensates for higher insurance fees and rescheduling in countries, where there is a risk of armed conflict,

- Alameda Corridor, which compensates for a fee the railroads charge for inland transportation via Southern California to cover the cost of the Alameda Corridor facility.
- Chassis Usage, which compensates for a chassis the carrier may provide in addition to the standard container equipment,
- Container Service, which compensates for the cleaning and maintenance of a container after use,
- Documentation Fee, which compensates the carrier for work due to increased magnitude and complexity of paperwork,
- Hazardous Rail Security, which compensates for inland rail transportation of hazardous material,
- Panama Canal, which covers the fee for passing through the Panama Canal,
- Suez Canal, which covers the fee for passing through the Suez Canal,
- Terminal Handling, which covers the cost of handling the container after it arrives at the port of origin until it is placed on the ship (the charge varies by ports),
- Detention, which compensates for the shipper's use of the container equipment after the shipment has been delivered,
- Demurrage, which compensates for every day the shipper delays to pick the container up from the destination terminal,
- Drayage, which compensates for the handling of the container at the port of destination until it is picked up by the shipper, and
- Hazardous Cargo, which compensates for the handling of hazardous cargo.

4.1.2 Contract Management

For first-tier carriers, almost all of the cargo moves on service contracts. Carriers use service contract number as primary key to track volume, timings, revenues, costs, etc. that allows the carrier to see which contracts are the most profitable and which contracts are having problems. A key indicator is revenue per TEU. Another trend that a carrier practitioner confirmed in an interview to have noticed, is that seasonal variations are becoming less drastic as shippers use inventory policies to smooth them out. This was not confirmed in conversations with shippers, apart from one large shipper that said it would not consider changing its inventory policy in order to smooth out peaks in transportation. One way that carriers use to mitigate seasonal variations is to negotiate sub-MQCs that guarantee the carrier some volume over the low season, say from December to April, in return for a guaranteed capacity to the shipper over peak season. There is also a peak season charge that in the beginning of 2005 was $400 per FEU for trans-pacific shipements. Surcharges were discussed in some detail in section 3.4.

The shippers generally measure their fulfillment of MQC and the carriers' service level. A large retailer in the US that uses seven ocean carriers measures every week how they are doing compared to the MQC promised to each carrier. From the total position against the carrier, the shipper creates a commitment schedule for the upcoming week. The same retailer measures the performance of its carriers qualitatively, giving five qualifications: Excellent, Very Good, Good, Fair, and Poor. The categories that are measured are Operational Performance, Communication, Technology, and Management Support.

Operational Performance is based on whether document handling is quick and correct, condition of equipment, availability of equipment, ability to meet transit time, ability to meet published vessel schedule, and ability to follow up on in-transit relays. Communication is based on how readily available customer service is and how courteous phone contact by employees at all levels is. Technology is rating is based on carrier's pro-active offering of new technology and responsiveness to technology requests. Management support is based on the flexibility of the carrier to help and the local knowledge of consignee business in the US.

4.2 Trends in Contracting

The industry deregulation described in chapter 3 has started to influence the way industry players think in terms of contracting. Ideas about new ways to make contracts were put forth in a presentation by a large first-tier ocean carrier in the US. They want to adopt a shared-risk relationship with the shipper and take a challenge-everything approach. In the presentation four new types of contracts were suggested.

The first type is a contract where the shipper pays at the beginning of each month a fixed amount based on a discounted market price. This will fix the shippers cost for that month and give him protected space for that time period. This is similar to a short-term forward contract, apart from the timing of the settlement. Forward contracts are discussed in detail in section 4.5.

The second type is a multi-year contract, with fixed dates for base rate adjustments, which would have a cap. This would reduce negotiation costs and provide some base rate stability, although there would continue to be instability due to surcharges.

The third type has a payment model where the shipper pays the carrier a fixed amount every month for eleven months, but on the twelfth month there is a settlement for the whole year. This might reduce administrative cost, make budgeting simpler, but also lead to troubles in the twelfth month due to outstanding disputes over incidents that happened too long ago to be easily settled.

The fourth type is a logistics contract where the ocean carrier would take over the responsibility of the whole transportation phase, door-to-door, for a fixed rate.

