



Marginal social cost pricing in European seaports

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Abstract

Europe's competitiveness in the global economy depends increasingly on an efficient and cost effective transport and port system. In the EU, Ports are becoming no different from any other multi-product industry offering a range of services and operating under different environments and organizational structures. Many port infrastructures and services are owned or managed by the private sector. In spite of the lack of standardization and homogeneity in ports, the European Commission is keen to adopt a common approach to pricing in ports. Therefore, a European Commission White Paper (1998) suggests the application of marginal social cost pricing taking into account externalities such as cost of accidents and environmental and congestion costs. The purpose of this paper is to show the recent changes in the port industry and to investigate the issue of port pricing in theory and the possible application of marginal social cost pricing in European seaports.

Keywords: Port pricing; Marginal social cost; Public goods; Privatization.

1. Introduction

Seaports are considered as an important link in distribution channels, particularly those involving international trade. The European port sector handles more than 90% of the Union's trade with third countries and around 30% of intra-EU traffic. Moreover, ports are an essential interface between seaborne and land-based modes of transport. In ports, as in many other industries, prices can 'make' or 'break' a port. Efficient prices can lead to prosperity and growth; the wrong ones can cause bankruptcy or the proliferation of subsidies and inefficiency. Europe's competitiveness in the global economy depends increasingly on an efficient and cost effective transport and port system.

Traditionally, ports were considered as a public good. Consequently, pricing and investment in this sector were among the responsibilities of the public port authorities. These responsibilities also covered security and environmental problems. In recent

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years, privatization has changed this image. Ports have become no different from any other multi-product industry offering a range of services and operating under different environments and organizational structures. Many port infrastructures or services are now owned or managed by the private sector.

In spite of the lack of standardization and homogeneity in ports (the ownership; organization, and administration of ports as well as their size; pricing and subsidies with the functions and geographical location varying from country to country), the European Commission is keen to adopt a common approach to pricing in ports, assuring the real costs of port services should be borne by the users. Supporting this view, the Green Paper on Seaports and Maritime Infrastructure (1997) discusses common port policies in Europe. An adequate pricing system for port infrastructures and services is one of the main instruments for achieving efficiency in ports. Such a system could improve the efficiency of ports and ensure free and fair competition in the port industry. Hence, the European Commission White Paper (1998) suggests the use of social marginal cost pricing taking into account externalities such as the costs of accidents and environmental and congestion costs.

The purpose of this paper is to investigate the issue of port pricing and to discuss social marginal cost pricing in the EU port industry. It is organized in three parts. The first part of this work (section 2) describes the evolution in port management. The following section investigates the theory of optimal pricing in ports. Finally, section four discusses the feasibility of introducing marginal social cost in the European ports.

2. Evolution in port management

2.1. Natural monopoly and public goods in seaports

Various theoretical reasons are given to justify public involvement in both the development and management of ports. Public intervention is mostly justified by either natural monopoly or public goods characteristics of some infrastructure and services provided in seaports.

Port investment poses a problem of indivisibility, high sunk costs and increasing returns to scale¹. Moreover, many port zones are conditioned by the geographical features of the coast, so the available area is very limited and it is necessary to use it in the most efficient way. Such seaports, which are serving captive hinterlands, have competitive advantages (lower transport costs than a competitive port structure, geographical position, etc.) and face little competition. Therefore, some seaports operate as a local natural monopoly. The "monopoly argument" in seaports is then, only relevant when inter-port competition is imperfect (Goss, 1999). For those ports who serve a captive hinterland, monopolistic power enables ports to discriminate according to the elasticity of demand, so that port users experience high tariffs. The most frequently used regulatory systems to prevent abuse from a dominant monopolist and to prevent market power is the application of price-cap and the limitation of firm profits

¹ More details for these characteristics in seaports will be given in section 3.1.2.

through the rate of return or through the encouraging of intra-port competition². Haralambides (2002) observes that for most ports, such captive hinterlands have diminished and that inter-port competition has become more intensive. Contestable hinterlands, those regions where there is no single port with a clear cost advantage, are more and more numerous and economic rents are smaller for competing ports.

The market is also inefficient for the production of a particular category of goods. These are public goods and services. One can mention for example, streetlights, the police and transport infrastructure. A public good is consumed simultaneously by several people without one person decreasing the quantities available for the others. One understands that the good is only public if there is no congestion. It is the principle of non rivalry in consumption. The second characteristic of public goods is non-exclusion. Indeed, one cannot exclude the consumer who doesn't agree to pay. If a good satisfies this condition, its marginal cost is equal to zero. Non-rivalry and non-exclusion are the intrinsic properties of public goods (Kaul and al. 2001).

