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Pricing guidelines for port authorities in the context of the theory of two-sided markets

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Acknowledgements

Abstract

Port authorities often face the dilemma of allocating what share of total costs to what group of port users in order to generate sufficient revenue (which is assumed to be known in the thesis). There is no consensus between port authorities on this issue. Moreover, port authorities often do not make use of specific pricing mechanisms on which they base their pricing decisions. Often pricing is merely based on tradition. Compared to other infrastructural objects, such as roads or airports the inconsistency and complexity of the pricing situation in seaports is quite unique. In order to find answers that solve the dilemma of port managers the applicability of the two-sided market theory is tested on seaports. To do so useful insights are borrowed from the literature that tests the applicability of the theory of two-sided markets on airports. It is argued that seaports do not fit the assumptions underlying the two-sided market theory. What is obtained from the analysis is that port authorities can in broad terms be seen as multiproduct companies operating in vertically related markets, in which some port users – shipping lines and (hinterland) logistics service providers – cause vertical externalities that have an positive influence on other port users.

Subsequently a number of port pricing guidelines are introduced that port authorities can use in order to deal with the pricing dilemma of allocating what share of costs to what group of port users. These guidelines take into consideration the insights that are provided by the analysis of the two-sided market theory. In the last part of this thesis the guidelines are combined in such a way that per port user group a pricing strategy recommendation is introduced. The reason for not answering the management dilemma by means of a ready-made price allocation is due to important port specific characteristics that can have a major influence on the optimal price strategy.

Table of contents and Appendices

List of Tables

List of Figures

1. Introduction

Port authorities charge port users for their usage of the ports infrastructure in order to generate revenue. This money is primarily reinvested in the port area in order to maintain a certain quality level and used for the provision of support services for port users. The rationales behind the pricing structures that port authorities have adopted are in many cases unclear or based on mere tradition. Consequently, the way in which ports around the world generate revenue is different and not well founded.

This situation may drastically change as a result of the emergence of a rather novel theory known as the theory of two-sided markets. This theory has, to the best of our knowledge, never been applied to seaports. The theory of two-sided markets entails a platform surrounded by two distinctive but interrelated markets. The value of the platform to a user is dependent on the size of the market on the other side of the platform, so-called two-sided network effects. Network effects, as result of an increasing number of users in one market, can be created by subsidising one side of the platform with money generated at the other side of the platform. Intuitively it is tempting to perceive a port as a two-sided market. Port authorities provide infrastructure that is used to transfer cargo between the two surrounding markets consisting of port users that together form a network. The first market linked to the platform is the sea-side, consisting of shipping lines and the other market linked to the platform is the land-side compromising hinterland transport companies, shippers and tenants.

For the port authority or manager of the port, the management dilemma is how to charge port users in such a way that full costs are recovered while the loss of throughput volume – as a result of charging – is minimized. From this dilemma the following management question can be formulated: Which port users should bear what share of the total port costs?

1.1. Scope

The scope of this thesis is to propose a number of pricing strategy guidelines for port authorities that deal with ports with both a contestable hinterland and a competitive foreland. Moreover, for the insights to be useful port authorities should have the freedom to set prices at its sole discretion. We assume in the thesis that port authorities set prices in such a way that the required revenue is generated while throughput is maximized. Moreover, in the thesis it is assumed that the level of required revenue is known. Consequently, the key question is how port users should be charged in order to generate the required revenue. This all does not mean that we propose a ready-made optimal pricing structure. Circumstances differ from case to case thereby ensuring that the proposal of a generally applicable ready-made pricing structure is impractical.

1.2. Aim research question

The purpose of the thesis is to provide port authorities with a way of reasoning that provides them with a useful tool in dealing with the question what type of port users should bear what cost burden of a port in order to generate the required revenue. In this consideration the insights that are provided by the analysis of the two-sided market theory are key.

1.3. Methodology

For this thesis an exploratory research design is chosen. The reason for this is that, despite the recent large body of academic literature on two-sided markets, the theory has not been applied to seaports before. First, the applicability of the theory of two-sided markets and the insights of the theory have to be considered. Consequently, a qualitative approach is the appropriate approach. To be more precise, in order to answer the management question an extensive secondary data analysis is performed in combination with developing linkages by means of reasoning. Below a more detailed overview is given of the types of data that are used.

In the first part of the research pricing textbooks and governmental pricing sources are used to identify the most commonly used pricing mechanisms for infrastructural products and services. Given their conceptual and straightforward approach these sources are most appropriate to give background information. In addition, for the pricing structure of ports income and pricing statements are consulted of a number of ports. Furthermore, in order to analyze the theory of two-sided markets articles from academic journals are used, since these are able to provide for in-depth assumptions that are critical for testing the theory. More specifically, papers are consulted that have tried to apply the insights of the theory to a airports. The reason for considering this type of research is because of the similarities with seaports. (Blumberg et al., 2011)

Subsequently, a number of guidelines are proposed that should act as a useful tool for port authorities in dealing with the question which port users should bear what share of total costs in order generate the required revenue. Again, for validating the proposed guidelines insights are used from other infrastructural pricing issues. These examples are the result of a secondary data analysis focusing on academic journals. This is key since in these papers the conceptual basics are introduced which are key for checking the compatibility with the seaport environment.

1.4. Structure of the thesis

The structure of the thesis is as follows. After this introductory section, in which the literature review and the analysis layout are discussed, the thesis continues with discussing infrastructure pricing mechanisms that are widely used. Subsequently, the rationales behind port pricing are discussed, followed by a number of exemplary ports with their own pricing structure. Thereafter, the theory of two-sided markets is introduced and the applicability of the theory on the seaport case is assessed. The section following describes a number of guidelines that should be the basis for an appropriate pricing structure. Finally, the main findings and answers to the research question are discussed and conclusions are drawn, limitations revealed and recommendations for further research introduced.

2. Theoretical background

2.1. Literature review

The theory of two-sided markets, which is at the core of this thesis, has its roots in two distinct research fields. The first research field is that of network industries, which have been contributed by Katz and Shapiro (1985, 1986) and Farrell and Saloner (1985, 1986). The drawback of their insights is that it does not take into consideration the multi-sidedness characteristic and therefore also not the price allocation determination. The second research field is that of multiproduct pricing literature, as introduced by Baumol (1982) In contrast with the network industries research field, the multiproduct pricing literature does take into consideration the multi-sidedness and the corresponding price allocation, however it does not consider network externalities.

As a result of combining both research fields, the theory of two sided market arose as a recent contribution to economics and strategic management literature. Rochet and Tirole (2003, 2006) and Armstrong (2006) defined the logic, characteristics and assumptions of two-sided markets which can be best described as a chicken-and-egg problem. The chicken-and-egg problem can be explained by the following: in case of declining demand on one side of the platform, then, there is also a declining demand on the other side. The solution to this problem is to create a critical mass of users on one side of the market by actively stimulating this user group to join the network, which in turn, due to network effects, stimulates users on the other side of the platform to join their network and therefore the platform. Pricing strategies are key in this respect.

In recent years many academic papers are written that apply the theory of two-sided markets. Often these papers apply the theory to a specific case setting: for example technology platforms such as Microsoft Widows and Sony's PlayStation (Economides and Katsamakas, 2006), the magazine industry (Kaiser and Wright, 2006) and payment networks (Chakravorti and Roson, 2006). The approach of these papers is mainly econometric, since these cases neatly fit the underlying assumptions of the two-sided market theory. Because the assumptions of the theory first have to be tested on seaports, the two-sided market research that focuses on airports is more valuable for this thesis. There are two reasons why airports are more relevant. First, the approach in this type of research is in accordance with the methodology of this thesis. Secondly, airports show a strong resemblance with seaports. They both provide a location where cargo or passengers can arrive, depart or connect to a destination and at both ports the transport operator needs to pay dues for usage of the infrastructure. Based on this observation Gillen (2011) has considered airports as platforms which bring the passengers and airlines together. In contrast, Fröhlich (2010) argues that airports differ from other two-sided markets in a number of ways.

Notwithstanding the large body of literature on seaports only a limited number of papers have identified ports as platforms where cargo is being moved between multiple separate markets (Carbone and Martino, 2003). Needless to say, ports also need to deal with the chicken-and-egg problem. Ports will only be visited by shipping lines if there is enough cargo which makes a stop economically interesting. On the other hand, shippers will only take a port into consideration if a shipping line calls the specific port.

A famous example here is the container terminal in Amsterdam. Due to port specific characteristics, such as a lock, a limited draft and the vicinity of a few large competitive container terminals, the foreseen container flows never materialized, which led to a bankruptcy of the terminal. Another similar and fairly recent chicken-and-egg example is the underused container terminal in Jade-Weser Germany.

Despite this logical reasoning there is a gap in the literature. As has been argued in the methodology section, the theory of two-sided markets has never been applied to seaports. The gap is clearly highlighted by Van den Berg and De Langen (2011), who have questioned whether ports have their pricing structures right. Obviously, their recommendation for further research is the reason for this research.
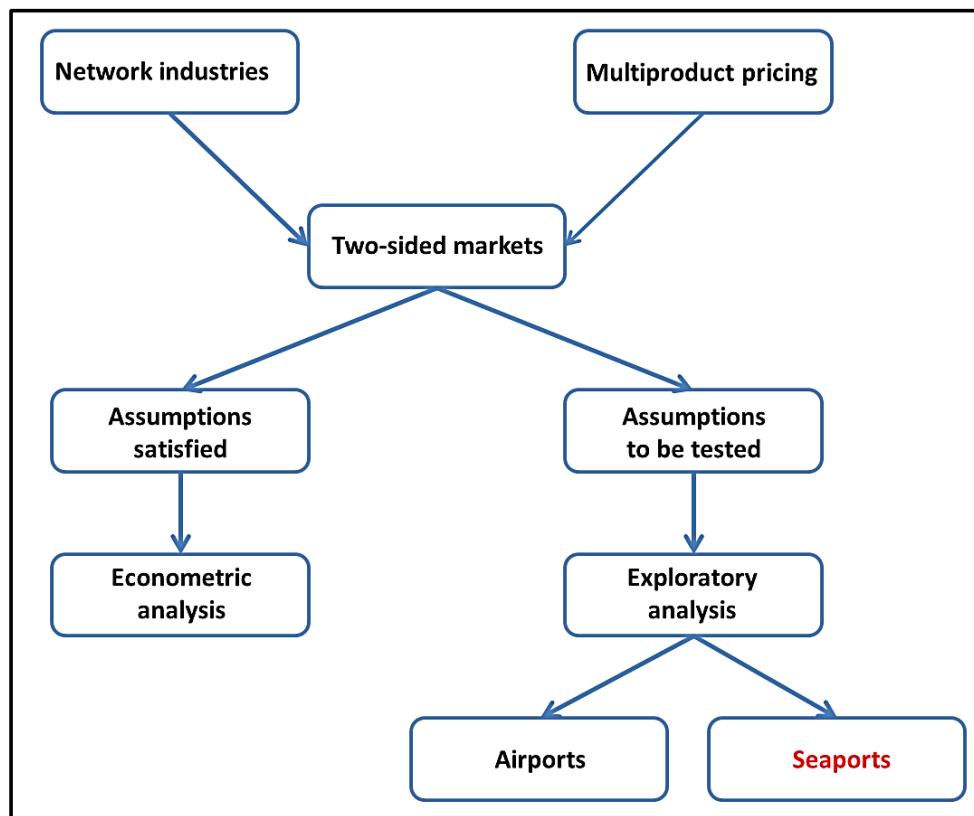
Figure 1 – Theoretical background of the thesis
Source: author

3. Analysis layout

The layout of the analysis can be best described on basis of the research questions. In order to test the management question a main research question has been formulated. This main research question is supported and divided into four research questions that will be introduced below. The analysis will start with answering the research questions. Subsequently, the results are combined for answering the main research question.

3.1. Main research question

How do the insights, that are provided by the analysis of the applicability of the two-sided market theory to seaports, influence the guidelines aimed at helping port authorities to optimize their pricing strategy?

3.2. Research questions

1. Which mechanisms are used to price infrastructural products and services?
2. What type of port pricing structures are used by port authorities throughout the world?
3. To what extent is the theory of two-sided markets applicable to seaports?
4. What are guidelines for a pricing strategy for port authorities?

4. Results of the analysis

4.1. Results research question one

The first research question is: Which mechanisms are used to price infrastructural products and services?

In this section the first step is to provide a review of pricing principles and strategies as a basis and context on which later paragraphs build. In order to achieve this first classical macro-economic theory about market structures and price setting practices in these markets are briefly discussed. Subsequently, the scope is narrowed down to pricing mechanisms that are used to price infrastructural products and services.

4.1.1. Classical economic theory

Market structures can range from perfect competitive markets to monopolies. In principle, the more competitive a market is the less the market power firms have. Market power expresses itself in the ability of a single firm to raise its price above marginal costs. So in case of a perfect competitive market, prices are dictated by the market and reflect marginal costs. Firms in these markets cannot raise their price above marginal costs, since demand will evaporate. When market power of single firms grows, for example as a result of entry barriers or differentiated products, also the mark-up over marginal cost will increase. This means that besides cost recovery – that is covered by marginal cost – market players can use pricing in order to achieve other objectives such as profit maximization, market penetration or survival pricing. In the extreme case where competition is virtually non-existent – the monopoly situation – prices that should be charged are determined by the point where marginal revenue equals marginal costs. (Mankiw and Taylor, 2011)

There are two concepts in pricing that are linked to market power and are used, implicitly or explicitly, by many pricing mechanisms. These concepts are price elasticity and price discrimination.

To start with the first, price elasticity is a concept that shows to what extent demand changes as a result of a change in price. When demand changes more than proportionally to an increase or decrease in price, demand is assumed to be elastic. In contrast, when demand changes less than proportionally to an increase or decrease in price, demand is assumed to inelastic. To emphasise the importance of price elasticity, consider a monopolist faced with very elastic demand. In this example the monopolist is barely able to charge a price higher than marginal costs, even though the monopolist is not faced with competition. Amongst other determinants, the availability and attractiveness of substitutes is an important factor that influences price elasticity. The more close substitutes there are for the product or service in consideration, the higher the price elasticity. (Button, 2010; Mankiw and Taylor, 2011)

A concept closely related to price elasticity is cross-price elasticity. Cross-price elasticity measures the change in quantity demanded for a certain product or service while the price of another product or service changes. When the products or services in

consideration are complements, cross-price elasticity is negative. On the other hand, when the products or services are substitutes, cross price elasticity is positive. If as a result of a change in price for one product or service the change in quantity demanded for another product or service does not change at all it can be concluded that there is no relationship between both products or services. (Button, 2010; Mankiw and Taylor, 2011)

The second factor is the ability to price discriminate. Price discrimination means that a company can charge separate customer groups – with a different willingness to pay for the product or service - different prices for the same product or service. There are varying degrees of price discrimination, ranging from perfect knowledge of each individual customers willingness to pay to customer separation on the basis of their reaction to pricing schemes.
Conditions that have to be met in order for price discrimination to work are market power, resale must be impossible and firms should be able to segment customers. (Phlips, 1981) The result of price discrimination is an increase in profit for firms with market power at the expense of higher prices for customers. (Hubert, 2006; Mankiw and Taylor, 2011) In conclusion, pricing behaviour is for a large part determined by the market structure.

4.1.2. Pricing mechanisms used to price infrastructural products and services

The scope is narrowed down to infrastructure pricing mechanisms that are currently used to price infrastructure. In order to categorize all the different pricing mechanisms, this section is based on a white paper of the European commission dealing with infrastructure charging. (European Commission, 1998) Additionally, the insights of Button (2010) have been integrated. Before introducing the different pricing mechanisms it is important to introduce the concept of social welfare. Suppliers pricing their products or services in a social optimal way set prices equal to marginal costs. To be more specific, they set prices equal to short term marginal costs. The reason of this short term character will be elaborated on below. Social welfare is particularly important since we deal in this section with infrastructural pricing mechanisms, which is from time to time – wholly or partly – provided by public organizations. As a result, social welfare is prevailing over private (supplier) welfare. (Button, 2010)

The first – and socially most optimal – infrastructure pricing mechanism is *short term marginal cost pricing*. Charging according to short term marginal costs means that users of the infrastructure pay the price of their additional usage of the current infrastructure. This way of pricing ensures the most efficient use of current infrastructure, since the prices are as low as possible without running an immediate loss. An important condition is that the capacity of the current infrastructure is sufficient to accommodate all demand. (European Commission, 1998) However, short term marginal cost pricing does not allow to recover costs for future investments. A solution to this, that only works in long term constant cost environments, is to extend the period that is used to calculate marginal costs. By extending the period under consideration certain fixed costs items become variable, such as future investments. As a result, also

future investment costs and other necessary expenses are covered. (Button, 2010) Short term marginal cost pricing corresponds to pricing in perfect competitive markets.

In the cases where long term costs are not constant, marginal cost pricing does not work. According to Haralambides (2004) marginal cost pricing can cause destructive competition and losses in industries that are faced with high fixed costs, falling costs when output increases and excess capacity. This situation is not uncommon for certain infrastructures. Hence, additional infrastructure pricing mechanisms are introduced below. Although these pricing mechanisms are from a social perspective not optimal, they are suitable for recovering costs in decreasing cost environments. Important to bear in mind is that these pricing mechanisms cannot be used by players in perfect competitive markets, because costs are above marginal costs.