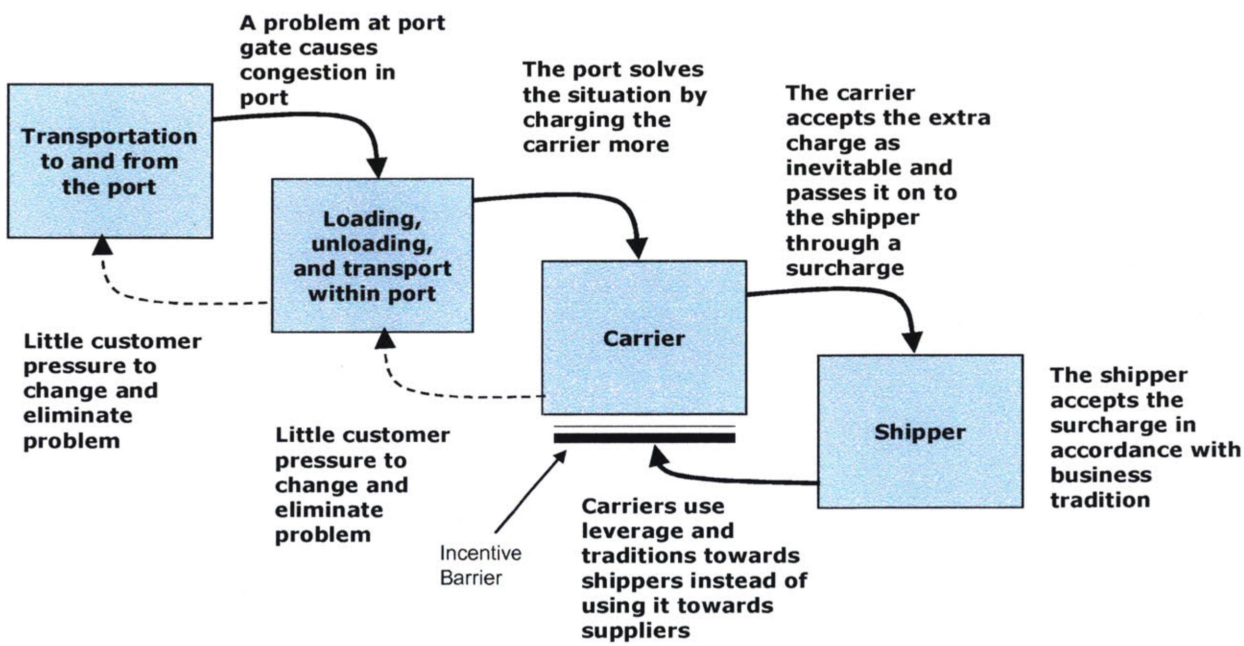
These ideas are put forward here to give the reader a sense of what is possible and that carriers have started to think about an approach to contracting that challenges the traditional way of doing business. The ideas, however, do not address tying the operations of the shipper and the carrier together to remove inefficiencies, a concept that is described in the next section.

4.3 Managing Uncertainty through Intercompany Operating Ties

Shippers frequently mention relationship building with the carriers to help manage capacity and demand better (CTL, 2005). Byrnes and Shapiro (1991) describes one form of such cooperation that it calls "intercompany operating ties". It however points out that in order to unlock value in the channel the intercompany operating ties must stretch through the whole channel. The paper focuses on the management of the product flow, eliminating excess inventory and lack of information sharing. From this perspective the container can be defined as the product that is "manufactured" when it is filled for shipment. Instead of building huge yards to carry thousands of containers, in effect creating a huge buffer inventory, it is conceivable to think of a system where the containers flow through the system without ever stopping in an inventory buffer. This means that in order to unlock value in the channel that is composed of *shipper – inland transportation – port – carrier – port – inland transportation – receiver* the whole channel would need to be considered.

The largest obstacles to creating these operating ties throughout the channel are, according to Byrnes and Shapiro (1991), lack of awareness of root causes of a problem, lack of data, and organizational structure. Any successful attempt at "intercompany operating ties" is dependent on the incentive structure in the channel. The incentive structure within containerized ocean transportation does not encourage the channel partners to seek out and eliminate uncertainties. Figure 18 describes how the incentives in the industry of containerized ocean transportation are aligned today and introduces a concept this thesis chooses to call an incentive barrier.

Figure 18
Incentive Barrier works against management of uncertainty



The incentive barrier is created when company A is charged with a fee that it cannot do anything about. A fee it has to pay for a situation it is not in control of, but is not significant enough for it to change its behavior thereby threatening company B that is charging the fee. The cost that the fee is meant to cover does not originate with company B, but with company C, which has some kind of a situation incurring extra cost. What this implies is that since B knows that it can pass the extra cost on to A, it is willing to accept the extra charge from C. Although a fee can sometimes be a solution it is less so if the recipient of the fee has no alternatives to react to it. If C was more restricted in solving its inefficiency problems through an extra charge, it would have more of an incentive to resolve the root causes of the problem.

The list of ancillary charges in section 4.1.1 has examples of this, such as the congestion charge to compensate for rerouting of containers, the feeder charge, the terminal handling charge, and the drayage charge.

Focusing on eliminating inefficiencies that create industry specific uncertainties may make everyone much better off than they are today. A starting point in creating the right incentive is to price things according to their value. Real options can help there as section 4.4 describes.

4.4 Defining Real Options for the Containerized Ocean Transportation

What kinds of options are applicable in containerized ocean transportation? The following sections list situations based on the uncertainties listed in section 3.4 and suggest a real options approach to pricing them. Some of the ideas below suggest pricing for things that are not being charged for in the industry today. These suggestions are however a part of a larger suggestion that is aimed at eliminating many of the inefficiencies that are leading to high costs. This thesis states that unless players in the industry realize the costs involved in certain behaviors, they are unlikely to change.