However, the model according to which ports are seen as a public good begins to disappear and the present tendency is about the sharing of the functions in the port between the public and the private sectors. Given the importance of the investment in ports, the public nature of port infrastructures has been widely discussed in port economics.

Goss (1990) defines public goods as "those which are unlikely to be provided sufficiently, satisfactorily, or at all by competitive industries". To the general characteristics of a public good, Goss (1990) adds a third one. He alludes to three distinct conditions for the presence of public goods in ports:

- Their joint or non-rivalrous consumption;
- The inability to exclude those who refuse to pay;
- Their non-rejectability of consumption.

Goss (1990) notes that although some infrastructures and port services fulfill these theoretical properties, the practices and the experiences of some European countries have proven that the private sector is also able to exploit the port activity. For example, navigation aids and dredging are non-rivalrous "because their cost will be exactly the same no matter how many people are using them". However, the UK port privatization serves to confirm that the private sector is able to provide these services and that the costs can be recovered through user charges. The supply of a dredged channel, considered as a public good, is really no more than a political decision as there is clearly evidence, particularly from the UK, that the market is able to provide a deep-water channel and make an economic return from it (e.g. Harwich Haven, Southampton etc.). The second condition noted above relates to the inability to exclude those who refuse to pay for the use of the facility. Vessels using a given navigation channel are relatively easily recognizable. Those who refuse to pay would be subject to legal proceedings brought against them. For Goss (1990), the non-rejectability of consumption means that it is impossible for a user to reject the consumption of a good or service. Lighthouses and the police and security services are some examples. However, competition is so intense that some ships refuse these services and divert to other ports especially when

² Intra-port competition refers to a situation where two or more different terminal operators within the same port are vying for the same market.

the port serves a contestable hinterland. As Baird (2004) concludes, port users can reject a given port in favor of a competing facility elsewhere in the same region. The public good condition of non rejectability of consumption also therefore lacks substance.

In the port sector, lighthouses are the typical example of a public good. All the ships, no matter their number, can benefit from the light (Kaul and al., 2001). In several countries, notably in GB, lighthouses have been constructed by private investors, by maritime transportation companies or by partnerships³. Nevertheless, economists continue to define as public goods those goods that have the same features of lighthouses, specifying that it is not possible to fix a charge against their use given their indivisible costs. In addition to lighthouses, Sloman (1997) classifies pavements, dikes and police as public goods.

To identify public goods in seaports, Notteboom and Winkelmanns (2001) classify port activities into two categories. The first one includes services whose costs can be covered by user charges. In this category, one can find pilotage, berthing, handling and storage. The second category includes the services provided without any discrimination between users. This category includes navigation aids, security, and the provision of a dredged channel. These services are defined as public services and should be provided by the public port authorities.

Erol (2000) has a contrary view point concerning the privatization of pilotage. He thinks that it is a very important service that must combine quality and safety. He noted that the privatization of this service in some countries has not succeeded insofar as the competition pushed the private firms to minimize their costs by using unqualified staff and inexpensive equipment. In other countries, firms in a monopolistic position have discriminated between users in service quality and prices. The World Bank (2001, p71) has underlined the risks of privatizing pilotage and several countries have forbidden its privatization. This is the case of the EU countries and the United States.

Some of these suggestions are a reaction to the publication of the European Commission Green Paper (1997). This paper considers that port access, quays and services related to navigation aids are considered as public goods. Consequently, their public financing is justified. The definition of a public good given by the European commission seems to be dictated not by the intrinsic characteristics of the good itself, but by political considerations (Bergantino and Coppejans, 2000). The aim of the following section is to identify to which extent public investment in ports is acceptable, notably in relation to its impact on competition.