The second infrastructure pricing mechanism is *average cost pricing*. This approach is almost the same as marginal cost pricing. The only exception is that now all costs are taken into consideration, not only the costs of additional usage. Average costs pricing implies that the total costs of providing the infrastructure are divided by an indicator of output such as the number of handlings or the number of kilometres. An advantage of this approach is that all costs, both short term and long term, can be recovered from the users. A disadvantage is that users with low marginal costs pay the same price as users with high marginal costs. In other words, the equal allocation of costs over all users leads to some users paying too much and some users paying too less. (European Commission, 1998)

The third infrastructure pricing mechanism is *price discrimination*. This pricing mechanism corresponds to price discrimination, as discussed in the previous section. In the context of infrastructure financing there are some drawbacks of price discrimination pricing policies. At first, the willingness to pay for a certain product or service is difficult to determine. Secondly, different prices charged to different customers are at odds with price transparency and fairness. (European Commission, 1998)

A closely related concept to price discrimination is *yield management*, which is the fourth infrastructure pricing mechanism This concept is widely used in the airline industry. Yield management is a pricing mechanism that is being used to ration out limited capacity in service offerings. Prices are increased when supply is becoming scarce and a pre-specified ending time is approaching. The ones with the highest willingness to pay will get the service. Markets and customers are segmented based on the timing of their decision to buy as well as their preference for the quality of the service offering compared to other service offerings from which can be chosen in the same time window. (Smith et al., 1992)
Yield management differs from price discrimination in the sense that the aim is cost recovery and granting products or services to the ones with the highest willingness to pay instead of charging every single buyer its willingness to pay. A condition that is critical to be satisfied is the availability of computer reservations systems with sophisticated software programs that can changes prices real time according to market changes. (Button, 2010)

The fifth infrastructure pricing mechanism is *Ramsey pricing*. This pricing mechanism actively deals with the economic concept of price elasticity of demand. Ramsey pricing suggests that the price level has to be dependent on the price elasticity of demand. In other words, when a firm has to set price levels for a number of products or services, it has to impose higher mark-ups over marginal costs on products or services that face inelastic demand. For this explanation to be true it is implicitly assumed that cross-elasticity is zero, or put differently, it is assumed that demand for two products is independent. (Ramsey, 1927) If this unlikely scenario is not the case, the above introduced rule has to be modified. Now prices has to be set in such a way that the shares of certain products or services of the total number of products or services sold should be equal to the situation in which marginal cost pricing was the pricing mechanism. (Baumol and Bradford, 1970)

There are a few conditions to be satisfied in order to be able to make the theory work. First, a firm has to have more than one product or service that has to be priced. Subsequently, a firm has to have the ability to segment markets in which it offers its products or services. If this is not possible price differentials are impossible to maintain. Finally, a firm has to have knowledge about price elasticity and cross-price elasticity. (European Commission, 1998; Button, 2010)

The sixth infrastructure pricing mechanism is *two part tariff pricing*. This pricing mechanism consists, as its name suggests, of two elements. The first element to which is referred is ordinary marginal cost pricing. The second part, which ensures the filling of the gap between income and expenditures, is a so-called club system. This means that users that want to make use of the infrastructure have to pay a fixed amount for a specified period of time. (European Commission, 1998; Button, 2010)

The seventh infrastructure pricing mechanism is *peak load pricing*. Peak load pricing deals with systematic short term variations in demand. Because of the short term character, changes in capacity cannot be made. As a result, supply and demand cannot be matched with each other. In order to balance supply and demand, both during peak hours and off-peak hours, as well as allocating joint costs the right prices has to be set. During peak times, charges has to be set in such a way that not only the costs – both marginal and joint costs – are covered but that the price is also high enough to limit demand in such a way that it is equal to supply. In contrast, during off-peak times, charges should reflect marginal costs. In the end, the goals are full cost recovery and to smooth variations in demand. (Boiteux, 1960; Button, 2010)

In conclusion, it can be inferred from this section that there is a broad range of possible pricing mechanisms to price infrastructure. Each pricing mechanism is appropriate under different circumstances. Before entering the discussion on seaports it is useful to briefly interpret the above insights for seaports. Because seaports are decreasing costs environments, short term marginal cost pricing is inappropriate, thereby assuming that ports recover their own costs. Hence, prices have to be set above short term marginal costs. For the question which pricing mechanism is then appropriate – or in other words which port users should bear what amounts – additional analysis is necessary. To be more precise, at this point one cannot say whether ports are able to price discriminate, whether they can determine price elasticity's in different markets or whether they have to deal with congestion. The sections below will provide insights in these matters.

Table 1 – Overview of infrastructure pricing mechanisms

Infrastructure pricing mechanisms	Description
Short term marginal cost pricing	• Users pay the price of additional usage of the current infrastructure + Efficient usage of infrastructure, socially optimal - Not recovering all costs in decreasing cost environments
Average cost pricing	• Users together pay all the costs related to usage of the infrastructure + All costs are recovered from users - The equal allocation of costs over all users leads to some users paying too much and others paying too less
Price discrimination	• Different user groups pay different prices for the same product, based on their willingness to pay for infrastructure + Charges are based on what the user can bear - Price discrimination can be considered as unfair and not transparent
Yield management	• Users pay higher prices when supply is becoming scarcer + Users with the highest willingness to pay will get the product - Yield management can be considered as unfair and not transparent.
Ramsey pricing	• Charges to users are dependent on the price elasticity of demand in different product groups of a single firm. + Prices are set in such a way that as less customers as possible are discouraged to refuse buying the product or service - Knowledge about price elasticity's is hard to obtain
Two part tariff pricing	• Users pay via a club system for access to the infrastructure and additionally pay for usage of infrastructure based on marginal costs + Prices are based on usage and full costs are recovered - The fixed fee for a certain period might expel potential customers
Peak load pricing	• Users pay during peak hours excessive prices that are used to subsidise users that make use of the infrastructure during off-peak hours. + Prices ensure optimal usage of existing capacity - The match between demand and supply is very difficult to realize

Source: author

4.2. Results research question two

The second research question is: What type of port pricing structures are used by port authorities?

This section starts with discussing the functions of port authorities in general as well as several general pricing mechanisms that are used by port authorities. The insights about the functions of the port authority are particularly valuable for the next section where the applicability of the two-sided market theory on ports is tested. For this part the goal is to provide insights into the operations of port authorities as well as the rationales behind the pricing decisions. Subsequently, a subset of six ports are worked out in more detail, thereby specifying the elements from which revenue is generated. To be more precise, from each port the revenue generating elements are summed as well as the relative share of revenues generated from each element, thereby aiming to compare various ports on this dimension.

4.2.1. Development of port authorities

This section starts with briefly discussing the historical development of port authorities in order draw the right context. Subsequently, against this background the port functions are discussed. Before starting the discussion on the development of port authorities, first a definition is given defining the role of port authorities. Although there are many definitions defining the role of port authorities, in general it can be stated that the role of a port authority is to take care of management and administration of the infrastructure of the port as well as the regulatory and coordinating function in relation to various port actors. This means that port authorities are a mix of activities that can be found both in public organisations and private firms. (Verhoeven, 2010)

Many port assets have been for long in the hands of the public sector. Moreover, the public sector has developed the required infrastructure and performed all necessary activities. The reason for the large public role in seaports was because of the important economic function of the port itself (for example as a result of the required labour), the wider economic impacts of ports on the surrounding regions because of the port's trade supporting role and also the capital intensive nature of the ports infrastructure. Each port served its own isolated captive hinterland. This basically meant that ports were monopolies in their respective region. Moreover, ports in the past have been characterized as congested, inefficient and expensive. (Haralambides, 2002)

This situation has changed drastically mainly as a result of the containerisation revolution. From this moment on port users increasingly demand reliability and cost-effective services. Moreover, the hinterland of ports has been expanded because of the possibility of intermodal transport. Hence, nowadays ports are more competing with other ports than has been the case before. This situation is further reinforced due to scaling up of vessels in ocean transportation. More cargo is consolidated in a single shipment and less ports are called during a certain journey. Due to larger competitive forces in the seaport markets, governments have understood that the ports have to improve efficiency. Key in this respect is the changing role of the public sector in the seaport environment. (Haralambides, 2002)

The changing role of the public sector in seaports can be translated into the privatization – that is the retreat of public interests – of seaports. The privatization process has resulted in a number of port models, each with a different degree of privatization. In the United Kingdom, for example, many ports have developed into fully privatized ports, whereas in continental Europe landlord models are more common. Furthermore, in countries with strong central government control, tool ports or even service ports are prevalent models. These models show the least degree of privatization. (The worldbank, 2007a) Important to stress is that culture plays a large role in the degree to which ports are privatized. (Haralambides et al., 2001) Nevertheless, it is argued that the majority of ports are developing into landlord ports. (Verhoeven, 2010; Peters, 2001)

4.2.2. Port authority functions

Since the development process of port authorities has been discussed, the focus is shifted towards the functions of port authorities. As will be argued below, the development process has had impacts on the functions of port authorities. The discussion is loosely based on a contribution of Verhoeven (2010).
Traditionally, activities of port authorities can be classified in three broad categories, namely the activities related to the landlord function, activities related to the regulatory function and activities related to the operators function. (Baltazar and Brooks, 2001; Baird, 1995)
To elaborate on the first function, activities that are related to the landlord function of port authorities are the development, construction and maintenance of port land and (basic) infrastructure. Also management and exploitation of these assets is an important activity for port authorities. (Baltazar and Brooks, 2001; Van Hooydonk, 2003) Generally, this function is considered to be the most important function of port authorities, as can be derived from the valuation of supply chain actors. (Slack, 1993; Notteboom and Winkelmans, 2001)
The second group of activities arise from the ports regulatory function. This is the function of a port authority with the largest public character. The regulatory role of a port authority can be best described as a police of the port. The main objectives of port authorities in this setting are to provide a safe, competitive fair and environmentally protected port area. (Baltazar and Brooks, 2001; Baird, 1995)
The third and last group are the activities of port authorities that are related to the operator function. Operational activities performed by seaports are classifiable in activities dealing with the transfer of cargo or passengers between the sea-side and the landside, activities on the sea-side that are often described as nautical services and finally ancillary services. (Verhoeven, 2010)

As a result of the privatization trend of port authorities, the type of operational activities – the third group of activities of port authorities – that are provided by port authorities have drastically changed. Moreover, the overall number of operational activities that port authorities perform have declined. Port authorities withdraw from cargo handling operations and are more focussing on landlord and regulator based activities. The cargo handling function is taken over by powerful terminal operating companies. These companies, in turn, have a large influence on port authorities. The market power of these players influences the strategic leeway to manoeuvre of port authorities. (Everett

and Robinson, 2007; Martin and Thomas, 2001) In contrast, nautical activities are less influenced by both privatization and global market players, due to the nature of these services. Often competition is lacking because the markets are simply not large enough to provide for these services. (Haralambides et al., 2001) The last group of services are ancillary services. The character of these services varies from public services (e.g. utility provision) to commercial services such as warehousing. (Verhoeven, 2010) For the operational activities key for a port authority is the consideration whether the activities should be performed or not. The changing relations as a result of the privatization process are depicted below.
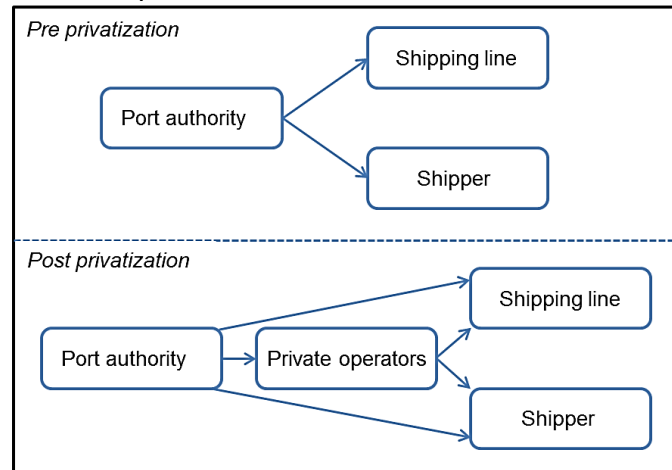
Figure 2 – Changing relations as a result of port privatization
Source: based on The Worldbank, 2007a

Besides these more traditional roles, port authorities are also developing new functions and related activities. De Langen (2004, 2007) has proposed the role of a port authority being a cluster coordinator as well as a port community coordinator. The cluster coordinator role has emerged due to globalization of port actors. Due to their global nature, these operators are less embedded in a port. Looser ties with a specific port goes against the interest of a port authority. (De Langen and Chouly, 2004; Verhoeven, 2010) The port community role of a port authority arises from the growing spatial integration of ports and surrounding cities. Various stakeholders with obstructive attitudes have to be taken seriously and managed. Famous are the environmental issues, labour-related issues as well as more urban related issues such as resident voices. (De Langen, 2007) The role a port authority assumes is that of a solver of collective action problems. Examples are education, ICT systems as well as marketing. (De langen and Chouly, 2004; Van der Horst and De Langen, 2008).

Besides, an additional function of port authorities in more recent times, also the geographical scope of port authorities is expanding. Port authorities roles are extending their role into the hinterlands, by cooperating with or investing in inland hub locations (Van den Berg and De Langen, 2011). This is because well-accessible and reachable hinterlands streamline port operations and generates income for port authorities. Furthermore, port authorities can impose more environmentally friendly was of hinterland transportation. (Notteboom and Rodrigue, 2005; Notteboom and Winkelmans, 2001; Verhoeven, 2010)

4.2.3. Port authorities rationales behind port pricing

Because ports have entered into a privatization process and are being faced with more competition it can be inferred that port pricing is becoming increasingly important for seaports. (Haralambides, 2002) To be more precise, cost recovery as pricing objective is gaining importance. This fact is extensively recognized in the literature. (Button, 1979; Haralambides et al., 2001; Haralambides, 2002)
Although cost recovery is gaining importance, a considerable share of ports do not recover all their costs. In view of this Haralambides et al. (2001) introduce in their paper a number of criterions that have an influence on the pricing behaviour of seaports and determine to what extent a seaport is able to adopt the cost recovery pricing objective.

The first criterion is ownership. Ownership refers to the degree in which governments and other public organisations are involved in day-to-day decision making in seaports. This function is directly related to the degree of privatization of ports, as discussed previously. Generally, the more a port is in private hands, the better it is able to recover costs. (Haralambides et al., 2001) A second criterion are port objectives. Basically, port objectives reflect the view price setters have of the port. They can either perceive a port as a standalone entity or as an economic instrument that serve entire economic regions. By adopting the narrow view of a port as a standalone entity – which is often the case because of privatization, ports are better able to recover costs. This is because in this case microeconomic goals such as profit, revenues and costs are used. In contrast, when the broad view of a port as a regional business enabler is taken, macroeconomic goals are much more important. (Haralambides et al., 2001) The third criterion addresses the degree of autonomy. The more autonomous a port is – this means the ability of port managers to operate independently and pursue own objectives – the easier cost recovery is. Restriction of autonomy of port operators is mainly caused by constraints and limits that public organisations impose on port operations. (Haralambides et al., 2001) The fourth criterion influencing pricing behaviour is the scope of activities of port managers. This criterion corresponds to the discussion of the functions and roles of port authorities in the previous section. As already introduced there, port authorities should critically assess which of the port operations to perform themselves. The more a port is privatized, the more functions are outsourced that can be run on a commercial basis. (The Worldbank, 2007a; Haralambides et al., 2001) Finally, the fifth criterion deals with public funds. A key determinant for pricing behaviour of ports is the generosity of governments with respect to granting public funds for the development of port areas. (Haralambides et al., 2001)

In conclusion, cost recovery for a seaport is closely linked to the way a seaport is organized. Put differently, the more a port is privatized, the more important it is for such a port to recover its costs. This relation is logical, since a port that is characterized by a large degree of privatization is most similar to a normal company. Alternatively, when a pricing structure deviates from cost recovery – for example because of a large public role in the seaport – the reason has to be sought in one of the five criterions as described above. (Haralambides et al., 2001)

4.2.4. Pricing mechanisms adopted by port authorities

At this point the trend towards cost recovery is clear. However, the pricing mechanisms in order to recover costs are ignored so far. Haralambides et al. (2001) argue that there is large diversity of port pricing mechanisms within Europe. This finding can be explained by the degree of privatization of port authorities, which have an influence on the ability to recover costs and therefore on pricing, as shown above. On the other hand, conformity in pricing mechanisms can be found for nautical services. These services are in many ports priced against marginal costs. The reason for this is the nature of the services, as described previously. Important to bear in mind is that the choice for a pricing mechanism is largely influenced by the degree of sophistication of monitoring systems. Because often these monitoring systems are not in place, information regarding costs is lacking and therefore seaports often choose for less sophisticated pricing mechanisms such as average costs pricing, competition based pricing or capacity based pricing. (Haralambides et al., 2001) Since the factors discussed above are not prevalent only in Europe, we assume that the above findings are generalizable to the entire world.