4.4.1 An Option to Ship More

Description: A shipper commits to shipping X number of containers with a specific carrier but has the right to ship more. Today the shipper can request to ship more than the MQC, but the carrier has the right to refuse the shipment.

Type of option: This situation describes a call option that the shipper has. He has the right but not the obligation to ship more than X containers.

Strike price: The option could allow him to ship the containers for the same price and with the same service level as the other containers, or it could give him different rights. In any case, the cost of shipping the extra container is the strike price.

Price of the option: Today the shipper pays for this option by taking more risk with a higher MQC, since, according to an industry practitioner, carriers are more likely to take extra cargo from those who are willing to commit more of their shipments than others. The price of exercising the option today is however 0. In time of under capacity this option clearly has a value to the shipper. If the shipper had to pay for the option directly it would have more incentive to cooperate with the carrier to better manage the transportation orders.

4.4.2 An Option to Ship Less

Description: A shipper commits to shipping X number of containers but can ship less.

Type of option: This situation describes a put option that the shipper has. He has the right but not the obligation to ship less than X containers.

Strike price: It could either be zero, i.e. the shipper doesn't pay for shipments it doesn't ship, or it could be at a price per container.

Price of the option: Today the shipper has this option for free according to an industry practitioner, who said that if shippers didn't meet their MQCs the carrier wouldn't go after the penalty. If, however, it became industry practice for carriers to seek payment for committed shipments that weren't shipped, this option would have a value, for example to a shipper that is introducing a new product and wants to err on the higher side of demand.

4.4.3 An Option to Bump

Description: A carrier commits to shipping a certain volume, but has the right to bump containers, i.e. to ship them later than promised (bumping is also called rolling).

Type of option: This is a put option, the carrier has the right but not the obligation to get out of a bad situation.

Strike price: The strike price could either be zero, or a price per container. The only strike price today is an uncomfortable phone call to the shipper telling him that the shipment will arrive late.

Price of the option: Today the carrier has the free option to bump containers. In times of under-capacity the right to bump containers has obvious value. As Pompeo and Sapountzis (2002) points out, the shippers have different sensitivity to the bumping. The shipper that doesn't intend to pick its container up in the delivery terminal until at the last possible moment, might be happy to sell the carrier an option to bump its container for a week. Making the carrier feel that bumping has value should lead to a different behavior, since the carrier would know which containers it could bump, and a telephone call to tell the shipper that it has excercised its option is easier than a telephone call to tell him that you have violated the contract.

4.4.4 An Option to Raise Charges

Description: Handling charges go up in a port that a shipment passes through. The carrier has the right but not the obligation to raise the handling surcharge.

Type of option: This is a call option.

Strike price: This is in effect an option with no strike price.

Price of the option: The carrier should be aware that being able to increase handling charges has value, and the shipper should understand how much it gains by giving that option away.

4.4.5 An Option to Delay Pick-up

Description: Due to the capacity constraints of container terminals some terminal operators have started to charge a demurrage fee if the container is not picked up from the terminal before a negotiated number of days. It may seem farfetched to represent a fee as a real option. But whether they are considered to be the same or separate, the end result is that the shipper feels that not picking the container up has value. For a major train operator in the US, the introduction of demurrage fees relieved the congestion in its terminals that had become a severe operational problem, with trainloads of containers passing by terminals because there was no room for the containers.

Type of option: Demurrage fee can be represented as series of call options the shipper has to keep the container in the terminal. Keeping the container there one extra day gives you the right but not the obligation to keep it there another day.

Strike price: The fee charged per extra day.

Price of the option: A shipper that has capacity problems at its facilities may see value in delaying the picking up of a container.

4.4.6 An Option to Cancel Contracts

Description: A carrier builds or contracts more terminal space than it needs and rents the excess capacity to other carriers. It then has the right but not the obligation to cancel the agreements with the other carriers if it needs more space.

Type of option: This is a call option.

Strike price: This is a real option which has a strike price of zero, unless there is a penalty for canceling the contract.

Price of the option: The price of the option may be a higher initial investment or having over-capacity that may be impossible to rent out.

4.4.7 An Option to Change the Destination

Description: A container ship has to wait for an access to a port on the West Coast of USA due to capacity constraints or a strike. It changes directions and goes to a port on the East Coast. This is an option. The carrier has the right but not the obligation to switch ports. This is exactly what happened during a strike on the US West Coast Ports in 2002. Many carriers decided to sail directly to ports on the East Coast (A. Westhoff, Interview, 2005, March 31).

Type of option: This is a call option.

Strike price: The strike price is the cost of sailing to the East Coast.

Price of the option: The price of the option could be loss of economies of scale for operating a ship that can pass through the Panama Canal.

4.4.8 An Option to Reroute

Description: A carrier and a shipper negotiate a door-to-door contract. The carrier can decide the route the shipments take. The carrier then has the option to go through different ports, in effect has the flexibility to choose the most efficient means of transportation.