2.2. Public financing of ports

The role of ports in economic growth justifies government intervention (Song and al., 2001). The economic influence of a seaport also spreads beyond the industrial and commercial sectors of a nation to include a whole economic region. In practice, the responsibility of investment in ports is divided between the local, regional and federal authorities. In the most widespread model in the EU, the federal authority takes in charge dredging and investments in maritime and land access infrastructures, whereas the regional authority is responsible for the development of the operational infrastructures (construction and maintenance of terminals). It leaves to the private

³ Sechrest (2003) gives many examples of private provision of public goods from maritime history.

sector the responsibility to provide equipment and probably the other types of superstructure (buildings, etc.). In the autonomous ports in France, the state finances 80% of the investments in maritime access (dredging), 100% of their maintenance, and 60% of the investments in quays. For the remainder, the ports are self-financed, either by borrowing or financed by the local collectivities. However, there are no subsidies in the United Kingdom where seaports (public or private) must be self-financed.

Thus, there are two completely opposed arguments concerning the investment in the maritime ports. On one hand, the public nature of port infrastructures and their value added make it necessary for the state to finance them; on the other hand, subsidies hinder competition, and the non subsidized ports will be relatively penalized. Discussions about subsidies have increased with the increase in competition between Europeans ports.

Public authorities justify subsidies by the high costs of dredging and by the number of jobs that can be created once the port activity is maintained. However, Baird (2004) notes that the creation of employment on a local or national scale through the port activity, in spite of its advantages, cannot justify the subsidies. Indeed, the supply and demand of employment are determined by macroeconomic factors. Subsidies can only displace the supply or the demand from one market to another. Subsidies come with an increase in taxes which makes the port zone less attractive for residents and for industry. We can mention another inconvenience of subsidizing ports: subsidies allow imports to compete with exports which can lower the number of jobs. In some ports like Hamburg, Antwerp, Rotterdam, Le Havre and Bremerhaven, the expenses of dredging maintenance are substantial. Thus, Baird (2004) qualifies these expenses as "public investments" and thinks that the only arguments that can justify subsidies must be the net effects on producers, consumers and on the environment in the whole region concerned. Naturally, every member state is free to finance or not its maritime ports. However, and on a European scale, the investment decisions must take into account the environmental and economic consequences.

Van De Voorde and Winkelmanns (2002) think that states should distinguish between public and private infrastructure in order to identify what can be subsidized. They consider that the financing of the basic infrastructures is tolerated. However, they don't explain why these infrastructures must be subsidized, nor to which extent the capital invested constitutes some "public good".

A unique theoretical answer to the identification of public goods and their financing in ports doesn't exist. Indeed, the recent deregulation of port activity has shown that the private sector is also able to exploit infrastructures and to offer port services.

2.3. Port activity deregulation

According to UNCTAD (1992), one can distinguish three port generations. The first remained predominant until the 1950s: the port was limited to providing a refuge, to ensure the transfer of goods and the temporary storage and delivery of goods. The role of the second generation ports expanded to industrial and commercial activities and the port turned into a center of handling and services. This function became more pronounced again with the third generation. Since the beginning of the 1980s, and to this day, the port has become a center of logistics and distribution. Some important

European ports such as Rotterdam and Antwerp have blossomed according to this formula.

The port infrastructure was therefore, for a long time, created, maintained and exploited by the public authorities. This model has begun to disappear with the growth of private capital in the construction of the infrastructure and the supply of port services. The models of port organization differ by the degree of the intervention of the private sector in the supply of infrastructure, superstructure and services. There are mainly four models: the *Landlord* port, the *Tool* port, the *Public Service* port and the *Private Service* port (World Bank 2001).

Table 1: Involvement of the private sector in port activities.

<i>Management model</i>	<i>Infrastructure</i>	<i>Superstructure and equipment</i>	<i>Stevedoring</i>
<i>Public service Port</i>	Public	Public	Public
<i>Tool Port</i>	Public	Public	Private
<i>Landlord port</i>	Public	Private	Private
<i>Private Service Port</i>	Private	Private	Private

Source: Kruk (2005).

The most widespread model in European ports is the Landlord port: the public sector is owner of the infrastructures and is responsible for regulation and control, whereas the private sector supplies services. The port authority plays the mediator's role between the public and private sector by coordinating the process of investment (Alfredo and Sabatino, 2005).