4.2.5. Revenue generators

So far this section only has discussed general seaport pricing principles, thereby ignoring the question how ports practically earn their money, or put differently what share of total revenue is generated by which port users. The reason is the non-uniform approach of seaports. Therefore, this section elaborates on this topic by taking a number of exemplary ports. The decision to make use of the seaports that are described below is not because they ought to have some special characteristics, but is merely based on data availability. It is necessary to say that because of sometimes lacking information on certain income elements little deviations from reality might occur. However, since the percentages depicted below act merely as a rough indication of the ways in which ports generate their income, these small deviations are not insurmountable. The data that are used are subtracted from the most recent financial statements of the different ports. In most cases data is from the accounting year 2012. Moreover, the amounts in the tables are stated in their original currency, since the goal is not to compare the overall sizes of revenue but the relative revenue shares.

Before the first case is introduced, it is helpful to sketch the way in which charges flow in a seaport, that is operated by a landlord type of port authority. Therefore, figure 3 – which describes the charge flows for the port of Cartagena – is depicted below. Important to remember is that the case details do not matter since the situation in each and every port is different. However, by understanding how financial flows move between users, it may help to more clearly interpret the insights that the cases below give.
Obviously, the outbound flows from the port authority to other users reflect the port charges. Generally, charges to shipping lines and private operators are common in most ports. This does not hold always for direct port authority charges to shippers. Furthermore, in the case below it is seen that private operators not only pass on costs to shipping lines – which is very common in most ports – but also pass on costs to

shippers directly. This situation is not prevalent in all ports. Moreover, in the port of Cartagena it can be seen that pilotage and tugboat services are not in the hands of the port authority. There are also ports in the world that – although they are to some extent privatized – perform these activities themselves though. Finally, shipping lines that pass on port charges incurred by port authorities, private operators and eventually other providers (performing tugboat services and pilotage) is standard in the majority of seaports around the world. Finally, it is important to note that port authorities generate revenue not only by means of charges, but also by means of leases to tenants. This way of generating revenue is not considered in the figure below, but sometimes contributes a substantial amount to total revenues generated by port authorities. Evidence for this fact is given in the section that is following. (The Worldbank, 2007b)

1: Wharfage	6: Empties storage	11: Yard handling
2: Cargo wharfage	7: Stuffing / Destuffing	12: Ship stevedore
3: Yard wharfage	8: Transshipment wharfage	13: Terminal handling + all port charges
4: Berth wharfage	9: Cargo wharfage / empties	14: Pilot / Tug
5: Cranage	10: Dockage	15: Other services
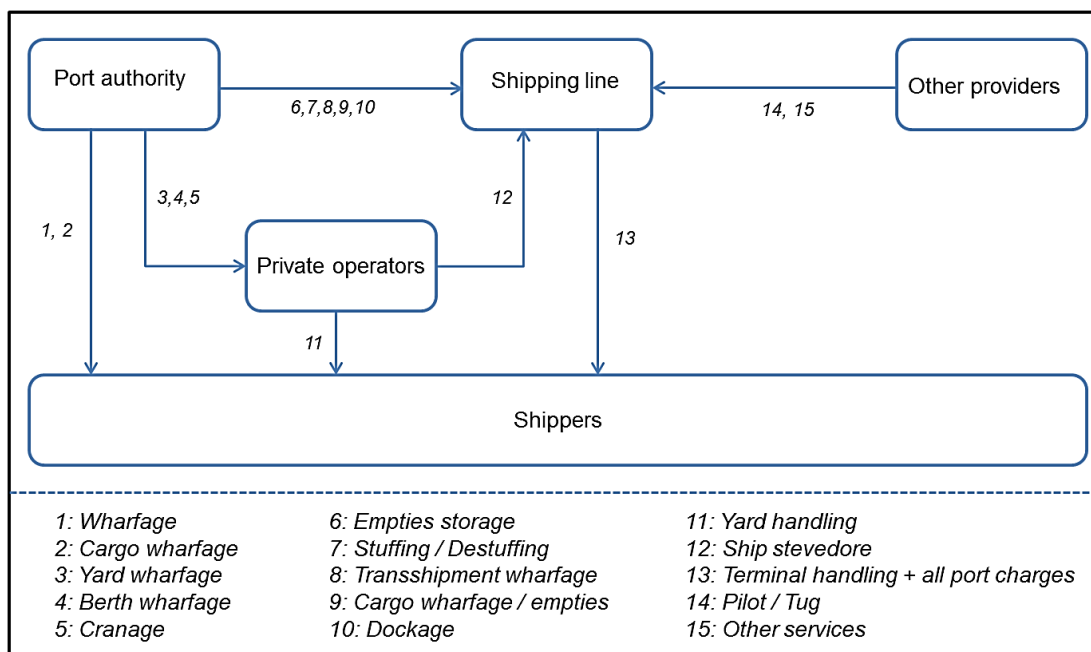
Figure 3 – Port charge flows in the seaport of Cartagena, Colombia
Source: based on The Worldbank, 2007b

South Africa

This part starts with the case of South Africa. The port authority of all South African ports, called Transnet National Ports Authority (TNPA) sets for several years for all ports – which are characterized by the landlord model – a tariff structure. The services provided by TNPA are basic port infrastructure as wells port services. In contrast to many ports around the world, TNPA has full responsibility for the entire port infrastructure. There is no government support. The current pricing structure is considered to be inappropriate – there is no clear reasoning and economic rationale behind the structure – and therefore TNPA has come up with a new tariff structure proposal. Preceding this proposal extensive research and stakeholder consultation has been conducted. Stakeholders that were involved are shippers, shipping lines, terminal operating companies, governments and the ports regulatory body. It is believed that this

charging structure will lead to more efficiency and economic growth. (Transnet National Ports Authority, 2012)

There are a few key principles in the tariff proposal. Important to note in the light of the previous part of this section is that the aim is full cost recovery. Investment costs, maintenance costs as well as operational costs should be recovered. The required income to cover all costs is not calculated on an aggregate level, but each product or service should recover its own costs. Also the user pays principle is important. Users of a specific port service or facility should pay the port for this service. However there are a few exceptions to this principle. First, the cost allocation is not always on a one-to-one basis. For example, the costs of nautical infrastructure is not completely charged to shipping lines. Competitive forces have to be taken into consideration. Since there is no government funding for basic (nautical) infrastructure of South-African ports, it is proposed that shippers partly have to bear this cost burden. The rationale behind this is that because shippers in South-Africa do not pay for basic infrastructure by means of government taxes, they have to pay it now directly to the ports. Second, terminal operators bear a larger cost burden than the user pays principle would require. The relative share is based on the rent terminal operators are expected to earn in a given time period. The last principle of the proposed tariff structure is that tariffs are set in such a way that fair competition with competing ports is assured. An example of this is the relative smaller cost burden for shipping lines, as described above. For each tariff that is set by a port authority, terminal operating companies should contribute 33% (lease revenues), shippers should contribute 46% (cargo dues) and shipping lines should contribute the remaining 21% (port dues) of the costs (see figure 4). By using this allocation the aim is to avoid price discrimination and cross-subsidization. (Transnet National Ports Authority, 2012)
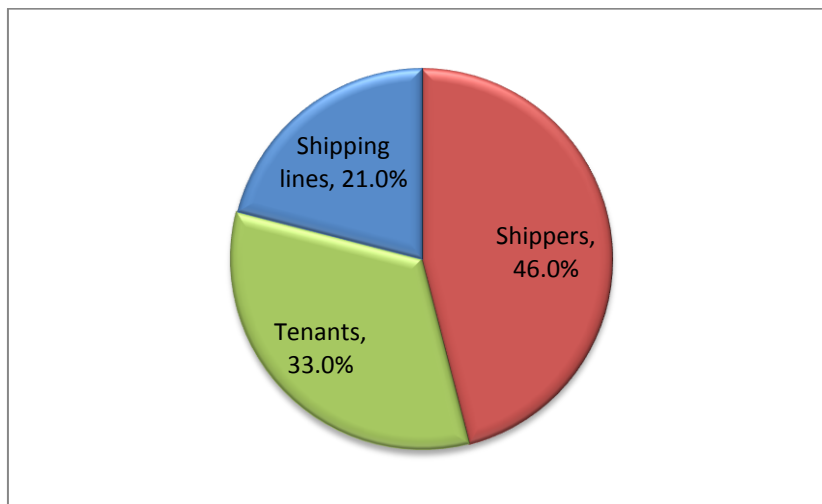
Figure 4 – Revenue generators South-Africa
Source: based on Transnet National Ports Authority, 2012

The division that is made by the South African port authority – that is revenue generation not based on the type of activities but based on the port users – is followed in the other cases in order to be able to make a reliable comparison.

Rotterdam

In contrast to the South African proposal where relatively the largest share of total revenue is generated by charging shippers, the Rotterdam port authority – which operates the port under a landlord model – does not levy shippers at all. The revenue in Rotterdam is generated by charging three types of port users. The first user group consist of tenants that are charged by means of rent, ground lease and quay fees. The second group is composed of shipping lines that pay the general port dues. The last group comprises barge operators that are charged inland port dues. The revenue generated by the latter group is limited though. Allocating the income statement item 'other operating income' to the appropriate user group is important for determining the appropriate share that is contributed by respective users in the total revenue. In the annual report it is stated that the vast majority of revenues that are aggregated in this term are contributions to traffic guidance system services. This type of service is in the South African proposal labelled as a maritime service and hence part of port dues. For this reason, the item other operating income is assigned to income generated by shipping lines. (Port of Rotterdam, 2013)

Table 2 – Income amounts generated by ports users in Rotterdam

Revenue generators	Amounts in €
Shipping lines	309,841,000
Tenants	291,744,000
Barge operators	13,745,000
Total	615,330,000

Source: based on Port of Rotterdam, 2013
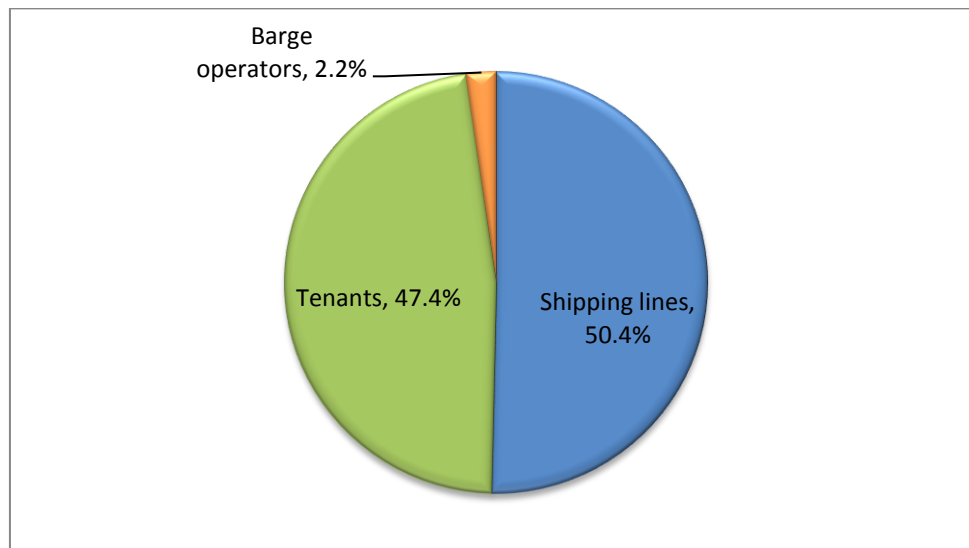
Figure 5 – Revenue generators Rotterdam
Source: based on Port of Rotterdam, 2013

Amsterdam

The second Dutch landlord seaport that is taken into consideration is the port of Amsterdam. Also the port authority of Amsterdam does not charge shippers directly. In large terms the way of generating money is comparable to the port of Rotterdam. To be more precise, the port authority of Amsterdam generates revenue in three ways. The first group are tenants that are charged the regular rents, leases and quay fees. The next group consists of shipping lines. Besides the regular seaport dues, this group also pays environmental taxes. In exchange for a mandatory fee – the environmental tax – shipping lines are able to get rid of their waste. The third group is composed of barge operators paying inland port charges, like in Rotterdam. In the income statement it is stated that public funds are made available for maintenance and repair of public roads within the port area. Since this income is not generated by one of the port users, this item is ignored. Finally, the item other income in the profit and loss account is not further specified. Hence, these costs cannot be assigned to the appropriate group of users and therefore we omit the item in the analysis. (Port of Amsterdam, 2013; van Oosten, 2012)

Table 3 – Income amounts generated by ports users in Amsterdam

Revenue generators	Amounts in €
Shipping lines	51,639,599
Tenants	66,049,464
Barge operators	5,496,960
Total	123,186,023

Source: based on Port of Amsterdam, 2013
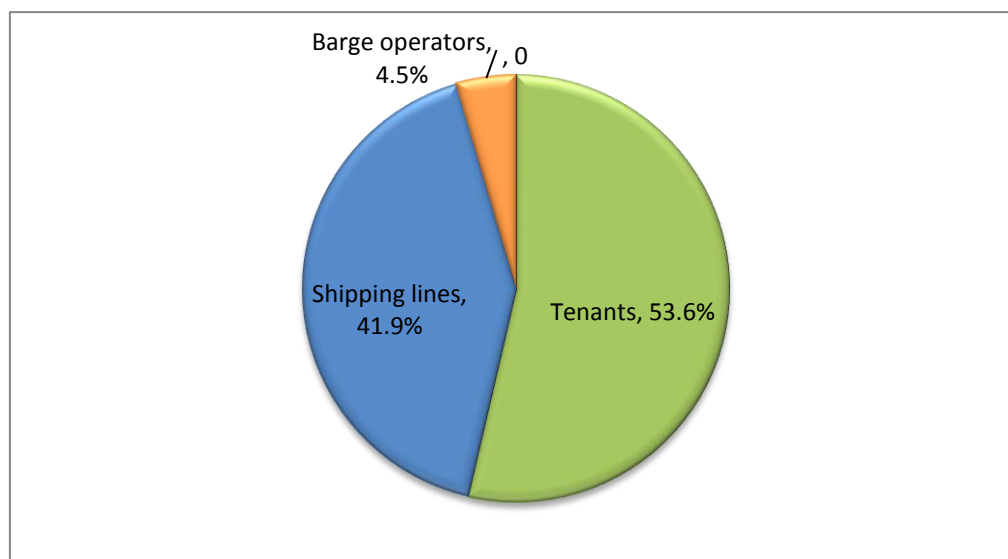
Figure 6 – Revenue generators Amsterdam
Source: based on Port of Amsterdam, 2013

Melbourne

The Australian port of Melbourne – which its characterized as a landlord port - generates, in contrast to the two above discussed Dutch ports, relatively the largest share of its revenue by means of wharfage fees. Wharfage fees are comparable to the cargo dues of the South African proposal. These wharfage fees are paid by shippers. (Port management Act 1995, 2010) The second way in which the port authority of Melbourne generates money is by means of channel fees. Shipping lines have to pay these fees in order to reach the port of Melbourne. Finally, money is generated by means of lease agreements with tenants. Like in the other cases, the income statement of the annual report 2011/2012 describes the item other operating income. The costs that belong to this item have emerged from a transfer of a hinterland rail connection from the government to the port authority. Since these results are incidental, the costs are ignored in the analysis. (Port of Melbourne, 2012; Port of Melbourne, 2013)

Table 4 – Income amounts generated by ports users in Melbourne

Revenue generators	Amounts in AU $
Shipping lines	30,900,000
Tenants	45,200,000
Shippers	171,800,000
Total	247,900,000

Source: based on Port of Melbourne, 2012
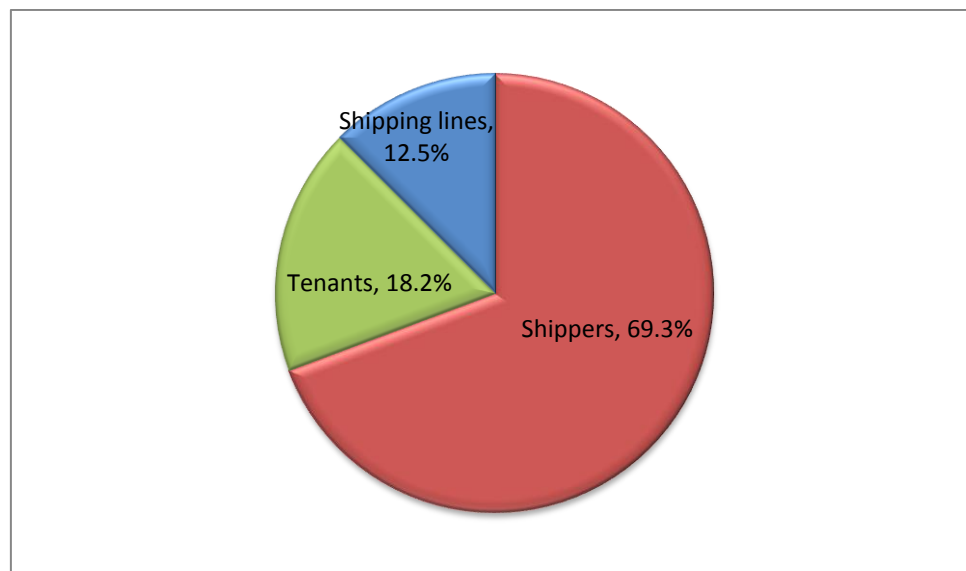
Figure 7 – Revenue generators Melbourne
Source: based on Port of Melbourne, 2012