Type of option: This provides the carrier with options that de Neufville (2004) calls "in the system". That means that the system is fixed, the carrier still has to pick the shipment up and deliver it, but can have contracts with different ports, different inland carriers, and different terminal operators, which gives it flexibility.

Strike price: The strike price is the cost and effort needed to reroute the shipment.

Price of the option: The flexibility to make the most use of the system, not only through planning, but also through execution.

4.4.9 An Option to Buy Out

Description: A shipper and a carrier form a joint venture for some defined shipments. They share the ownership of the joint venture and therefore have the incentive to make it as profitable as possible. The shipper or the carrier could then have the option to buy the partner out at a certain time, as explained in chapter 2.

Type of option: This is a call option.

Strike price: The cost of buying the partner out.

Price of the option: The cost of setting up a joint venture.

4.4.10 An Option to Switch

Description: This option is included here although it is from the air transportation industry. A parcel service and an airline make a stand-by agreement. In this case the airline has an aircraft standby for the parcel service at certain predetermined times. The parcel service pays the airline a certain fee per year, and guarantees it a minimum of flight hours. In return the parcel service has the right not to use the standby aircraft.

Type of option: From the parcel service side, this would be a put option, as they don't have to pay for a flight they don't need. They get out of a bad situation.

Strike price: The strike price is cost of having the airplane fly each time it is used.

Price of the option: The cost of having the airplane stand by.

4.4.11 An Option to Expand the Infrastructure

Description: One of the more traditional ways of thinking about real options is in the planning of infrastructure projects in light of high uncertainty of forecast demand. De Neufville (2004) describes how a real options approach helped in making decisions about a large new airport in South-America. Instead of looking at the infrastructure problem as a one large inseparable project it is separated into phases. For example, even though a decision has not been made to build the airport, the process of securing land and acquiring building licenses, a process stretching over years, can be started, so that if demand for the airport evolves as forecast the project managers have the right, but not the obligation, to build it. A similar approach is applicable to the development of ports, roads and rail. Instead of thinking of the expansion of a port as a one large inseparable project, the port might have all licenses and land prepared for construction, if demand develops as forecast.

Type of option: Call option to expand.

Strike price: The cost of building the expansion.

Price of the option: The price of the option is the cost of a preparation process, that may not be utilized.

4.4.12 An Option to Build

Description: Shipyards sell options for newbuildings of ships. In a boom and bust industry where the value of a ship can double over one or two years as R. DuMoulin (Presentation at MIT, April 11, 2005) pointed out, the value of a shipbuilding options should be high. The shipyards should therefore not only look at shipbuilding options as a way to attract customers, but rather as the selling of a strategic asset.

Type of option: A call option to build a ship.

Strike price: The cost of building the ship.

Price of the option: The high uncertainty in a boom and bust industry should lead to a high price of the option. The shipyards have traditionally put a too low price on the options (Høegh, 1998), so if demand soars, the owners of the options stand to gain a lot.

4.4.13 An Option to Ship More through Dual Sourcing

Description: A shipper uses Hewlett Packard's concept of dual sourcing (Billington, 2002). He contracts 90% of its estimated shipments to one carrier and reaps the benefits of a long term contract. He contracts 10% of its estimated shipments to another carrier that has higher price but guarantees delivery of extra orders.

Type of option: An option to expand.

Strike price: The price per extra container shipped.

Price of the option: The price of paying more for 10% of the shipments, as well as the cost of having to deal with two suppliers instead of one supplier.