Four types of reform tools have served to increase the involvement of the private sector in ports (World Bank, 2001; UNCTAD, 1995b). Firstly, commercialization consists of splitting the main port activities. It gives more flexibility to the created entities and authority to operate in an autonomous way. In practice, these entities don't enjoy total liberty since the state intervenes in the decision process, in particular pricing and investment policies. Secondly, corporatisation is where the port authority is transformed into a commercial organization. However, the infrastructure remains public property. The objective of the port authority is to make as much profit as private operators. The third tool is liberalization. This method permits the transition from a monopolistic structure to a form where the private sector is more engaged in the operational process and in investment. The last tool is privatization. For several authors, privatization is synonym to reform in the port sector whereas it is only a tool that permits the introduction of the private sector into the port sector (World Bank, 2001, p38). Few ports in the world have been completely privatized (for example in the United Kingdom, Hong Kong and New Zealand). Most countries prefer partial privatization where the terminals are privatized under a management contract or concession agreement or Built Operate Transfer (BOT)⁴.

Several motives are at the origin of port reforms: the need for resources to modernize the port, to finance the infrastructure or the facilities, to reduce costs and the public deficit and to increase efficiency in some activities by introducing more flexibility (World Bank, 2001).

⁴ See Trujillo and Nombela (1999) for a detailed description of these contracts.

The involvement of the private sector in the port industry seems therefore feasible and desirable. So that, this sector can face the increasing demand of maritime transportation. The type of the contract and price regulation are determining factors for the success of privatization and in the improvement of port efficiency. According to Song and al. (2001), the empirical studies haven't put into evidence the relation between the management model (public, private, or semi-public) and port efficiency. However, it has been shown that a positive relation exists between the involvement of the private sector in port activity and the increase in output (Estache and al., 2002). These conclusions are coherent with many economic findings that suggest that the separation between transportation activities where there are economies of scale (infrastructure supply) and other activities (the supply of services) reduces the total costs. However, one has to note that the fixing of cap prices can provoke the deterioration of the quality of services and can increase environmental damages.

Public ownership in the seaport industry has usually been justified by the argument that seaports play a key role for national economies, and they have special characteristics that can easily provide the firms running port facilities with market power (expensive specialized assets, sunk costs, indivisibilities and economies of scale) or some public good characteristics. Moreover, in some countries seaports are regarded as focal points for regional development, which justify the subsidies from governments for the building and improvement of port facilities. In the last two decades, a more competitive environment led to a consideration of the role that the public sector must play in the running of seaports.

International experiences have shown that private participation in both these aspects (operations and infrastructure) is beneficial for seaports. These experiences make a case for a revision of the traditional organization of seaports around the world, changes that will prepare ports for a more competitive market and less financial help from governments. The evolution of the port role and the involvement of private and public sector in port activity have induced a need of new models of port pricing. Thus, port pricing focused on the models of pricing that are based on cost but also on the strategic and commercial pricing that adjust more with the new forms of port organization. The forthcoming section is a literature review of the optimal port pricing.

3. Port pricing

3.1. Objectives and constraints

Pricing is the main tool of resource allocation. The major elements that enter into the determination of the pricing system for a port are objectives and constraints.

3.1.1. Port objectives

The politics of pricing depends on the fixed objectives. These objectives depend on the supplier of the service (public or private) and on market conditions. For example, the price fixed to maximize profit (objective of the private supplier, so commercial pricing), is not the one that could maximize the social welfare (objective of the public

supplier, so marginal social cost pricing) or the one that permits to maximize the receipts. Sometimes the prices are fixed in order to reach objectives such as security, environment or to preserve a minimal market share. For port infrastructure, Bennathan and Walters (1979) have identified a major distinction between the European and Anglo-Saxon doctrines for setting port prices. They argue that European prices facilitate the economic growth of the port's hinterland, whereas the Anglo-Saxons attempt to ensure that ports cover their costs and, where possible, make a profit irrespective of the effects on the wider local economy.

The different objectives are complex and are often incompatible (see the table below for some examples). Whilst there are many transport pricing objectives, economists often focus on the pursuance of economic efficiency in the transport sector alone. Prices that are socially optimal are seen as the first-best benchmark (marginal cost pricing), which is in most cases politically desirable.

Table 2: Pricing policy objectives and possible conflicts.

<i>Pricing Policy Objectives</i>	<i>Conflicts</i>
Economic efficiency vs. profit maximization (or cost coverage)	Efficient pricing of the use of transport capacity may lead to financial losses
Profitability vs. income distribution	Pricing for profitability may lead to higher transport prices with adverse effects on the poor income groups
Economic efficiency vs. macroeconomic policy	Macroeconomic price restraint policies may conflict with the need to increase transport prices during periods of congestion and excess demand

Source: Adapted from United Nations, 2001.

The main constraints for ports are related to the economic character of infrastructure and service production. These constraints lead some ports to choose one pricing system and not another.