Vancouver

The landlord port authority of the port of Vancouver, called Port Metro Vancouver, generates part of its revenue by means of leases that are paid by tenants. Also the item utilities in the income statement is allocated to tenants. Furthermore, shipping lines pay the port authority harbour dues, cruise dues and berthage dues. Besides these charges, container shipping lines contribute for wharfage and gateway improvement dues that are charged on containerized cargo. Moreover, shippers that transport non-containerized cargo are levied for their usage also by means of wharfage and a gateway improvement fee. In other words, wharfage and the gateway improvement fee are levied to different users on the basis of the type of cargo involved. In order to assign the right proportion of costs to the right users, the share of containerized cargo in 2012 is calculated on the basis of its contribution in total tonnage, which is 19%. Finally, the item other revenues that is described in the income statement of the annual report 2012 is not further specified and is therefore, like in the above described cases, omitted. (Port Metro Vancouver, 2012; Port Metro Vancouver, 2013; Port Metro Vancouver, 2013)

Table 5 – Income amounts generated by ports users in Vancouver

Revenue generators	Amounts in CAD $
Shipping lines	31,893,712
Tenants	120,789,219
Shippers	29,670,100
Total	182,353,031

Source: based on Port Metro Vancouver, 2013
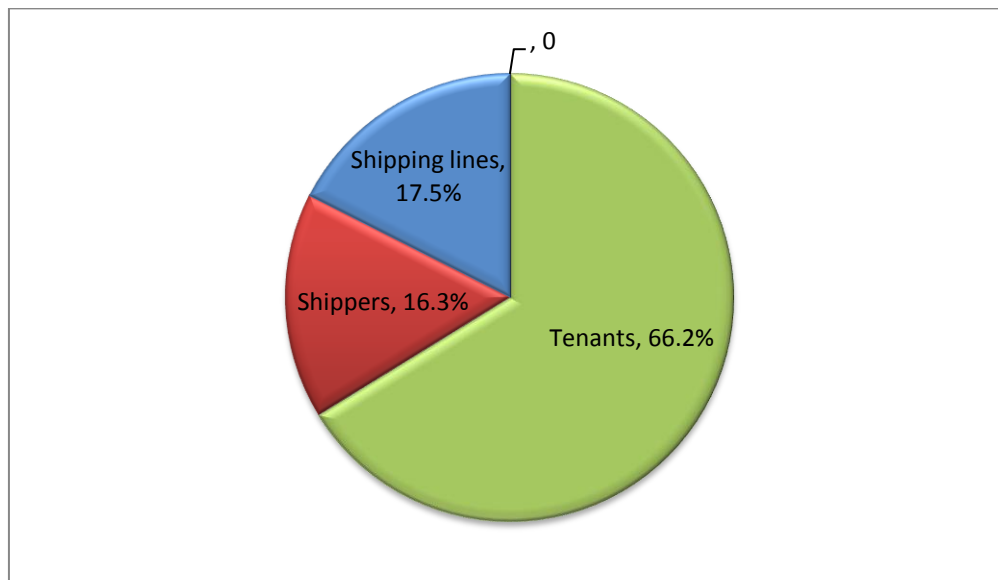
Figure 8 – Revenue generators Vancouver
Source: based on Port Metro Vancouver, 2013

<u>Singapore</u>

The last case that is discussed in this part is the port of Singapore, one of the largest ports in the world. The port authority of Singapore, called the Maritime and Port authority of Singapore (MPA) runs the port according a landlord model. It has stated five items on its operating revenue account, namely port dues and marine services, shipping services, rental income, training and miscellaneous revenue. The vast majority of all revenues are generated by charging shipping lines. This group pays the port dues and marine services and shipping services. Secondly, rental incomes are generated by charging tenants. The item training is are revenues arising from the maritime master programmes that are offered by the port authority. However, due to the limited amount this item is ignored in the analysis. This also holds for the revenue item called miscellaneous revenue. No additional information is available about this item. (MPA, 2013; The Worldbank, 2007a)

Table 6 – Income amounts generated by ports users in Singapore

Revenue generators	Amounts in S$
Shipping lines	269,141,776
Tenants	3,788,299
Total	272,930,075

Source: based on MPA, 2013
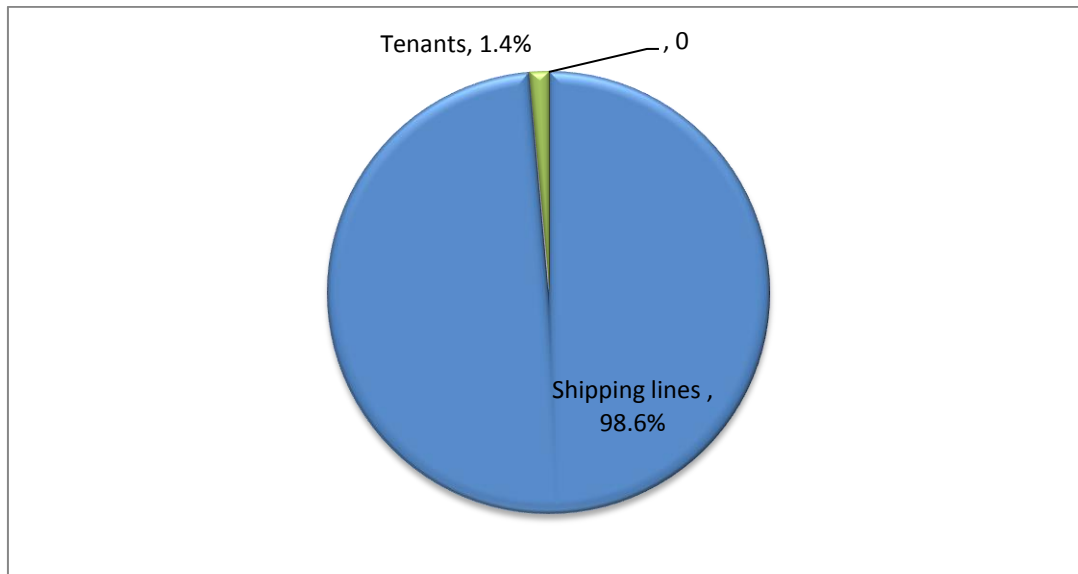
Figure 9 – Revenue generators Singapore
Source: based on MPA, 2013

In table 6, an overview is given of all the different ways in which ports generate revenue. The conclusion is that there is no uniformity between ports in the way revenues are (or should be) earned. Shipping lines and tenants are the ones that are always charged by port authorities, however even for these users the contribution in the total revenue varies considerably. For example, in Singapore shipping lines generate more than 98% of the total revenue, whereas in Vancouver the amount generated is only 18%. The contributions of tenants in the total port revenue also differs significantly per port. In Vancouver this group of port users accounts for 66% of the total revenue generated. In contrast, tenants in Singapore are accountable for a meagre 1,4% of total revenue. Moreover, in the ports where shippers contribute in port revenues they generate a rather large share of total revenues. Illustratively, in Melbourne almost 70% of the revenues is generated by shippers. Finally, the Dutch ports in our sample earn money by levying barge operators when calling in the port. The revenues stemming from these port users is rather limited though.
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Table 7 – Income amounts generated by ports users

% of revenue generated	South-Africa	Rotter-dam	Amster-dam	Mel-bourne	Van-couver	Singa-pore
Shipping lines	21,0%	50,4%	41,9%	12,5%	17,5%	98,6%
Tenants	33,0%	47,4%	53,6%	18,2%	66,2%	1,4%
Shippers	46,0%			69,3%	16,3%	
Barge operators		2,2%	4,5%			

Source: author

4.2.6. The uniqueness of seaport pricing

The above findings are regarded as unique in the infrastructure pricing setting. The first characteristic that makes seaport pricing unique is the number of users that can be charged. In a random sample of six ports there are already four users that can be charged a share of the costs. The second characteristic that makes the seaport pricing unique is the non-uniform approach towards pricing as well as the non-uniform way of levying port users.

The uniqueness which is advocated above can be illustrated and underlined by means of considering other infrastructure pricing issues. This is done by means of the airport case which plays a central role in the next section. Airports can only charge two users of the infrastructure, airliners – making use example use of the runways, terminals and security services of an airport – and passengers – making use of use of parking space, shops and terminals. (Schiphol Group, 2013) Moreover, the rationales behind airport pricing are extensively discussed in the literature and for most airports – especially of the same size – comparable. To be more precise, much attention in the literature is devoted on how airports can best charge their aeronautical and non-aeronautical product in order to recover costs. The specifics of the airport situation will be elaborated in the next section.

Another infrastructure case that can underline the uniqueness of seaport pricing is the pricing of roads. The 'owner' of a road has only two options, either making the road a collective good or making it a private good. When the owner chooses to make the road a collective good, users of the road are charged indirectly by means of taxes that are equal to marginal costs. In contrast, when the owner chooses to make the road a private good, users pay directly for the usage of the good. Value-based pricing and congestion charging are more prevalent in these cases. Important to note is that the road 'owner' can only charge one user of the infrastructure, namely the car driver. The only choice the price setter has is to charge everyone indirectly or a specific group directly. The approach to this type of issues is uniform. (Johansson and Mattsson, 1995; Button, 2010)

Against this background the consideration of the applicability of the two-sided market theory on seaports is an attempt to create order out of the port pricing chaos

4.3. Results research question three

The third research question is: To what extent is the theory of two sided markets applicable to seaports?

In this section the two-sided market theory is introduced. In order to do this, first the two theories underlying the two-sided market theory – network industries theory and multiproduct pricing theory – are briefly discussed. This is beneficial in order to get a better understanding of the technical aspects of the two-sided market theory. Subsequently, the main features and assumptions of the theory itself are elaborated. Once this is done the literature that has applied the theory to airports is extensively discussed. Based on both parts, the applicability of the theory to seaports is analysed.

4.3.1. The two theories underlying the theory of two-sided markets

The first underlying theory that is discussed is network industries theory. The basic idea of this theory is that when the number of users of a certain product increase, the utility to all of its users will increase as well. In other words, besides the utility that a user derives from its use of the product there is an indirect effect to other users of the same product, so-called network externalities. Important to note is that the scope of a network in the network in this theory is not clear-cut. In some cases a network constitute of customers of a single firm. In other cases networks are broader and include the customers of an entire product group or a subset of a product group. The key determinant for the scope of a network is the product compatibility. (Katz and Shapiro, 1985)

Under the network industries theory it is assumed that buyers base their buying decision on the expected future size of the network from which they derive externality benefits. As a general rule it can be stated that firms, operating in markets with network externalities, set prices that match the expectations of potential buyers with respect to the expected future size of the market. Subsequently, when price levels are determined customers make their buying decision based on the trade-off between price versus expected benefits of product use as well as network effects. Yet, in this initial phase often reductions are given to early adopters or lead users in order to compensate for the uncertainty with respect to the future development of network effects. At a later stage, where there is an existing network size, the price has to be set at such a level that a marginal buyer is willing to join the network. (Candogan et al., 2012; Katz and Shapiro, 1985)

The second underpinning of the theory of two-sided markets is the multiproduct pricing theory. In the multiproduct pricing theory firms are central that produce a number of products that have – in varying degrees – relationships with each other. This means that when quantity of products sold changes, it does not merely have an influence on the revenue generated for that one product, it also influences the revenues generated by the other product. This condition is key for the applicability of the theory. If firms sell products that are virtually unrelated, single product pricing is the right concept. In contrast, if products are related, the way in which these products are related is very important for pricing decisions of the multi-product firm. Two or more products can be

either characterized as substitutes or complements. The nature of the relationship between products can be measured by the concept of cross-elasticity, as is discussed in the first section of this thesis. In case of two complementary goods, the prices are negatively correlated. So, when the price of one of the products is relatively high, the price of the other product has to be relatively low. By being able to change prices of single products – by allocating the overall costs differently between the two products – tailor made offerings can be made to specific groups of customers leading to higher revenues. This possibility only holds when products are not perfect complements. To illustrate this fact, consider the example of a monopoly producer of razors and razor blades. The price allocation between razors and razor blades is irrelevant, since at the moment of buying the razor consumers already anticipate on buying the razor blades and hence internalize the price to be paid.

Changing cost allocations is also impossible when products are substitutes. If one of the substitute goods is sold at a discount and this is 'compensated' by higher costs for another substitute, than it turns out that only the cross-subsidized good is being sold leading to major losses. In other words, when goods are substitutable the best way is to set prices individually, taking into consideration price elasticity of demand for determining the mark-up over marginal costs. (Shelegia, 2012; Wilson, 1993; Rochet and Tirole, 2003; Wilkinson, 2005)

The multiproduct pricing theory has some linkages with Ramsey pricing, which has been introduced in the first section. Ramsey pricing can be considered to be the most optimal form of multiproduct pricing since it aims to price as close as possible to marginal costs. In the Ramsey pricing case, cross-elasticity values are used to determine the minimum, relative mark-up over marginal costs. In addition, peak load pricing can be considered as a form of multiproduct pricing. During the peaks a high price is charged, whereas during off-peak times low prices are charged. Although peak load pricing deals with a single product that is priced, it can be seen as two product; one product with a high demand and a high price and one product with low demand and a lower price. The same way of reasoning holds for two part tariff pricing. The fixed part or club fee, can be seen as one product and the variable marginal cost part can be seen as one product under the multiproduct pricing theory. Finally, the multiproduct pricing theory makes also use of price discrimination practices in setting price levels for complementary goods.

As is already touched upon, the two-sided market forms a combination of both previously described theories. There is a good reason for doing this. As Rochet and Tirole (2003) argue, network industries theory merely has a one-sided focus and does not consider allocation of costs over multiple products. In contrast, the multiproduct theory does take cost allocation into consideration, but ignores network effects and externalities.

4.3.2. The principles of the two-sided market theory

A great deal of attention in two-sided market literature is paid to the chicken-and-egg problem. This means that both sides of the platform are dependent on each other. Moreover, the value to a user on one side of the network is dependent on the number of users on the other side of the network. In more technical terms, the value for a user on one side of the platform increases as a result of network externalities on the other side

of the platform. For example, when the number of users on one side of the platform is limited and the users on the other side of the platform are very keen on the number of users on the opposite site, the platform is in trouble. This example clearly shows the combination of indirect network externalities and multi-sidedness, the two core concepts of the theory. (Rochet and Tirole, 2003; Evans and Schmalensee, 2005)

In order to exploit the combination of network externalities and multi-sidedness a critical mass should be attracted on one side of the platform, thereby creating attractiveness on the other side. This situation can be realized by setting appropriate prices in both markets. In order to be able to set appropriate prices in two-sided markets, a number of factors have to be considered, which are introduced below.

The first factors that require reflection are two well-known elements in general pricing literature, namely that of marginal costs and price elasticity in both markets surrounding the platform. Reflecting on the price elasticity simply expresses the ability of a platform to raise prices above marginal costs. Price elasticity is greatly influenced by the market structure of markets surrounding the platform. When players in one market are linked to more than one platform, they are considered to be multi-homing. In contrast, when players in a linked market are only using one platform they are single-homing. Obviously, users that multi-home show higher price elasticity's. (Rochet and Tirole, 2003, 2006; Evans and Schmalensee, 2005) Appold and Kasarda (2011) argue that in cases in which the theory of two-sided markets is applied to infrastructure projects, single-homing is more common due to geographical aspects and high switching costs
Secondly, also cross-group externalities that evidence indirect network effects have to be taken into consideration. By considering cross-group externalities a price setter is able to identify which side of the market is benefitting relatively more from a larger network of users on the other side of the platform. In other words, cross-group externalities mean that lowest prices must be offered to the ones which have, relatively, the largest positive externalities on members of the opposite market. (Rochet and Tirole, 2003, 2006)
To give an illustrative example of the above factors, in the specific combination of one market with single-homers and the other market with multi-homers, the side that is characterized by multi-homing is levied the highest price since access to these users can be offered exclusively. Meanwhile, the single-homing users are cross-subsidized. This allows the single-homing side of the market to grow, which in turn, results in an even more attractive proposition for the other side of the platform. (Rochet and Tirole, 2003, 2006)

There exist four distinctive types of two-sided markets. The first type of two-sided markets are advertising supported media markets. Free newspapers are a famous example of such a two-sided market type. In order to attract a critical mass on the readers site, the paper is freely available. Costs arising from creating and printing the papers are borne by advertisers. This side of the market, in turn, is pleased with access to a large public of readers. (Rochet and Tirole, 2003; Evans and Schmalensee, 2005)
Secondly, transaction systems are considered as two-sided markets. Large credit card companies are an example of this type. In most cases, credit card companies charge merchants, while users can make use of the credit card for almost nothing (at least for using the credit card for payments). (Evans and Schmalensee, 2005)

The third type of two-sided markets are software platforms. Software platforms are surrounded by program developers and software users. Users can only benefit from the applications of the program developers if they have access to the software platform. Typical examples are mobile operating systems and desktop operating systems. Users in the software platforms often bear the cost burden of the platform. Developers are often granted free access. This example clearly shows that it is not always the case that corporate type of users of a platform pay the larger share of the costs. (Evans and Schmalensee, 2005)

The last type of two-sided markets are exchanges. Exchanges are places that provide a platform on which buyers and sellers can do business and negotiate their way to best prices. The more participants there are in markets, the bigger the chance of finding a match. However, this relation is not unlimitedly positive. At a certain point congestion comes into the picture. This type of two-sided market is closest related to seaports. (Evans and Schmalensee, 2005)

4.3.3. Assumptions of the two-sided market theory

Obviously, based on these empirical rules of thumb no generalizations or conclusions can be drawn. In order to make reliable statements a more thorough analysis has to be performed. The first step in this process is to introduce the assumptions of the theory. These assumptions are used later in this section for testing applicability of the two-sided market theory on various cases.