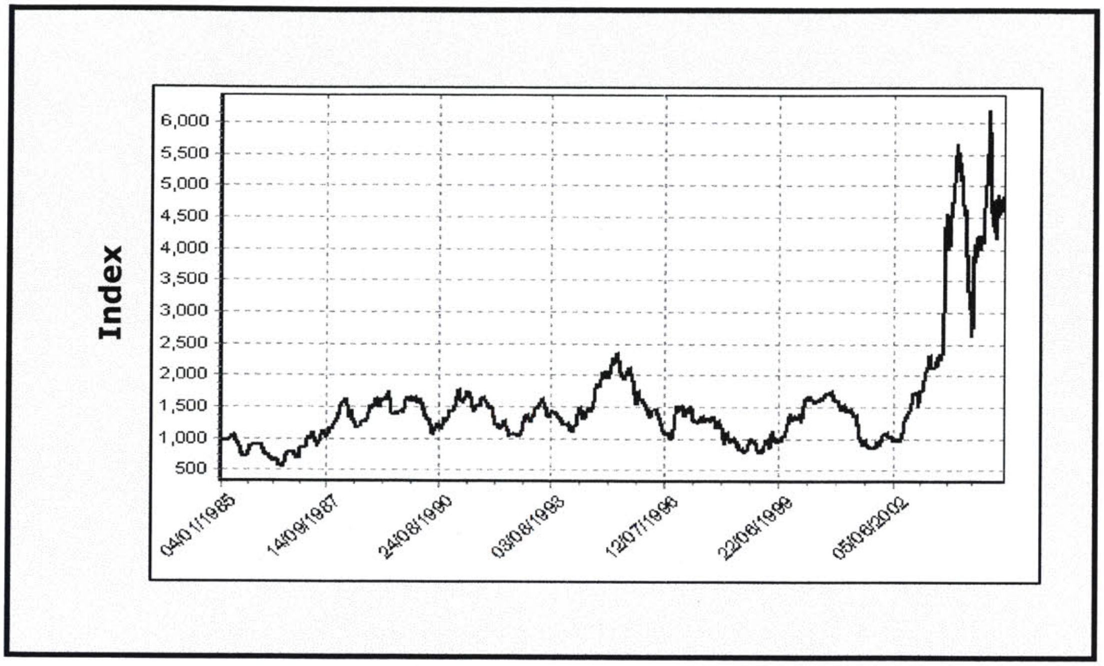
4.4.14 Pricing Flexibility

This section has proposed new ways of pricing flexibility. It does not mean that prices should go up. It means that shippers and carriers will be better off and in a better position to manage their business if they know where the value in the system is. These are however not methods that can mitigate exogenous uncertainties. The next section takes up that issue which leads the discussion back to financial derivatives.

4.5 Hedging with Shipping Derivatives

Trading of derivatives for dry and wet bulk shipping rates increased by 70% to USD 30 billion between the years 2003 and 2004, and is forecast to increase by another 70% from 2004 to 2005. This does however not necessarily mean that there is a market for derivatives in the containership industry. The dry and wet bulk transportation prices are linked to the prices of the commodities being shipped. There is a strong market for derivatives of those commodities, which has led derivatives traders to try to hedge against the volatility of the transportation part of the commodity (Pierron, 2005).

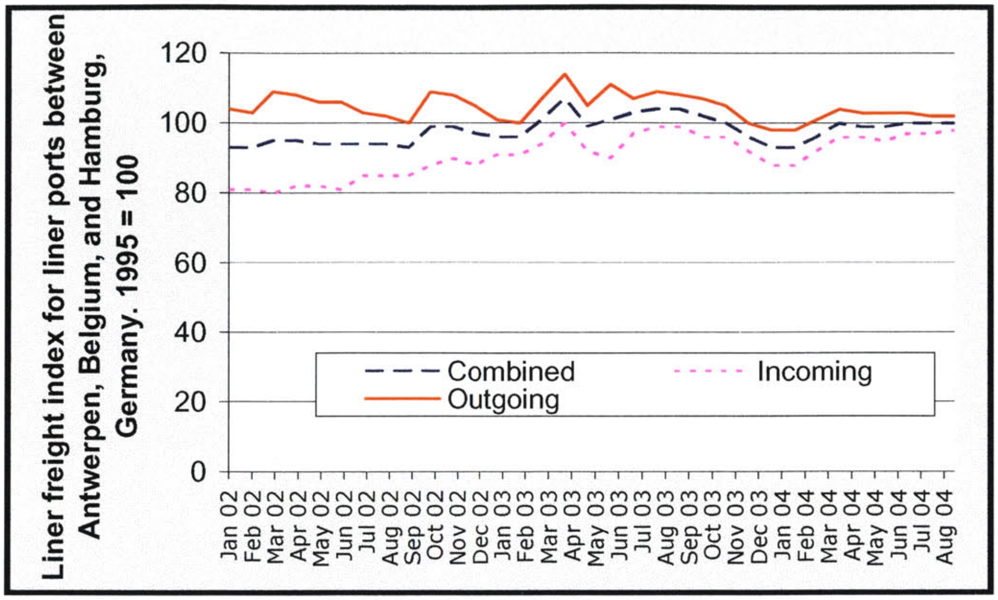
Figure 19
Baltic Dry Index January 1985 to April 2005



Source: Baltic Exchange (2005)

However, just as in dry and wet bulk there is price volatility for containerized freight, as can be seen in Figure 20, which might attract interest in derivatives from those that want to hedge against this volatility.

Figure 20
Monthly Liner Freight Index for incoming and outgoing containers for the liner ports from Antwerpen in Belgium to Hamburg in Germany.



Source: United Nations (2004)

4.6 Spot Prices – Forwards – Futures

There is a clear difference between spot contracts, forward contracts and futures contracts. Spot contracts are short-term contracts that are based on the price on the market at the exact time the contract is made. Spot contracts are over the counter contracts, i.e. a contract unique to the parties to the contract.