1. The first assumption is that the main benefits of the two distinct markets arise from interacting via a common platform (Rochet and Tirole, 2003). A common feature of platforms is that they are able to minimize transaction costs and provide a platform that offers interaction as service. As a result, the existence of a platform is justified by transaction cost minimization as its value offering. (Evans and Schmalensee, 2005)

2. The second assumption is that when the two markets linked to the platform interact with each other, complementarities arise from interplay. This means that both markets gain from each other's presence and interaction. In fact, the larger the size of the networks on both sides of the platform the larger the gains of presence and interaction. Yet, the positive externalities arising from the interaction – that are, in turn, a result of the complementarities between the markets – are not internalized by users. So, a potential user of a platform does in its decision to make use of the platform not consider the positive externalities that are caused on the other users of the platform. This stands in contrast to the razor blade example in the previous section. In this multiproduct pricing example, when deciding to buy the razor the benefits of buying the razor blades are already internalized, since buying the blades is anticipated. (Rochet and Tirole, 2003, 2006)

3. The third assumption is that the attractiveness of the platform, expressed in total number of interactions, depends not only on the overall price charged by the platform, but also on distribution between both sides. (Rochet and Tirole, 2003, 2006) A key condition for this to work is that users of the platform are unable to bypass the pricing structure. (Evans and Schmalensee, 2005) In other words, Coase theorem – which states that under certain conditions users are able to efficiently allocate externality costs irrelevant of the initial allocation – is not

applicable. (Rochet and Tirole, 2006) There are some reasons that prevent the possibility for platform operators to cross-subsidize between the two markets. The first reason is that both sides align their purchases. The second reason is that of neutrality. This means that any changes in the distribution of charges between both sides of the platform will ultimately be passed on to the end-user. Therefore in this case a price reallocation does not have any influence on the economic performance. (Rochet and Tirole, 2003) Yet, there are some intervening factors that limit neutrality. For example, in many industries there exist transaction costs resulting from intermediaries, that increase the costs of redistribution and therefore limits neutrality. Finally, also platforms can impose constraints on passing through charges (Rochet and Tirole, 2003).

4.3.4. Airports as two-sided markets

Like is stated in the literature review, although there has been some research that applies the two-sided market theory to airports, there is no consensus to the question whether the assumptions of the theory allow to do so.

4.3.5. Advocates of airports as two-sided markets

Gillen (2011), Appold and Kasarda (2011) and Ivaldi et al. (2001) have recently argued in favour of an airport as being a two-sided market. Besides the traditional revenue streams from airlines, airports are increasingly aware of the earnings that can be generated from passengers without involvement of airlines. In this respect, Amsterdam Schiphol airport is a good example. 70% of the operating income of Schiphol airport is consists of non-aviation revenues. Besides the traditional non-aviation revenue streams such as parking and retail related revenues, Schiphol airport has developed conference rooms, offices and touristic zones at and around the airport. (Appold and Kasarda, 2011)

It is argued that as a result of revenue generation from two markets – the airliners and the shopping passengers – airports are basically a platform operating in a two-sided market. Airports bring together passengers and airlines and internalize the network effects of both markets. By this it is meant that airlines benefit from a large group of passengers, whereas passengers benefit from a large network of destinations and frequent flights.

According to Gillen (2011) airports should adopt a two-sided market view and reconsider the pricing structure of airports. Airports should no longer solely focus on cost-based pricing, but make price choices also subject to cross group network externalities and price elasticity's of demand. Moreover, the value participants place on participating in the market is becoming important. It might happen that for some users prices should be charged below marginal costs because this type of user provides larger benefits for other users of the platform. (Ivaldi et al., 2011; Gillen, 2011; Appold and Kasarda, 2011) Practically, most airports choose to treat the airline side of the platform as loss-leader by lowering for example landing fees. By doing this, airports hope to attract more carriers, leading to a larger network of destinations and more frequent flights, which, in turn, attract more passengers. The revenues that are lost on the airline side are borne by, for example, additional parking and shopping revenues. (Ivaldi et al., 2011; Gillen, 2011; Appold and Kasarda, 2011)

Airports are also being tested on their two-sidedness characteristic. Ivaldi et al. (2011) have developed a structural model and have empirically tested this model with data on US airports for the 3rd quarter of 2006. In the model, the platform is assumed to be a profit-maximizing monopoly airport. The authors argue that empirical evidence of two-sidedness is found. A number of arguments are underlying this statement. The first argument is that the quality of airport facilities do matter to customers. This can be derived from significant changes in demand by varying the quality of these facilities. The same is true for the aeronautical product of an airport, expressed by the number of destinations and frequency. Yet, the positive relation between passenger demand and the quality of the aeronautical product is not unlimited. At a certain point, congestion comes into the picture reducing passenger demand for flights. (Ivaldi et al., 2011)

As a consequence of the above, it is argued that by changing fees charged to airliners, airliner demand for the platform changes as well as passenger demand for the platform. Likewise, changing concession fees for shops would change passenger demand for the airport platform as well as demand of airliners arising from less network effects. In addition, in most of the airports investigated cross-subsidization takes place by taking into consideration the respective elasticity's, shown by a positive margin on one side of the network and, simultaneously, a negative margin on the other side of the network. This finding corresponds to the third assumption of the two-sided market theory, as described above. (Ivaldi et al., 2011)
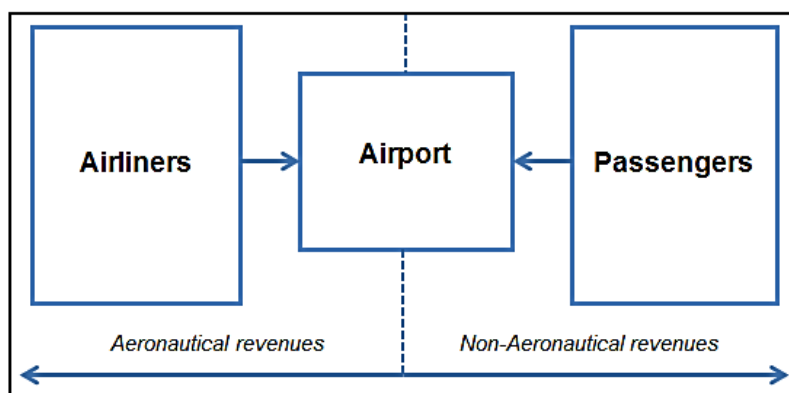
Figure 10 – Airports seen as two-sided markets
Source: Author

4.3.6. Opponents of airports as two-sided markets

Fröhlich (2010) is the main opponent of airports as being two-sided markets. He does not have merely critical notes on certain assumptions of the theory, but questions whether the theory can be applied at all to airports.
Fröhlich (2010) argues that it is not the theory of two-sided markets that applies, but it is the multi-product theory. In order to justify this claim Fröhlich (2010) uses more or less

the three assumptions that have been introduced previously in this section. Therefore we analyse the insights of Fröhlich (2010) on the basis of these assumptions.

The first assumption on which the two-sided market theory is based states that a platform provides both markets the ability of coming together and of interaction. According to Fröhlich (2010), airports do not fit this definition. The vast majority of tickets, which evidences the existence of a relation between airliner and passenger, are sold before a passenger actually arrives at the airport. As a result, airports are circumvented when passengers are deciding to buy a ticket. Due to this fact, it is argued that airports are nothing more than an input factor for airlines. Nothing in an airports function relates to internalizing externalities or lowering transactional costs when both markets interact. (Fröhlich, 2010) In sum, airports do not comply with the first assumption.

The second assumption of the two-sided market theory states that the cross-group externalities that arise from interplay via the platform are not internalized by users. Fröhlich (2010) states that the relationship between airliners, airports and (shopping) passengers is purely vertical. Hence, one cannot speak of cross-group externalities. The externalities that arise from mutual (vertical) dependence of airliners, airports and passengers are in fact vertical externalities. Vertical externalities can be best described by the effects on other stages as a result of product decisions a single firm makes. Results are similar to results arising from cross-externalities though. An example of these vertical externalities is that if airliners decide to increase the number and frequencies of destinations to be served from a certain airport, it will lead to advantages not only for the airliners themselves, but also for airports. This is the case since a larger number of passengers will be attracted and more flight-related airport activities will take place. The decision of an airliner to improve its service already internalizes the effects it has on the other side of the market, by means of a higher expected number of passengers. As a result of this consideration, airport operating companies are multiproduct companies, selling complementary products (both the passenger transfer function as well as shopping space) to different groups of airport users. In sum, also the second assumption underlying the two-sided market theory is not satisfied by airports, according to Fröhlich (2010).

The third assumption states that two markets surrounding a platform are considered as two-sided if the volume of transactions increase as a result of shifting prices between the two markets while maintaining the same overall price level. Although, changing the price structure of the complementary products might be beneficial, Fröhlich (2010) argues that airports do not fit this definition. The rationale behind this is that in context of the two-sided market theory benefits arising from different price allocations stem from taking into consideration cross-group externalities. However, in the airport case these effects occur due to favourable income effects in the context of a multiproduct firm. By lowering the price of one the complementary products, proportionally more might be spend on the other complementary products. In order to make a correct price change, economies of scope, cross-price elasticity's as well as price elasticity's of both products should be taken into consideration in order to determine the precise values. Accordingly, in general it can be stated that since lowering charges for airliners has a larger positive effect on shopping revenues than the other way around, the price levels for airliners should be relatively lower than the price levels for shopping. This example shows that even though airports are not two-sided markets, the effect on pricing is very similar. (Fröhlich, 2010)
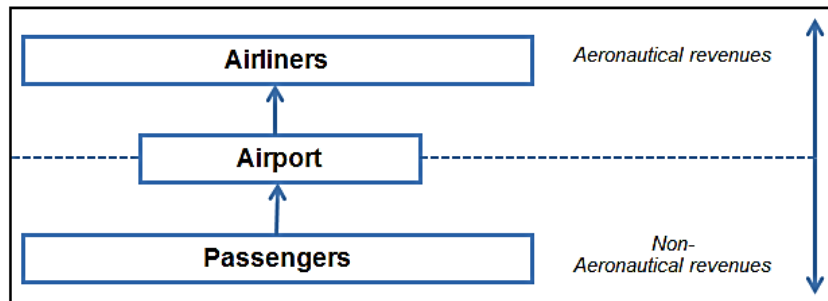
Figure 11 – Airports seen as an input factor in vertical markets
Source: Author

4.3.7. Conclusion of the airport case

In order to determine whether the airport case can be seen as a two-sided market we take both viewpoints in consideration and test the case characteristics on the basis of the three underlying assumptions of the theory.

The first assumption is that the platform provides interaction as service and is able to minimize transaction costs. Passengers that decide to buy a ticket do not have to make use of the airport platform in order to deal with airliners. Hence, airports do not minimize transaction costs. Airports are a mere input factor for shopping passengers. Important to note is that this assumption merely deals with the commercial aspect. The physical impossibility of bypassing a port is not relevant.

The second assumption is that both markets gain from each other's presence and interaction. This effect is increasing when market sizes are getting bigger. However, the positive externalities resulting from interaction are not-internalized. Amongst others, Ivaldi et al. (2011), Gillen (2011) and Appold and Kasarda (2011) argue that airports internalize externalities and therefore prices between both markets must be set in order to take advantage of the network effects and price elasticity's. In contrast, Fröhlich (2010) argues that the relationship between airliners, airports and (shopping) passengers is purely vertical. Hence, cross-group externalities are out the question. The externalities that arise are vertical externalities and are internalized when the contributors of the vertical externalities make a decision. This way of reasoning is followed in this thesis. The argument for this is that the airport case differs from the two-sided market platforms types as introduced above. The main difference is that airport platforms are part of a vertically related supply chain in which the way of conducting business is primarily one-way, namely downstream. In contrast, in typical two-sided markets the interactions via the platform are more two-way or horizontal. As a result, the second assumption underlying the two-sided market theory is not satisfied.

The third assumption is that the attractiveness of the platform, expressed in platform profit and total number of interactions, depends not on the overall price charged by the platform, but also on distribution between both sides. Important is that users cannot

bypass the pricing structure. Ivaldi et al. (2011) have found evidence that by changing the price distribution between both markets the overall number of interactions change. In their paper, these effects are attributed to cross-group externalities. In contrast, Fröhlich (2010) claims that changing the price allocation between the two markets can be beneficial, not because of taking advantage of cross group network externalities, but because of more beneficial income effects in a vertically related market. Since we have determined that the externality effects that occurs are a result of the vertical dependence of airport users, it is logical to follow the reasoning of Fröhlich (2010). Because the airport operating companies operate in markets that are characterized by vertical relations, changing the price allocation might be beneficial for ports by taking into consideration the insights of the multiproduct pricing theory. The emphasize is on might. The reason for this is that the multiproduct theory prescribes that allocating costs over different products is only beneficial when products are complements. This does however not hold for perfect complements. Changing cost allocations in this case is irrelevant. An example of perfect complements is a monopoly multi-product firm that both sells razors and razor blades, as described previously. At the moment the razor is bought, the buying decision for the razor blade is already anticipated and therefore internalized. Hence, charging different prices for razors and razor blades is irrelevant. In the case of airport operating companies the reason that changing price allocations is beneficial is first because the aeronautical product is not a perfect complement to the non-aeronautical product. To illustrate this, shopping for passengers is not essential when flying and therefore both products are not perfect complements. Moreover, because the complementary services that are sold to passengers are not provided by the port itself, but are provided by firms that operate in competitive markets, changing cost allocations might be relevant by taking into consideration the competitive forces in these specific markets. In sum, also the third assumption of the theory is not satisfied. Consequently, all the three assumptions that are used to determine the applicability of the theory on airports are not satisfied and therefore the theory is not found to be applicable. As a final remark it can be stated that the empirical results of Ivaldi et al. (2010) are perfectly valid, but the reasoning behind the findings is wrong.

4.3.8. Seaports as two-sided markets

In this section the extent to which the theory of two-sided markets can be applied to seaports is tested. In order to do this, first the tempting view of a seaport as being a two-sided market is discussed. Subsequently, the market environment of seaports as well as the way in which business is conducted are discussed. Based on this description the two-sidedness of seaports is being tested, like in the airport example, on the basis of the three underlying assumptions of the theory. Where possible, parallels with the airport example are drawn in order to take advantage of the insights of that section.

The viewpoint of seaports as two-sided markets is introduced by Van den Berg and De Langen (2011). The view of a port as a platform is based on the view of Carbone and De Martino (2003). These scholars argue that the successfulness of a port is not affected by operational excellence, but arises from the seaports links with the supply chain in which they operate. According to Van den Berg and De Langen (2011), seaports are the platform and the markets surrounding the platform are the shipping

lines on the sea-side and the hinterland transport companies on the land-side. By increasing the land-side network – this is by attracting a larger share of shippers in the contestable hinterland of a port – network effects emerge. An example of this are fuller trains, which allow cheaper transportation as well as higher frequencies. The result is a higher quality of the 'land-side product'. This is not only beneficial to ports, but also to the shipping lines calling at the seaport. The larger the number of customers that can be reached at lows costs in the hinterland, the more attractive it is for shipping lines to call at a certain seaport. In turn, the more shipping lines that call at a seaport, the more attractive it is for shippers in the hinterland to make use of that particular port and hence, the higher the quality of the 'hinterland product'. It is assumed that by setting the appropriate prices in each market, seaports can take advantage of the existing cross-network externalities. (Van den Berg and De Langen, 2011)

4.3.9. Characteristics of the seaport environment

In order to test the three assumptions of the two-sided market theory it is important to analyse and assess the structure of the platform related markets, the roles played by the actors involved and the way in which business is conducted. Finally, also important to consider is the platform itself. In this paragraph the role of shippers is the central concept since shippers are the ones ultimately deriving value from the movements of goods and therefore also from the seaport platform.