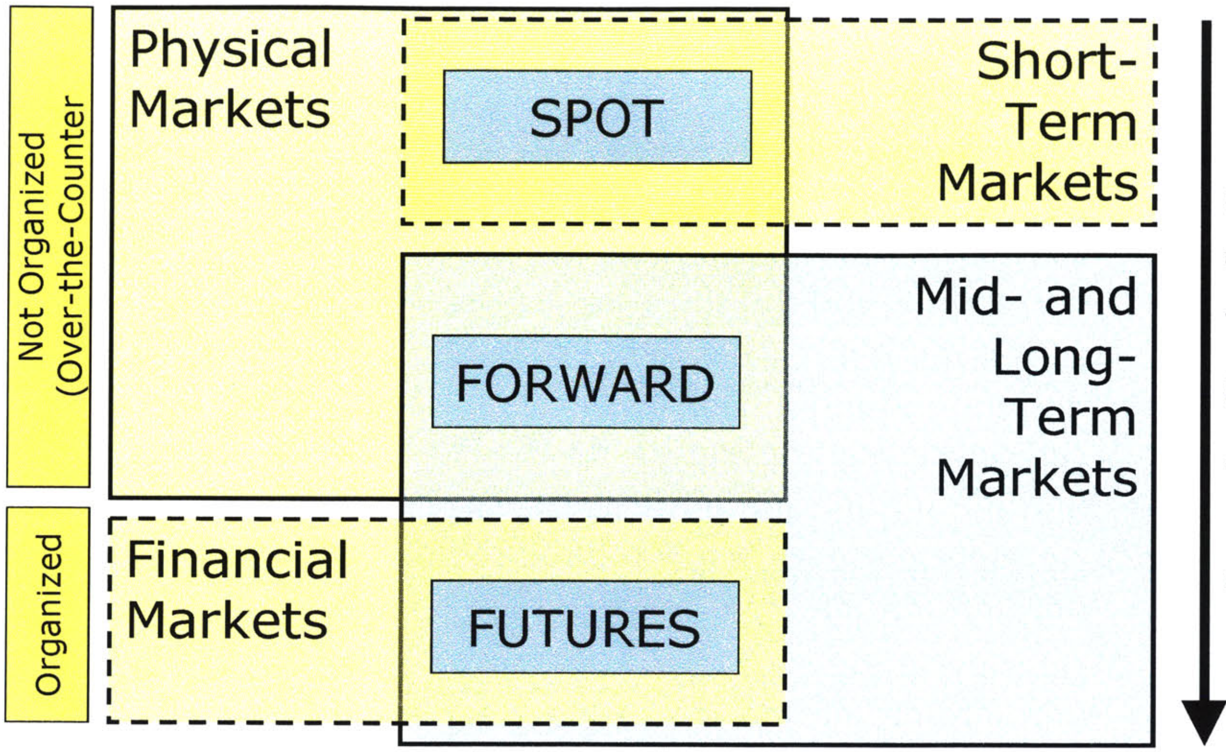
Forward contracts are mid and long term contracts, for example from one month up to a year, that are non standardized over the counter contracts between two partners. The parties fix the price for a future transaction and exchange the money at the time of the transaction. Forward contracts are an indicator of what industry companies expect the price to be at a future date.

Futures contract is a completely standardized contract that is managed by an exchange that guarantees their payments through a clearing house. How futures work is best explained by an example. On April 1, a shipper buys a future contract for USD 200,000 for the shipment on

September 1 of 100 containers from Hong Kong to Long Beach. The price has been set by the exchange. To enable this business the shipper has to create a margin account that will be used for the marked-to-market transactions. In this example it is assumed that the margin account is 10%, i.e. the shipper puts USD 20,000 into the account. On April 2, the Exchange's rate for its futures contract is USD 196,000. This means that USD 4,000 are removed from the margin account. On April 3, the Exchange's rate for its futures contract is USD 195,000, so a further USD 1,000 are removed from the margin account. On April 3, the Exchange's rate for its futures contract is USD 199,000, so USD 3000 are added to its account. And so on. The margin account may have to be refilled if the futures rate goes beneath a pre-specified threshold. If the shipper intends to use the 100 container spaces the future contracts specifies, it simply keeps the contract until the settlement date.

If, however, the shipper does not wish to use the 100 container spaces it can decide to close out its position by neutralizing its agreement, i.e. it sells (shorts) a shipment on September 1 of 100 containers from Hong Kong to Long Beach. It is this feature that allows speculators to enter into futures contracts without requiring the service they specify. Having speculators in the futures market is necessary to provide the liquidity needed.

Figure 21
Difference between spot, forward and futures markets.



Source: REPSOL (2002).

Forward Freight Agreements (FFAs) are flexible contracts that shippers and carriers of dry and wet bulk do in order to hedge against future changes in spot prices. The terms of the contract include the lane, time of shipment, volume, and the agreed forward rate. The settlement is then done against an independent index, such as the one published by the Baltic Exchange, at the time of shipment. These contracts are over the counter and are not done through the exchange.

Trading of Freight futures for dry and wet bulk has also started through Imarex, a Norwegian Electronic Exchange, and is growing rapidly. Imarex had 10 transactions in the first quarter of 2002 but in the last quarter of 2004 it had 1200 transactions and 15% of the freight derivatives market (Pierron, 2005).

One point of view, expressed by a carrier practitioner is that containers can be looked upon as commodities. (CTL, 2005). Looking at ocean transportation of containers from that point of view would allow the creation of an index for transportation of containers over specific lanes. If the carrier requires different payments depending on the content of the container, e.g. due to insurance cost, that is something that can be negotiated separately from the transportation cost itself.

The power of this idea is that a futures market for container shipments combines uncertainties into one metric. Instead of having industry players try to hedge internally against currency fluctuations, fuel price fluctuations, and other exogenous uncertainties, and thereby compete with large financial institutions that are specialized in each separate market, they can hedge against a metric that is specific to their industry, a metric that they have the advantage of knowing well.

5 Conclusion

This thesis has described an industry that is stuck in historical inefficiencies. The practices within the industry pitch shippers and carriers up against each other, with each making their fortune when the other one is doing badly. It is an industry that accepts uncertainties that are specific to the industry as given, instead of creating a cooperative environment that can eliminate the uncertainties.

5.1 Challenge Everything

The first conclusion of this thesis is that carriers and shippers need to break out of the current paradigm and start cooperating on a level that creates value by removing inefficiencies. In order for this to succeed they must make sure that the cooperation stretches throughout the transportation chain to the ports and the infrastructure that links the ports to the inland. This can only be achieved if incentives are aligned so that the industry has a clear perception of where the value lies. The thesis states that flexibility is an asset that has been severely undervalued in the industry. A real options approach is suggested in order to correctly value flexibility. This will lead to a restructuring that will unlock value.

The second conclusion of this thesis is that shippers and carriers should join to create a futures market for transportation of containers. This would allow them to hedge against uncertainties that affect the market of containerized ocean transportation the most. The uncertainties that the industry cannot eliminate, the exogenous uncertainties, are also being handled inefficiently today. Carriers hedge against fluctuations in fuel prices, but still have contractual mechanism to change prices to shippers when fuel prices change. Shippers are generally not hedging against individual exogenous uncertainties because of the high risk it can involve.

5.2 Where to Start

The change that is recommended here has to be well thought out, carefully planned, and the companies involved have to be both willing and able to make the transition. The first steps will define the success of the change.

The first step is for shippers, carriers, and ports to get together. They need to understand each others operations in order to be able to bring forward ideas that add value. These must be companies that are willing to share all information about their operations. The shipper taking part must be willing to have the carrier come over to its facilities to understand how they operate and make suggestions. Conversely, the carrier must be willing to have the shipper look at its operations and to be open to suggestions. The same thing applies to the carriers and the ports, and the ports and the shipper, since the shipper is often on both sides of the transportation chain. It is both shipping the goods and receiving them. A carrier doesn't need to select its most important customer to participate in the project. A better choice may be a smaller innovative shipper that is close to a smaller innovate port. And it need not be the whole operations of the shipper or the port that would be looked at.

The second step is to direct the focus to a narrow area of the business, so that the project doesn't fail because of an over-ambition. The companies should then go through activities based costing to understand exactly where the cost is created. They should also go through a real options study to understand where flexibility is needed and how much it is worth.

The third step is to create a pilot project based on the results from the second step, that could prove how much value there is to be unleashed. Everyone that would be involved in the change needs to be informed on what is taking place and why it is taking place. The incentive system of the companies and their employees needs to be aligned with the change process of the pilot project. Otherwise they will continue to do what they did before, i.e. to do what they are paid to do. The pilot project needs to be well defined and metrics need to be created in order to measure the success. The problems incurred in the pilot project would then need to be analyzed and understood before broadening the focus and tying other parts of the operations together. A pilot project and the experience it brings are essential in order to get more shippers and ports to participate and believe in the concept.

5.3 Future Research

There are three main areas that need further research.

First, a study of shippers, carriers, and ports, needs to be carried out in order to seek out companies that are both willing and able to take part in the steps described in section 5.2. The study should address what are the largest obstacles to the change and suggest ways to overcome them.

Second, an activities based costing research would be valuable. This research would focus on the transportation chain and seek to understand what drives the cost in the chain as a whole, as opposed to doing an activities based study only in the manufacturing facilities and another one only in the ports. Optimizing the operations at each point in the transportation chain without taking the other points into consideration can only lead to suboptimal results. One approach might be to follow a container on its way from the origin to the destination. The manufacturing cycle and how the container is loaded and then unloaded would have to be studied in this context. This research should address how the cooperation between carriers and terminal operators is, how the cooperation between a shipper and a carrier is, and where the inefficiencies are. This should be a challenge-all study that doesn't accept any assumptions as obvious.

Third, data needs to be collected on the uncertainties identified in this thesis. The volatility needs to be calculated and analyzed. It is important to realize if the volatilities are correlated. This data is necessary in order to put a price on the real options suggested in this thesis. The research should also address how surcharges have developed and analyze if they fall as easily as they rise. In order to create a futures market, it also needs to be understood, which uncertainties drive the price of shipping the container and a method needs to be defined in order to create an index that could be used for such a market. Experience from other derivatives markets, such as those for energy, should be analyzed with the industry of containerized ocean transportation in mind.