The first consideration is the way in which business is conducted. It is worth mentioning that the buyer of the goods – the shipper in a consignee role – is the one who decides on transportation specifics. This means that in general the shipper is the one who is deciding which seaport is being used. After a buyer and seller have made a deal, a contract is drawn up. A few important points are specified in this contract besides the price of the deal, namely what ports will be used and the incoterms to be used, mostly either FOB or CIF. (Tongzon, 2009; Tarelli, 2009)

Although there exist a lot of contractual variations, it can be generally stated that under FOB terms the seller is responsible for the goods on their way from the sellers warehouse to the ship at the port of loading (as determined by the buyer). For this trip, the seller has to organize transport. All the costs that are incurred for this trip are paid by the seller of the goods. The buyer, in turn, arranges and pays for the remainder of the journey, including ocean transportation. Insurance is often paid by the buyer of the goods or the entire trip. (Tongzon, 2009; Tarelli, 2009)

In contrast, under CIF terms the seller arranges for ocean transportation as well as insurance for the goods. The CIF price entails all the costs that are incurred from the moment the goods leave the sellers warehouse up to the port of discharging, as appointed by the buyer of the goods. To be more precise, the buyer of the goods does pay for import duties and unloading of the vessel. (Tongzon, 2009; Tarell, 2009)
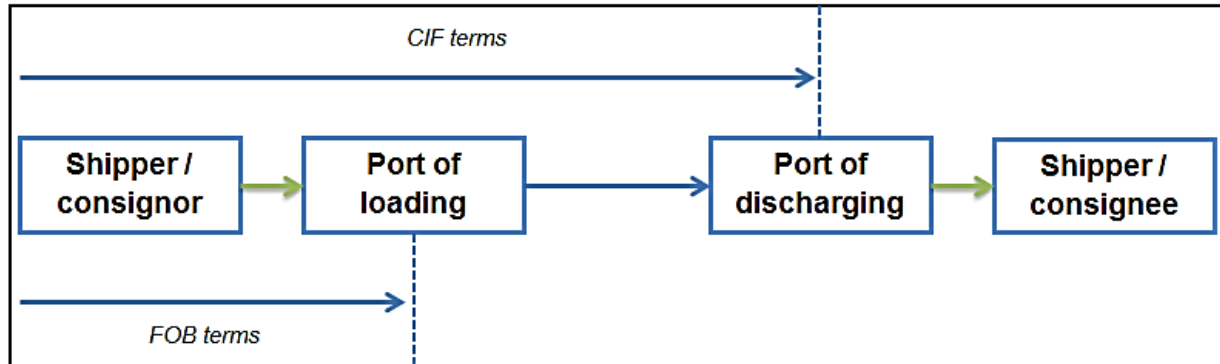
Figure 12 – Contractual terms used in international maritime transportation
Source: Author

According to Tongzon (2009) shippers can be divided in a number of groups, based on the way they are linked to the supply chain. The groups that are introduced below are loosely based on this subdivision. The groups are (ordered on the basis of the degree of integration): integrated shippers, shippers having contracts with shipping lines, shippers having contracts with freight forwarders and independent shippers. (Tongzon, 2009) The classification in these groups is not very useful for this section. However, because this research question also acts as input for the next section – for which this section is key – the different ways in which shippers are linked to the supply chain are already discussed below.

The first group of shippers perform all transport related activities themselves, the so-called integrated shippers. They charter their own vessels, have their own dedicated terminals and perform logistics activities such as warehousing and distribution. Examples of this type of shippers are oil companies such as Shell and automobile manufacturers such as Hyundai. (Bichou and Bell, 2007) In these cases there is no such thing as sea-based markets and land-based markets and therefore interaction by means of the platform is irrelevant. All activities are organised in-house and interaction between the different functions takes place within company borders. Important to note is that this is an exception since these practices occur only when companies have the scale to do so and the goods are not containerized. (Bichou and Bell, 2007)

Before introducing the next groups of shippers it is useful to give some information regarding outsourcing of logistics activities. As a start it is important to note that the majority of shippers have outsourced the transportation function to logistics service providers. To be more precise, it is found that 86% of the shippers in Europe have outsourced international transportation activities. Although this share is higher than the world average of 71%, it is obvious that outsourcing of transport activities by shippers is already ubiquitous. Furthermore, on a worldwide scale it is found that 65% of the shippers are considering to outsource – besides international transportation – more logistics functions. In the study it is concluded that the industry of logistics service providers is moving towards completely integrated one-stop-shops and demand by shippers for these services is increasing. In other words, the first group of shippers – the so-called integrated shippers – form currently a rare group and it is expected that they will become even rarer in the future. The outsourcing decision is based on a few

determinants. Amongst others, cost reductions can be a motivation to outsource transportation related activities. In addition, when it turns out that transportation activities are not directly related to core competences they can be better outsourced. (Langley, 2012)

As a result of this outsourcing trend, the traditional way of supply chain organisation has changed drastically, mainly due to vertical and horizontal integration of logistics markets. Traditionally, supply chains were characterized by a fragmentation, meaning that for each part of the supply chain a different actor performed the service. Below the novel way of organising supply chains is further elaborated. (Theofanis and Boile, 2009; Notteboom, 2004; Heaver et al., 2001)

The second group of shippers is characterized by their relationships with shipping lines for logistics services, often called carrier haulage. As long as there is an existent agreement between the shipper and the shipping line, shippers are fixed to use the port in which the shipping line has its port of call. (Tongzon, 2009)

Shipping lines are relatively new actors in the hinterland logistics market, that have entered the scene due to the above described integration of logistics markets. Shipping lines have entered into terminal operations as well as logistics operations. They have achieved this by creation of a new logistics company or division, acquisition or joint ventures. (Song and Panayides, 2012) The result of this expansion is that they are able to act as one-stop-shops by fulfilling all logistics needs of shippers. This means not only an enlargement of the network, but also offering a complete package of logistics activities such as taking care of documentation, taxes and customs. By providing all logistics necessities to shippers, shipping lines aim to create additional value and therefore higher margins, better streamlining of sea-based, port- based and land-based operations. (Veenstra et al., 2012; Robinson, 1998) As a result of the above, shipping lines are no longer shipping lines but global logistics service providers.

The third group of shippers are the ones having contractual relationships with freight forwarders for fulfilling their logistical needs. A consequence of this type of relation is that as long as the agreement between the shipper and the freight forwarder runs, shippers are not able to freely choose for a port. They are tied to the port of choice of the freight forwarders. (Tongzon, 2009)

Like shipping lines, also freight forwarders are expanding vertically and horizontally in the logistics chain. This is on the one hand because of increased competition with shipping lines and on the other hand because of the demand of shippers for globally integrated logistics services. In order to be able to offer this type of services, freight forwarders have not only expanded their network globally, they have also enlarged their scope of activities. This expansion has been realized by means of acquisition or strategic partnerships. The way in which freight forwarders arrange ocean transportation is primarily based on partnerships with shipping lines. (Notteboom and Rodrigue, 2005, Frémont, 2009)

There are a few reasons that explain the successfulness of forwarders in their extended role. First, forwarders have long experience in organizing and coordinating intermodal transport flows. Furthermore, freight forwarders have lengthy and close relationships with shippers. Finally, large freight forwarders also have sufficient freight volumes to benefit from economies of scale. This has a few consequences. The first is that shippers can be offered low rates. The second consequence is that low rates lead to

more volumes and hence, freight forwarders have a better negotiating position in relation to other supply chain actors, such as shipping lines. Lastly, sufficient freight volumes leads to financial possibilities to develop networks with global coverage. (Notteboom and Winkelmans, 2001; Robinson, 1998; Martin and Thomas, 2001) Like shipping lines, also freight forwarders have developed into global logistics service providers.

The fourth group is a collection of different types of shippers that do not fit one of the above groups. They have one characteristic in common though, namely they all do not have contractual relationships with logistics companies. Hence, those shippers are free to choose the port they want. Shippers belonging to this group can use for every single transaction various types of organizations for the fulfilment of their logistical needs. Besides the more regular choice for shipping lines and forwarders in the role of logistics service provider, shippers in this group can also choose to perform or arrange transport themselves. (Tongzon, 2009)

Besides the aforementioned types of supply chain organisation, another, rather novel concept that does not fit one of the groups above is worth mentioning. This concept is terminal haulage. Terminal haulage implies that the sea transportation is performed by a deep-sea carrier who discharges the container at the port of destination. Thereafter the terminal operating company organizes hinterland logistics. This concept is characterized by frequent connections to the hinterland. Often, these inland connections go to an inland hub terminal from which cargo is distributed further into the hinterland. The service focuses on shipping lines, logistics companies as well as shippers. (De Langen et al., 2013; ECT, 2013)

Since now all the different ways in which shippers are currently linked to the supply chain are discussed – which acts as useful input for the pricing strategy guidelines that will be proposed in the next section – this section continues with analysing the drivers of expected market changes. Also this is important for the guidelines in the next section. To be more precise, guidelines for an appropriate pricing strategy for port authorities are only relevant when dealing with expected future trends regarding the market structure surrounding seaports.

Market changes can be translated into changing circumstances shipping lines and freight forwarders have to cope with. To start with the shipping lines, few drivers can be identified that make it for shipping lines even more attractive to develop into one-stop-shops for logistics services. The first driver is empty containers. Due to geographical concentration of producing activities, trade balances have emerged in a number of major trading routes. As a consequence, these empty boxes have to be repositioned, meaning that vessels transport empty containers around the globe. Expected costs of these inefficiencies are estimated to be $17 billion. (Theofanis and Boile, 2009) Since the share of containerized seaborne trade in proportion to total seaborne trade is expected to grow as well as absolute volumes of seaborne trade, the empty container problem is expected to worsen. (UNCTAD, 2011) Shipping lines try to mitigate this problem by gaining larger control over their containers, by means of carrier haulage. (Theofanis and Boile, 2009) The second driver is inland costs. Through for example alliances, conferences and shipping companies have reduced sea transport costs to a

minimum. In contrast, inland logistics is an element of the logistics chain were cost reductions are possible. Moreover, the share of total costs that arises from the land-leg of the total chain ranges between 40% to 80%. (Notteboom, 2004)

Furthermore, forwarders also have an incentive to focus on further developing integrated logistics concepts with global coverage. Shipping lines are in their new status as logistic service provider competing with forwarders for cargo of shippers. Shippers, in turn, desire integrated logistics packages. This means that if freight forwarders do not offer this type of service they will lose the battle. Moreover, there is an endogenous reason why forwarders would focus on further developing logistics services. The more cargo is being consolidated by forwarders, the more attractive they are for shipping lines and therefore the lower are the rates that can be negotiated for their customers. (Martin and Thomas, 2001)

A fairly new concept that has emerged is terminal haulage. Currently, this concept is not deployed on a large scale. Like for freight forwarders and shipping lines, terminal haulage revolves around connecting to the shipper in the hinterland. Hence, terminal operators can be seen as a new competitor for freight forwarders and shipping lines in the role as logistics service provider. Yet, in contrast to shipping lines and forwarders in their new role, the geographical scope of terminal haulage services is limited to the hinterland of the terminal. The successfulness of this concept remains to be seen.

As a conclusion it can be stated that outsourcing of transport activities is currently common practice. Only very large shippers that transport non-containerized cargo believe that performing transportation activities in-house is the most beneficial strategy. In turn, the outsourced transportation activities are currently performed primarily by two major actors, namely freight forwarders and shipping lines. As a result of horizontal and vertical integration in global supply chains these actors are able to offer shippers integrated logistics packages. Basically, this means that shipping lines and freight forwarders have become global logistics service providers. This implies that if shippers, with outsourced transportation activities, decide to transport cargo, they contact either the shipping line or freight forwarder with which they have a contract (in case of independent shippers it depends on the circumstances) and these parties arrange the whole range of logistics activities.

The role of shipping lines and freight forwarders has consequences for the interrelatedness of the sea-based and land-based markets. We agree on the way Heaver et al. (2001) put it: *'The level of integration is such that the demarcation between previously separate markets for logistics services is now blurred.'* In other words, because of the horizontal and vertical integration of logistics markets, no one can no longer speak of separate shipping markets and separate hinterland transport markets. Both markets are to a large extent integrated and influence each other seriously. In addition, certain market circumstances exist that push freight forwarders and shipping lines further into the direction of logistics service providers. The rivalry between both types of organisations reinforce this trend. As a result, both sea-based and land-based markets will integrate even further. Finally, additional competition may be entering the market by means of terminal operators stepping in the role as logistics service provider.

4.3.10. The assessment of the applicability of the two-sided market theory on seaports

Since the characteristics of the seaport environment are discussed and analysed the claim of Van den Berg and De Langen (2011) can be tested. The test is based upon the three underlying assumptions of the two-sided market theory. Therefore, the way of testing is essentially the same as the seaport case.

The first assumption states that the main benefits of the two markets arise from interaction with each other via the platform. The platform, in turn, offers a place where participants of both markets can interact with each other at lowest possible transaction costs. In the case of seaports one can safely say that this assumption does not hold in practice. Shipping lines are always contacted directly by the hinterland transport companies, by the actors arranging the transportation between land-leg and the sea-leg or in an extreme case by the shippers themselves. The same applies the other way around. Moreover, as a result of the expected further integration of sea-based and land-based logistics markets, the interaction between distinctive sea-based and land-based markets is getting less. In other words, even if there is interaction between the two separate markets, then interaction is directly between players in the separate markets, thereby circumventing the platform. In the hypothetical case in which a seaport develops and provides a system in which both sea-based parties and land-based parties interact, then still this would not satisfy the first assumption. This is the case since the platform does not provide the main benefits. Market parties can easily ignore the platform and enjoy the same benefits. This situation is analogous to the airport case in which passengers interact directly with airliners.

The second pillar on which the two-sided market theory rests states that attached markets to the platform gain from each other due to interactions. Increasing size of markets also means increasing value for both markets, due to network effects. Yet, the decision to make use of the platform does not take into account the effects on the other side of the network. More technically, cross-group externalities arising from interaction are not internalized by users.

Here parallels can be drawn with the airport case. Regardless of the type of supply chain organisation, the relation between shipping lines, ports, forwarders, hinterland transport companies and shippers is vertical. This is the case, since we are, like in the airport example, dealing with supply chains. This consideration is confirmed by Suykens and van de Voorde (1998). There is one key difference with the airport example though. In the airport situation, only one of the users of the airport causes vertical externalities, namely the airliners. Passengers are static users in the airports hinterland. In contrast, in seaports there are a number of user groups of seaports that cause vertical externalities. Besides shipping lines – that take on the same role as airliners in the airport case – seaports are dependent on the establishment of efficient logistics service providers. These port users are able to extend the hinterland of a port in order to reach in a larger share of shippers. More technically, efficient hinterland logistic service providers are able to enlarge the captive hinterland of ports and therefore provide benefits – vertical externalities – to shipping lines that are, in turn, able to attract more cargo to fill up their vessel. Moreover, also tenants cause vertical externalities. By

pursuing efficient performance, they have a large influence on the benefit other port users obtain. All claims are well supported empirically. For example, amongst others, De Langen (2007) has found evidence supporting the fact that the quality of shipping services is for both forwarders and shippers the most important port selection criterion. Quality of shipping services can be subdivided into the number of destinations that can be reached from a certain port and the frequency of service. (Tongzon, 2009) Furthermore, amongst others, Tongzon and Sawant (2007) have found that the variables connectivity, infrastructure and location are three important variables for shipping lines in determining which port should be called.

At the moment a logistics service provider, a tenant or a shipping line decides to make a decision dealing with the usage of the port, the potential effects of such a decision are already internalized. Otherwise, no decision would have been made. Needless to mention is that although the results of vertical externalities are comparable to cross group externalities, this is not case. Hence, port authorities can in broad terms be seen as multiproduct companies that sell complementary products to vertically related supply chain members that make use of the port. For these users the seaport is merely a technical input factor. Also the second assumption underlying the two-sided market theory is not satisfied.

The third and last assumption that underpins the two-sided market theory is that the distribution of costs over the two markets linked to the platform can influence the total number of interactions, provided that the overall price remains unchanged. Key is that platform users cannot circumvent the pricing structure. The reasoning behind the fact that changing the cost allocation is beneficial is because of taking into consideration cross-group externality effects. Because we have argued above that the relation between seaport users is vertical, cross group externalities are non-existent. The externalities that arise are vertical externalities. As a result, the price setter – the port authority – is a not a platform operator but a multiproduct company that sells its products and services to a number of vertically related seaport users. In order to determine whether changing cost allocations is beneficial, the insights of the multiproduct pricing structure have to be taken into consideration. There are three reasons that determine whether changing cost allocations might be beneficial.

First, the multiproduct theory states that changing the cost allocation is only beneficial when the products or services to be priced are non-perfect complements. In other words, it is only beneficial for port authorities to use different price allocations when its products or services are considered to be non-perfect complements. The question is whether port authorities sell products or services that are non-perfect complements. Put differently, do port authorities sell products or services that are already internalized when deciding to make use of the airport. An example that comes to mind is warehousing. In order to transfer cargo from the land-side to the sea-side or the other way around, warehousing is not strictly necessary, and therefore not seen as a perfect complement. Hence, warehousing is an example that might it make beneficial for port authorities to charge different prices.