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A Appendix A: Vocabulary

Aframax Tanker	80,000 to 120,000 dwt (about 500,000 barrels of crude oil). A part of the flexible market scale (Surveyor, 2002).
Air draft	The height of the span of a bridge over the surface of the water (Surveyor, 2002).
AISA	American Institute for Shippers' Associations
Baby capes	The first generation of *capesize* and are usually smaller than capesizes produced today (Surveyor, 2002).
BAF	Bunker Adjustment Factor, i.e. a surcharge to adjust for fuel price volatility
CAF	Currency Adjustment Factor
Capesize	Any dry bulk carrier above 80,000 dwt. Usually 130,000 to 190,000 dwt (Surveyor, 2002).
CAPM	Capital Asset Pricing Model
Dunkirk-size	A subcategory of *capesize*, which is restricted by the dimensions of the two ore and coal ports in Dunkirk, France (Surveyor, 2002).
Dwt	Dead weight tons
ELAA	The European Liners Affairs Association
ESC	European Shippers' Council
FEU	Forty-foot Equivalent Unit, i.e. a 40 foot long container
Fixed afra scale	A historical rigid scale for wet bulk carriers that has not been modernized (Surveyor, 2002).
Flexible market scale	A modernized scale for the sizes of wet bulk carriers (Surveyor, 2002).
FMC	Federal Maritime Commission
Geared	A ship that has its own crane for loading and unloading (Surveyor, 2002).

Gearless	A ship that is not *geared* (Surveyor, 2002).
GP	General Purpose. Wet Bulk Carrier below 25,000 dwt. A part of the *Fixed afra scale* (Surveyor, 2002).
GRI	General Rate Increase (decided or recommended by a conference)
Handy	Smallest carriers for dry bulk. There are two types: *Handysize* and *Handymax*. They carry a wide mix of cargo, can operate in all ports. There are around 3800 handys in the world, out of 6000 dry bulk carriers. They can be geared or gearless (Surveyor, 2002).
Handymax	Dry bulk ship of 40,000 dwt to 60,000 dwt by definition but are usually 50,000 dwt to 52,000 dwt (Surveyor, 2002).
Handysize	Dry bulk ship of 10,000 dwt to 40,000 dwt. See *handy* (Surveyor, 2002).
Intascale	International Tanker Freight Scale
LR-1	Large Range 1. Wet Bulk Carrier larger than MR but below 80,000 dwt. A part of the *Fixed afra scale* (Surveyor, 2002).
LR-2	Large Range 2. Wet Bulk Carrier larger than LR-1 but below 160,000 dwt. A part of the *Fixed afra scale* (Surveyor, 2002).
MQC	Minimum Quantity Commitment
MR	Medium Range. Wet Bulk Carrier larger than GP but below 50,000 dwt. A part of the *Fixed afra scale* (Surveyor, 2002).
NVOCC	Non-Vessel Operating Common Carriers
OHBC	Open hatch bulk carriers (Surveyor, 2002).
OSRA	Ocean Shipping Reform Act of 1998
Panamax	Next dry bulk size above handymax, 61,000 to 80,000 dwt. There were around 1,000 panamaxes in service in 2002 and they are designed to be the maximum size that can pass through the Panama Canal (Surveyor, 2002).
Panamax Tanker	60,000 to 80,000 dwt (about 400,000 barrels of crude oil). A part of the flexible market scale (Surveyor, 2002).
Product Tanker	10,000 to 60,000 dwt wet bulk carrier. A part of the flexible market scale (Surveyor, 2002).
PSS	Peak Season Surcharge

Suezmax Tanker	120,000 to 200,000 dwt (about 1,000,000 barrels of crude oil). A part of the flexible market scale. Few of them can actually pass through the Suez canal (Surveyor, 2002).
TEU	Twenty-foot Equivalent Unit, i.e. a 20 foot long container
ULCC	Ultra-large crude carrier. Wet Bulk Carrier larger than VLCC but below 550,000 dwt. A part of the *Fixed afra scale* (Surveyor, 2002).
ULCC	Ultra-Large Crude Carrier, 320,000 to 550,000 dwt (about 3,000,000 barrels of crude oil). A part of the flexible market scale (Surveyor, 2002).
USMC scale	A standard rate scale developed by the Ministry of Transportation in Britain during World War II, in order to fairly compensate private owners of ships that were used for the transportation of military supplies (Surveyor, 2002).
VLCC	Very Large crude carrier. Wet Bulk Carrier larger than LR-2 but below 320,000 dwt. A part of the *Fixed afra scale* (Surveyor, 2002).
VLCC	Very Large Crude Carrier, 200,000 to 315,000 dwt (about 2,000,000 barrels of crude oil). A part of the flexible market scale (Surveyor, 2002).
VLOC	Very large ore carrier, up to 365,000 dwt (Surveyor, 2002).
Worldscale	Short for New Worldwide Tanker Nominal Freight Scale. Scale for cost of transportation over specific routes. See www.worldscale.com. Actual freight rates for wet bulk is commonly presented as a percentage of the worldscale (Surveyor, 2002).