For the second determinant, again a parallel is drawn with the airport case. In the airport case it was stated that because the complementary services that are sold to seaport users are not provided by the port itself, but are provided by firms that operate in competitive markets, changing cost allocations might be relevant by taking into consideration the competitive forces in these specific markets. This is a different

situation than the monopoly razor and razor blade company that does not have to consider competition when setting prices. Because the seaport case is comparable to the airport case in this respect, changing the price allocation might be beneficial. This situation is conceptually illustrated in figure 13.
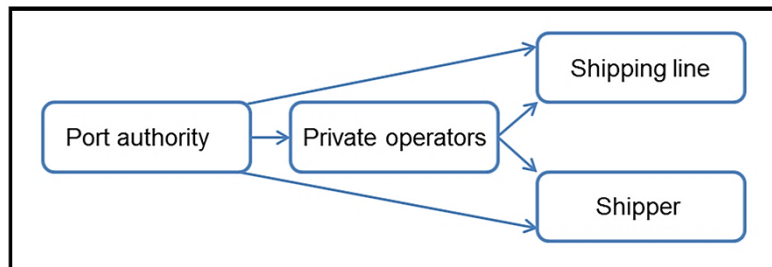
Figure 13 – Outsourced activities of port authorities
Source: adapted from figure 2

The third factor that has to be considered is the market structure and is related to the determinant just discussed. As has been discussed extensively above, the structure of the markets surrounding ports is characterized by vertical and horizontal integration. Because of the market integration, the port user can be seen more and more as one single customer, namely the vertically and horizontally integrated global logistics companies that act on behalf of the shipper. However, the fact remains that there are still a number of separate port users that are sensitive to price changes. For example, consider the case in which a shipping line acts as a global logistics service provider on behalf of a shipper selling under CIF terms, that has contracts with terminal operating companies and hinterland logistics service providers to perform the respective functions. In this case, although the port authority is virtually a multi-product company selling complementary services to the shipping line acting as global logistics company, each single player in the port is sensitive to the price charged to him. In other words, although the contractual relationship makes the port authority a multi-product company, the situation inclines towards single product pricing. This stands in contrast to the airport case, in which the aeronautical product and the non-aeronautical product (for example shopping) are offered to only passengers, making the airport operating company a purely multi-product company.

As a result of the above analysis, we can infer that changing costs allocations over different products might be beneficial, however the rationale behind this fact are not cross-group externalities. Hence, also the third assumption underlying the theory is not satisfied.

4.3.11. Terminals as platforms in two-sided markets

Before moving on to the next section, the aim is to briefly consider an additional perspective, namely that of terminals itself as platforms in two-sided markets. One might argue that this – alternatively to the port as a whole – is the platform on which the applicability of the two-sided market should be tested. Hence, we briefly test this viewpoint by the well-known assumptions of the theory. In the context of the first assumption we argue – like in the case of entire ports as platform – that the main benefits of interaction do not arise from interacting via the platform. In the context of the

second assumption it is argued that the market structure is vertical and therefore the externalities are not cross-group network externalities but vertical externalities. In the context of the third assumption we argue that changing the allocation of prices over various users does not change the overall performance of the terminal. The reason for this is that costs stemming from usage is already anticipated by the users of the terminal. Hence, also the perspective of the terminal as a platform operating in a two-sided market is not valid.

4.4. Results research question four

The fourth research question is: What are guidelines for a pricing strategy for port authorities?

This research question bases itself on the insights of the three previous research questions. The objective is to form in the light of these findings a subset of guidelines that port authorities can use in order to improve their pricing structure in order to generate sufficient revenue to recover costs. Before starting the pricing discussion, it is important to note that – although the market in which seaports operate has recently become more competitive – the market structure can still be considered as an oligopoly. Hence, firms are able to charge a mark-up over marginal costs and therefore specific goals can be achieved with pricing. (Haralambides, 2002)

4.4.1. Pricing guidelines for port authorities

Some of the guidelines that are proposed in this section are more general principles whereas others are characterized by a more practical approach. Important is to stress the starting point from which we approach the pricing issue. There are a number of port stakeholders with different interests. Governments pursue the efficient usage of port assets. In contrast, port authorities go for maximising throughput and maximising value-added objectives. Finally, port users demand transparent charges that reflect the true costs of the services. (Suykens and Van de Voorde, 1998; Strandenes and Marlow, 2000) As has been argued previously, out of these different port objectives throughput maximization is taken as the focus of analysis. Additionally, we once again repeat that in this thesis we take the required revenue port authorities need to generate as given. Before discussing the guidelines into detail, the table below summarizes all the guidelines.

Table 8 – Pricing guidelines

Guidelines
Unimportance of charges
Rationales behind port pricing
Vertical externalities
Incentives schemes
Port choice
Signalling effect of prices

Source: Author

The first guideline deals with the unimportance of port authority charges to port users. There are a couple of reasons for this statement. First, port costs are a minor share of the overall costs in a logistic chain. Secondly, other factors are far more important when port users consider which port to use. In other words, on the one hand it can be stated that demand for port services of different port users is generally relatively inelastic as a result of changing prices. On the other hand, specific price elasticity's subdivided to different port user groups in the context of port charges are impossible to obtain since more important factors blur the picture. (UNCTAD, 1995; Nagle et al., 2011; Suykens

and Van de Voorde, 1998) This finding has an important consequence. In the context of the previous research question we have argued that port authorities can broadly be seen as multiproduct companies. The products of the 'firm' are the activities that are related to the core functions of the port authority, namely the landlord function, regulatory function, operational function and the port cluster/community management function which are paid by port users. However, since price elasticity's for specific port user groups are impossible to obtain the pricing insights the multiproduct theory provides are not useful for port authorities. Consequently, the pricing mechanisms – which are introduced in the context of the first research question – that use the insights of price elasticity (price discrimination and Ramsey pricing) are not applicable by port authorities.

The second guideline deals with the rationales behind port pricing. Because of the limited applicability of the insights of the two-sided market theory and the multiproduct pricing theory this guideline proposes another rationale behind port pricing. As we have argued earlier, pricing is gaining importance for port authorities because of the changing competitive environment ports operate in. Ports are competing more and more with other ports in their environment, mainly as a result of the containerisation trend. Competition no longer takes place merely on the sea-side, but also increasingly on the land-side. Moreover, the government's role and influence in ports is diminishing. In contrast, the influence of shipping lines and (hinterland) logistics companies is increasing. These effects are so powerful that many port authorities have to rethink their role in order to be able to cope with these trends. (UNCTAD, 1995) In fact, competition is no longer between ports, but between logistics chains. It is a matter of belonging to a logistics chain or not belonging to it. (Meersman et al., 2003)

We follow the way of reasoning of Robinson (2002) who pleas as a result of this changing context for a new paradigm with respect to ports, port authorities and their functioning. In his eyes ports have to be considered as value-adding elements in value chains. Key in these environments is to develop port development plans that take as starting point competitive advantage. Port authorities, however, have to face the fact that this competitive advantage is a derived advantage from its port users. (UNCTAD, 1995)

As a result of the paradigm shift and in line with a strategic pricing report of UNCTAD (1995) *we propose that port charges should be set by taking into consideration the value that port users cause to other port users as well as the value port users derive from the port*. This way of pricing is considered to be strategic pricing. Practically, the starting point of value-based strategic pricing is to understand what factors cause value for customers as well as to understand what factors reduce the value perceived by customers. Pricing in this respect can be used to encourage the factors that are perceived valuable and to discourage factors that reduce the value for customers. (Nagle et al., 2011) In such a way strategic objectives can be achieved. As a consequence of value as basis of pricing, the pricing mechanisms – which are introduced in the context of the first research question – that bases itself on costs (average cost pricing and two-part tariffs) cannot be applied in the pricing proposal.

Value-based strategic pricing is totally different from the more commonly used rationale of cost based pricing. The main argument for deviating from cost based pricing is the changed competitive environment in which ports operate. In order to stay viable – this means in order to be able to recover own costs – port authorities have to take a more

commercial approach. Another argument that made us to decide to not follow cost-based pricing is that the allocation of costs over different seaport users is arbitrarily, since providing port services entail a lot of joint costs. Hence, the propagated fairness, equal treatment of users and transparency of this pricing principle are under pressure. (UNCTAD, 1995) Important to bear in mind is that by leaving cost based pricing this does not mean that public objectives such as efficient usage of assets have to be abandoned. The subsequent guidelines that will be introduced are rooted in value-based strategic pricing.

The third guideline deals with vertical externalities, an insight stemming from the analysis of the two-sided market theory. As has been argued previously, there are a number of port user groups that cause vertical externalities. First, shipping lines cause vertical externalities on other port users. The more shipping lines decide to call at a seaport, the more externalities or value their create for other port users. Besides shipping lines seaports are dependent on the establishment of efficient logistics service providers in the hinterland. These port users are able to extend the hinterland of a port in order to reach a larger share of shippers, thereby creating vertical externalities to other port users. Moreover, also tenants cause vertical externalities. Their degree of efficiency has important implications for the value other port users obtain from the usage of a port. In other words, shipping lines, tenants and hinterland logistics service providers are key for the creation of value for other port users. This fact has to be taken into consideration when setting prices

The fourth guideline deals with incentive schemes and is closely related to the previous guideline. We now know that vertical externality providers are crucial for the value perception of port users benefitting from vertical externalities. The question remains how to ensure that port authorities optimally benefit from the value these port user groups cause. The answer to this is incentive schemes. In order to illustrate the appropriateness of incentive schemes for vertical externality providers we borrow some insights from the airport case. For airport operators airliners take the same role as shipping lines. To be more precise, they also cause vertical externalities for the airport and for its users. In order to make sure that vertical externalities are internalized by carriers, a number of airport operating companies have revenue sharing agreements with carriers. A certain percentage of the revenues that are generated by means of the airports shops are shared with carriers. In this way airliners are more incentivized to make use of a certain airport over other airports because additional revenues can be generated as a result of the revenue sharing practice. This, in turn, leads to additional passengers for airports and therefore increasing shopping revenues. Obviously, the resulting benefits are reaped by both airliners and airports. (Fu et al., 2011)
By simply concluding that incentive schemes are the best way for port authorities to capture value one important aspect is forgotten, namely the level of charges. Low charges reduce the powerfulness of incentive schemes. To illustrate this point, we have analysed the existing way the port authority in Rotterdam charges shipping lines, which is designed to stimulate port users to increase their volumes handled by the port. The port of Rotterdam charges vessels on the basis of two dimensions, namely gross tonnage of the vessel and the volume of cargo that is (un)loaded. Together they form the port charges paid by shipping lines. In addition, the port of Rotterdam gives shipping

lines discounts when they generate cargo volumes above certain thresholds per year. The higher the volumes transferred via the port, the higher the percentage discount obtained by shipping lines. Below two tables are introduced. Important to remember for both tables is that the vessels are deep-sea container carriers, which do not enjoy special (environmental) discounts. Table 9 illustrates the pricing mechanism by showing the prices per ton paid by shipping lines in the port of Rotterdam. The reason for this is that port users are much focussed on prices per ton. Subsequently, in table 10 the same pricing rules are used as in table 9, the only difference is that both the gross tonnage and cargo charges are divided by a factor five. By this we want to show the effect of substantially decreasing charges to shipping lines. For more details on the calculations see the appendix at the end of this thesis (Port of Rotterdam, 2012)

Table 9 – Charges paid by shipping lines to port authorities in the port of Rotterdam, differentiated according to vessel size and number of calls

Vessel size	Vessel GT: 25,000	Vessel GT: 50,000	Vessel GT: 100,000	Vessel GT: 150,000	Vessel GT: 175,000
# of calls	Cargo ton: 12,500	Cargo ton: 25,000	Cargo ton: 50,000	Cargo ton: 75,000	Cargo ton: 87,500
1	0.94	0.94	0.94	0.94	0.94
4	0.94	0.94	0.94	0.88	0.88
7	0.94	0.94	0.88	0.88	0.88
10	0.94	0.88	0.88	0.85	0.85
16	0.94	0.88	0.85	0.85	0.82
21	0.88	0.88	0.85	0.82	0.82

Source: Port of Rotterdam, 2012

Table 10 – Charges paid by shipping lines to port authorities in the port of Rotterdam, divided by a factor five

Vessel size	Vessel GT: 25,000	Vessel GT: 50,000	Vessel GT: 100,000	Vessel GT: 150,000	Vessel GT: 175,000
# of calls	Cargo ton: 12,500	Cargo ton: 25,000	Cargo ton: 50,000	Cargo ton: 75,000	Cargo ton: 87,500
1	0.19	0.19	0.19	0.19	0.19
4	0.19	0.19	0.19	0.18	0.18
7	0.19	0.19	0.18	0.18	0.18
10	0.19	0.18	0.18	0.17	0.17
16	0.19	0.18	0.17	0.17	0.16
21	0.18	0.18	0.17	0.17	0.16

Source: Port of Rotterdam, 2012

It can be inferred from the tables that the higher the level of charges to a specific port user group, the more powerful the incentive of port authorities. This is the case because the costs differences are larger in the case of relatively higher port charges to shipping lines. In other words, the higher the charges to a specific port user group, the more value – by means of more successful throughput maximizing incentive schemes – is

generated for the port authority and other port users. However, the benefits as a result of charging increasing amounts to specific user groups are not infinite, as will be discussed in the sixth guideline.

Important to consider is the situation in which ports struggle to attract shipping lines or hinterland logistics service providers. This can be the case because the attractiveness of a port is low for shipping lines as a result of the non-existence of good hinterland logistics service providers. Or differently, because the attractiveness of a port is low for logistics service providers as a result of the non-existence of good shipping connections. In these cases a throughput maximizing incentive scheme might act as a bottleneck, since relatively the highest charges are charged to port users when the uncertainty with respect to making use of a port is highest. In other words, when dealing with a chicken-egg-problem, as described at the start of the analysis of the two-sided market theory, incentive schemes are not considered to be appropriate.

In conclusion it can be stated that incentive schemes are appropriate pricing instruments that should be used by port authorities – that have well developed hinterland logistics service providers and shipping lines – in order to capture the value vertical externality providers cause in the ports environment. The incentive schemes act in these cases as a boost to increase throughput, which in turn causes value to all port users. When at least either shipping lines or hinterland logistics service providers are not well developed in a specific port, the appropriateness of incentive schemes depends largely on the case details. An important element in this context is the type of hinterland a port has. When the hinterland of a port is largely characterized as contestable, then port charges and the quality of hinterland transportation are two very important determinants for the success of a port as a whole. In contrast, when the hinterland is characterized as captive, then port charges and the quality of logistic service providers is far less important.

The fifth guideline deals with port choice. This guideline is a direct sequel to the market structures we have discussed in the context of the previous research question. As has been argued extensively, hinterland logistics service providers more and more take over the role of shippers in making port choices as a result of changing market situations. Due to contracts shippers have with hinterland logistics service providers or shipping lines shippers do not longer make port choices themselves. This finding has an important consequence for the price strategy port authorities should adopt. Based on the fact that port users consider port charges of limited importance in combination with the insights that the guideline dealing with vertical externalities describes we argue that port users that have to make port choices have to be charged for strategic reasons.

The sixth and last guideline deals with the signaling effect of prices. Although the market is characterized by vertical integration, the charges of port authorities to port users still sends signals to port users. This is the case because the logistics markets are not completely vertically integrated. In other words, there still exist individual players that are sensitive to the level of charges. This puts a limit on the ability of port authorities to (unlimitedly) increase charges in order to create powerful incentives. However, the signaling effect of prices has not only drawbacks. Port authorities can for example use the signaling effect in order to get a grip on certain port users. A good example in this respect are hinterland logistics service providers. Using pricing incentive schemes for (hinterland) logistics services providers provides port authorities with a tool

to better deal with the current situation which is characterized by port users with lots of market power and logistic chain competition. This is key since port performance itself is not the only determinant that influences the value users obtain from the port. By being able to influence the operations of logistics service providers, specific hinterland objectives can be achieved leading to a more streamlined logistic chain from which all port users are able to take advantage. (Meersman et al., 2003) Not only hinterland objectives are important, better control over a ports hinterland also fits the new role of a port authority is being a cluster and community manager, as proposed by De Langen (2004, 2007).

The usage of pricing as a tool to achieve a certain port authority objective is illustrated by Bergqvist et al. (2012). They propose port dues charged to hinterland transport companies. The greener their ways of transportation, the larger the reduction they get on the port dues. In fact, they propose an incentive scheme in order to improve the model split of ports.

4.4.2. Effects of guidelines for charges to port user groups

The pricing proposal is further elaborated on the basis of the three mostly charged port users, namely shipping lines, tenants and shippers. In addition, we propose a fourth user group that should bear a part of the seaport cost burden, namely (hinterland) logistic service providers. In order to broadly determine the shares that one of the specific port users should be charged, the sections take into consideration the proposed guidelines and discuss both the way in which port authorities derive value from port users as well as the way in which port users themselves benefit from the port.

<u>Shipping lines</u>

Shipping lines are valuable for ports and its users. This importance stems from the fact that shippers and (hinterland) logistic service providers derive most value of a port from the presence of shipping lines. Indeed, shipping lines are port actors that cause vertical externalities. Therefore they are critical to attract. The value of shipping lines for port authorities, and therefore for the degree of success of ports, is further reinforced by the fact that shipping lines are increasingly the ones deciding which port to use.

As has been argued by one of the guidelines in the previous section, the higher the port charges the more powerful the incentive schemes of port authorities. There is another more value related reason for not charging very low charges. When shipping lines consider to call at a port also the turnaround time, the distance of the port from the trade route, the amounts of cargo available as well as the freight rates are more important determinants that influence the value for shipping lines. By making entry for shipping lines free or cheap, the port will not only attract more vessels, congestion might arise leading to longer turnaround times or competition may increase leading to lower freight rates. Both factors reduce the value of shipping lines. Hence, seaports are less valuable for shipping lines when port charges levied to this group are 'too low'. (UNCTAD, 1995)

Consequently, we propose a considerable charge to shipping lines in combination with a throughput maximizing incentive scheme. To be more precise, we agree on a yearly reduction in port charges based on total throughput volume per year. Each year the volumes that allow for rebates should be adapted per shipping line on the basis of the

throughput levels that have been realized by the particular shipping line in the previous year as well as an economic index indicator. In this way the incentive schemes are fair and feasible. Such an incentive encourages shipping lines to make use of the port. In addition, we propose an incentive scheme that focuses on increasing the call size in order to increase berth productivity and faster turnaround times, which, in turn, increases the value of shippers and therefore to attractiveness of the port. This is done by means of discounts on port dues when call sizes increase. So, the overall yearly charges to shipping lines are based on a combination of total throughput per year as well as call sizes. The closer the yearly throughput volume is to the pre-determined volume in combination with large call sizes leads to the lowest port charges to shipping lines. By proposing this way of charging shipping lines internalize the vertical externalities they cause and port authorities are able to increase value for themselves and for other port users. (Tongzon and Sawant, 2007; UNCTAD, 1995)

<u>Tenants</u>

Tenants are a group of port users that value ports higher when more cargo is transhipped. To be more precise, when tenants attract more cargo this will lead to more business for them. This will also cause value for the port itself and for the other port users. Moreover, ports and its users are very dependent on the performance of tenants. To illustrate this, consider the importance of turnaround times of large vessels, which is directly related to the performance of tenants. In other words, tenants cause vertical externalities.

Before introducing our pricing proposal for tenants it is important to consider two aspects. First, large shipping lines have considerable shares in terminal operating companies – an important member of the tenant group – and sometimes even own terminals, called dedicated terminals. In this context it is for example shown that 45% of the containers of Maersk are handled by its own terminals. Moreover, the charges that port authorities levy on tenants are directly passed on to shipping lines, as can be seen from figure 3. Hence, the charges levied to shipping lines and to tenants (in this case terminal operating companies) are in fact levied to shipping lines alone. (Soppé et al., 2009) Secondly, competition within a port – often called intra-port competition – is not always assured. This means that when there are no direct competitors for a terminal operating company, this company might abuse its market power by raising prices, thereby destroying value for other port users.

Consequently, we propose a tariff that give tenants incentives to improve both their cargo attracting activities as well as their cargo handling performance. To be more precise, port charges levied to tenants should be lowered when increasing cargo volumes are handled. In addition, the more efficient the cargo is handled – that is the less time required to move a certain amount of goods in a specified time window – the lower the charges. So, the combination of attracting a lot of cargo and simultaneously handling this cargo efficiently will lead to the lowest port charges. This gives tenants incentives to improve their own value as well as the value for the port authority and other users. In other words, this way of charging will help to materialize vertical externalities. When intra-port competition is not assured and tenants abuse their market power by charging excessive prices, port authorities should have the ability to undo the discount in port charges when performance is improved. Obviously, by proposing such

a possibility to escape, monitoring costs are a drawback. Port authorities have to continuously monitor the competitive environment in order to notice potential abuse. We argue that these monitoring costs are lower than the potential harming effects of abuse of market power.

A considerable charge to tenants seems to be appropriate in order to make the incentive scheme powerful. However, by reasoning this way it is forgotten that charges are eventually passed on to shipping lines. By charging both parties relatively high prices, shipping lines are deterred of high prices in the port. Moreover, because of the more mobile nature of shipping lines – they have some freedom to determine the port of call – versus the more fixed nature of tenants – they are more bound to one certain port – the incentive scheme for shipping lines is more important and therefore the charges to these users should be higher.

As a final note, we have not considered the concession agreements that are often involved in deals with tenants. The reason for this is that these agreements are for long times fixed and are more focussed on and appropriate for long term goals such as environmental objectives. Therefore we assume them to be fixed.

<u>Shippers</u>

Shippers are another group of port users that create value for ports and its users. However, shippers themselves do not create vertical externalities themselves, since they are not clustered together. To clarify this point, consider the situation in which a single shipper decides to choose for another port. This would not lead to a big change in the port that has been left by the shipper. The reason for this is the lacking scale of a single shipper. (In contrast, when a shipper has a large scale and a considerable influence on a single port than the situation would change. The results of this type of situation are comparable to the effects hinterland logistics companies cause. This situation is discussed in the next section.)

There are a number of factors that influence the value perception of shippers with respect to ports. Before introducing these factors it is important to introduce the basic value determinant for shippers with respect to ports, which is a place where their cargo can be transferred on a vessel in order to reach a destination. The first value determinant is geographical location. This is the most important factor in determining which port is chosen. The importance of geographical proximity can be explained by high land-based transportation costs that make other ports more expensive. Secondly, it is found that the sea-side product is an important port choice determinant. In other words, shippers benefit from the vertical externalities caused by shipping lines. (Malchow and Kanafani, 2004) Finally, also the quality of a port, expressed in the ability to transfer cargo quickly through a port is of major importance. In other words, also for shippers congestion reduces the value obtained from a certain port. These findings underline the importance of the efficiency promoting incentives we have proposed for shipping lines and tenants. (UNCTAD, 1995)

In sum, it can be inferred that the most important value driver of shippers is the geographical proximity of a port. In other words, one can argue that charging shippers a considerable share of port costs does not seem to hit throughput considerably. This viewpoint is supported by the fact that because of the increasing vertical and horizontal integration of logistics markets shippers make less and less port choices. On the other hand, charging shippers a considerable amount does not serve a strategic objective of

the port authority. To be more precise, they cannot use price incentives to achieve certain goals, such as increasing call sizes in the shipping line case or increasing performance in the tenant case. Hence, pricing incentives cannot be used to increase value for other users. As a result, we propose that shippers should not be charged at all.

Hinterland logistic service providers

A port user that is not priced widely currently, at least to our knowledge, are (hinterland) logistics service providers that act on behalf of shippers. As has been argued extensively in previous sections, due to vertical and horizontal integration of logistic markets these players are more and more important value providers for ports and its users due to the vertical externalities they cause. To be more precise, the reason that (hinterland) logistic service providers do provide externalities – as opposed to shippers themselves – is because they cluster shippers, mobilize shippers and are able to increase the number of shippers that can be reached cost effectively by a port. The value to ports is reinforced by the fact that (hinterland) logistics service providers increasingly make the choice for a port due to contracts with shippers.
The value of (hinterland) logistic service providers with respect to a port are comparable to the three introduced factors above, namely the geographical location, the quality of the sea-side product and the quality of the port cargo transferring function. (Malchow and Kanafani, 2004; UNCTAD, 1995)
Consequently, we propose relatively limited charges for (hinterland) logistics companies. Port authorities are able to do so, without harming the total throughput of a port, since logistic service providers do not change a port overnight as a result of a cost increase. (UNCTAD, 1995; De Langen, 2007) The are a few reasons for levying only limited charges. First, charging this user group at all is because it provides port authorities with the ability to get a grip on this port user group (signaling effect of prices) by means of an incentive scheme. (Nagle et al., 2011) A point that will be elaborated further below. Secondly, the reason for the limitedness of charges to (hinterland) logistics service providers is because virtually no port charges (hinterland) logistics service providers. As a result, they might be more sensitive to price changes than for example shipping lines who are charged in almost all ports.
More specifically, an incentive mechanism is proposed that lowers the charge levied to (hinterland) logistic service providers when cargo amounts increase. Obviously, the aim is to increase the total amount of hinterland cargo attracted to a port. The reason for this is that it increases vertical externalities.

4.4.3. Interpretation of the proposed pricing structure

The insights that the above section provides act as principles that port authorities should consider when setting and/or evaluating pricing structures. By following the guidelines port authorities are assured of a strategic way of charging that allows them to realize throughput maximization as objective. Moreover, the guidelines take into consideration the future developments that are expected to materialize and are therefore well designed to handle the future situation that ports will face.
It has to be stated though that each seaport has unique characteristics that can have a major influence on the price setting behavior of port authorities. In order to illustrate this

point, consider the example of the port of Singapore, as has been introduced in the context of the previous research question. Virtually all port authority revenues are earned by means of port dues paid by shipping lines. As can be inferred from the above discussion this is not the best way of pricing a port. However, the port of Singapore derives the biggest share of its business from being a transshipment hub along the Europe-Asia trade lane. The port has virtually no captive cargo, let alone a vast contestable hinterland. These facts partly explain and justify the pricing structure as adopted by the port authority. Moreover, also the type of cargo might have an influence. However, due to the complexity of this issue this dimension is not considered in this thesis. What is also not considered in the above analysis is congestion. It is assumed that port capacity is sufficient. When a port is congested it will seriously harm the willingness of shipping lines, (hinterland) logistic service providers and shippers to make use of a port. Pricing schemes are irrelevant in this case because the costs of congestion are higher. Due to the assumption of sufficient seaport capacity, the insights that are provided by peak load pricing and yield management are irrelevant for the proposal.

5. Conclusions

The applicability of the theory of two-sided markets to seaports has been tested on the basis of the three core assumptions of the theory. The first assumption is that the main benefits of both markets arise from interaction via a common platform. The second assumption is that positive externalities of joining the platform are not internalized by platform users. The third assumption is that the number of interactions via the platform depend not only on overall prices but also on the distribution of prices over different markets. The outcome of the analysis is that the seaport environment does not even fulfil one of these requirements.

Hence, the rich body of literature that is written on optimal pricing strategies in the context of two-sided markets cannot be translated to the seaport environment. This means that the dilemma port authorities face with respect to the question which port users should bear what share of costs cannot be solved with these insights. What the analysis of the two-sided market theory shows, though, is that port authorities can in broad terms be seen as multiproduct firms. Some of the key user groups of the port cause vertical externalities on other port users. To be more precise, the decisions shipping lines make with respect to their ports of call are key for the competitiveness of a port. The same holds for logistics companies that organise for hinterland transportation and tenants that efficiently handle and attract cargo. Based on the insights of the thesis a number of guidelines that greatly help port authorities in setting the appropriate prices to the appropriate parties are proposed. Important to note is that the level of required revenues are assumed to be known. Moreover, as starting point for the pricing strategy the main goal of port authorities is assumed to be throughput maximization.

The first guideline deals with the unimportance of port charges for port users. Because of this finding the price elasticity of different port users cannot be adequately measured, which makes the insights that the multiproduct theory provides with respect to pricing useless. The second guideline is about the rationales behind port pricing. Since the theory of two-sided markets as well as the multiproduct theory does not provide port authorities a rationale behind port pricing, we propose value-based pricing as the starting point for pricing issues. The reason for this is a paradigm shift. This is an important deviation from the more commonly used principle of cost based pricing. Vertical externalities – the most important finding of the analysis of the theory of two-sided markets – is discussed in the context of the third guideline. Port users that generate vertical externalities are key value generators and therefore very important for port authorities and ports. Next, a guideline dealing with incentive schemes is proposed. Incentive schemes aimed at throughput maximization are introduced. Practically this means that the better the 'cargo throughput maximizing performance' the lower the charges to the relevant users. This guideline can be seen as a practical way of pricing in order to capture the value of vertical externality providers, as has been discussed in the context of the third guideline. Moreover, the higher the discounts that are given (as a result of high initial charges) the more powerful the incentive schemes. Important to note is that incentive schemes have only the desired effects when both shipping lines and hinterland logistics service providers are well developed. In this case the incentive schemes act as a throughput boost. In cases where either shipping lines or hinterland logistics service providers are not well developed the incentive scheme acts as a

bottleneck for increasing throughput. The fifth pricing strategy guideline deals with the effect of users making port choices. Because shipping lines and increasingly hinterland logistics service providers make port choices they need to deserve attention in the pricing strategy. This practically means that these port users must be subject to strategic price schemes. Finally, the signaling effect of prices is discussed as an important guideline when setting prices. An important example in this case is charging hinterland logistics service providers. Because of the increased importance of a ports hinterland, port authorities can by means of charging hinterland logistics service providers achieve certain goals.

In the last part of this thesis the guidelines are combined in such a way that per port user group a pricing strategy recommendation is introduced. Generally, shipping lines, tenants and hinterland logistics service providers should be subject to charges in combination with incentive schemes. More specifically, the more cargo is attracted and the more efficient this cargo is handled, the lower the port charges. In this way, the value to other port users is maximized. The average charge to tenants should be lower than to shipping lines. The reason for this is the more mobile nature of shipping lines – they have some freedom to determine the port of call – versus the more fixed nature of tenants because they are more bound to one certain port. Consequently, the incentive scheme for shipping lines is more important and therefore the charges to these users should be higher. The charge to hinterland logistics service providers should be less than to tenants and shipping lines, since this group of port users is not priced very widely and therefore this group is more sensitive to charges. Finally, shippers are not charged at all. The reason for this is that shippers individually cause limited additional value for other port users and also port authorities cannot achieve throughput maximizing objectives by adopting charges or incentive schemes.

Important to consider when interpreting the pricing scheme is that a number of port characteristics were assumed when designing the proposal. To be more precise, we have assumed a port that competes in a competitive range on both the foreland and hinterland – in combination with a port authority that has freedom to implement their own pricing structure without severe restrictions from public authorities. Furthermore, it is assumed that ports have sufficient capacity all the time. There are plenty examples of ports and port authorities that do not fulfil these requirements. Consequently, these ports do not fit the general pricing scheme. This is exactly why this thesis does not answer the management question by means of a ready-made price allocation. Moreover, these assumptions make the infrastructural pricing mechanisms, as has been introduced in the context of the first research question, not applicable for port authorities.

In conclusion, each specific port has its own unique characteristics that cannot be captured in a general pricing scheme that can successfully be used by all ports. This partly explains the great diversity of pricing structures, as is shown by the six exemplary ports in the previous section. Yet, the fact remains that some port pricing schemes as adopted by port authorities are inappropriate. In this context, the proposed guidelines and the subsequent recommendations about the levels of charges to different port user groups are general principles that should help port authorities in dealing with their port pricing structure dilemma in a strategic way.

5.1. Limitations of the research and future directions

There are two limitations of this research. The first limitation is closely related to the last part of the conclusion that deals with the assumptions of port characteristics that underlie the thesis. Ports that do not fit one or more of the assumptions cannot, or only limitedly, take advantage of the general pricing insights of this thesis. The second limitation of the research is empirical support. The proposed guidelines and charges to the port user groups are merely based on secondary literature analysis as well as reasoning. No empirical research is supporting our findings.
Hence, for future research we recommend that empirical case studies should be conducted in which all relevant case details are included with respect to port characteristics and competing ports in order to test the appropriateness of our general pricing guidelines.

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7. Appendix

The tables shown below give background information on how the charges per ton, as depicted in table 9 and 10 of the thesis are calculated in the port of Rotterdam. More specifically, all the amounts are calculated on the basis of the formula's shown below the last two tables. The difference between the lowest two tables is that the lower of the two tables has charges that are five times lower than the ones in the upper of the two tables. (Port of Rotterdam, 2012)

Volume ≥ (x 1,000)	Volume ≤ (x 1,000)	Discount (in %)
250	750	6.0
750	1,250	9.0
1,250	1,750	12.0
1,750	2,500	14.0
2,500	3,500	16.0
3,500	4,500	19.0
4,500		22.0

* Vessel size # of calls	Vessel GT: 25,000 Cargo ton: 12,500	Vessel GT: 50,000 Cargo ton: 25,000	Vessel GT: 100,000 Cargo ton: 50,000	Vessel GT: 150,000 Cargo ton: 75,000	Vessel GT: 175,000 Cargo ton: 87,500
1	11,688	23,375	46,750	70,125	81,813
4	46,750	93,500	187,000	263,670	307,615
7	81,813	163,625	307,615	461,423	538,326
10	109,863	219,725	439,450	638,138	744,494
16	187,000	351,560	680,680	1,021,020	1,151,920
21	230,711	461,423	893,393	1,295,910	1,477,534

* $Port\ dues = (0.235 \times GT\ vessel) + (0.465 \times cargo\ rate)$ * # of calls * discount %

* Vessel size # of calls	Vessel GT: 25,000 Cargo ton: 12,500	Vessel GT: 50,000 Cargo ton: 25,000	Vessel GT: 100,000 Cargo ton: 50,000	Vessel GT: 150,000 Cargo ton: 75,000	Vessel GT: 175,000 Cargo ton: 87,500
1	2,338	4,675	9,350	14,025	16,363
4	9,350	18,700	37,400	52,734	61,523
7	16,363	32,725	61,523	92,285	107,665
10	23,375	43,945	87,890	127,628	148,899
16	37,400	70,312	136,136	204,204	230,384
21	46,142	92,285	178,679	259,182	295,507

* $Port\ dues = (0.047 \times GT\ vessel) + (0.093 \times cargo\ rate)$ * # of calls * discount %