3.1.2. Port constraints

Economists recognize that the market remains inefficient in the presence of two major problems that are the economies of scale and external effects. Indeed, when economies of scale exist, pricing at marginal cost does not generate enough revenue for the firm to be financially self-sufficient. Furthermore, the presence of externalities, in particular pollution, and security problems justify the intervention of the government in the production of port infrastructure and services. These constraints influence the chosen prices.

Sunk costs and economies of scale

The magnitude of fixed costs depends on the size of the port and its geographical position. For Rudolf (1995), in general, for container terminals, nearly 80% of the costs are independent of the number of the ships and the volume of the handled merchandise. For bulk merchandise, fixed costs are lower and represent 60% of the invariable costs with the volume. Much port infrastructure and equipment doesn't have any other use if the port activity is interrupted. Sunk costs are irretrievable investments and are sometimes much higher than fixed costs.

In order to analyze economies of scale for ports, Bennathan and Walters (1979) suggest that it is necessary to take into account two parameters which are localization and size effects. The localization effect concerns the optimal localization of the infrastructure and superstructures. As the demand varies, and the technologies of construction and dredging change, the present localization of the infrastructure becomes inefficient. The increase in demand and the construction of new sites entail high fixed costs that cannot be compensated by the decrease in the unit variable cost of the new infrastructures. Analytically, the port moves toward lower cost curves that didn't exist before the move to an optimal localization. The use of more efficient infrastructures and facilities in terms of volume and of deeper accesses (bigger ships can enter the port), permits a reduction of unit costs: this is the size effect. Bennathan and Walters (1979) conclude that, combining localization and size effects, all things being equal and for a given interval of handled quantity, the larger the port, the lower are the costs. Bennathan and Walters (1979) mention that economies of scale in ports are limited by the volume of the output and the size of the market in the hinterland and note, finally, that the structure of the costs in the port depends extensively on the geographical conditions and the indivisibility of the investments: some ports need more or less investment and maintenance according to their geographical location.

There are very few empirical studies on the evaluation of economies of scales for EU ports. The only studies have concerned Spanish ports. Both in infrastructure supply and cargo handling service, the authors have found increasing returns to scale. Four other studies have focused on economies of scale for the ports of Mobile, Melbourne and Ashdod. The results depend on the analyzed activity and the estimated function. The main conclusions are reported in the table below.

Table3: Economies of scale in port activities

<i>Author</i>	<i>Activity</i>	<i>Estimated function</i>	<i>Data</i>	<i>Scale economies evaluated in the approximation point</i>
Martínez Budría (1996)	Infrastructure	Monoproductive cost function	Panel data 27 ports in Spain	Increasing (S=3.47)
Jara Díaz and al. (1997)	Infrastructure	Multiproductive cost function	Panel data 27 ports in Spain	Increasing (S=1.43)
Jara Díaz and al. (2002)	Infrastructure	Multiproductive cost function	Panel data 26 ports in Spain	Increasing (S=1.69)
Reker and al. (1990)	Terminal-berth of containers	Production function	Panel data Three terminals in the port of Melbourne	Decreasing
Tongzon (1993)	Terminal-berth of Containers	Production function	Panel data Three terminals in the port of Melbourne	Increasing
Tovar and al. (2005)	Cargo handling	Multiproductive cost function	Panel data Tree port terminals in the Las Palmas port in Spain	Increasing
Chang (1978)	No mention	Production function	Time series for the port of Mobile	Constant
Kim and Shachis (1986)	Infrastructure and Services	Monoproductive cost function	Time series (the port of Ashdod)	Increasing (S=1.3)

Pricing at marginal cost, when there are economies of scale, leads to a financial deficit. Unless the port activity is subsidized, the application of another pricing system is required.

Externalities

In transport infrastructure, external costs are those imposed by the users of the infrastructure on the others. These costs may take the form of congestion, accidents and environmental costs. The efficiency of maritime transportation is heavily dependent on the smooth operation of land transportation. The ease of cargo handling and swift modal transfers are keys to successful intermodal operations. Port congestion poses a serious problem for handling firms and can be sometimes too expensive for them. This cost can come back in terms of more elevated rates of freight, a congestion of the traffic associated with the handling operations, a decrease in the level of security and a loss in terms of competitiveness in the whole region. Port authorities can prevent such problems by changing prices to adapt the supply to the demand, so by imposing congestion charges.

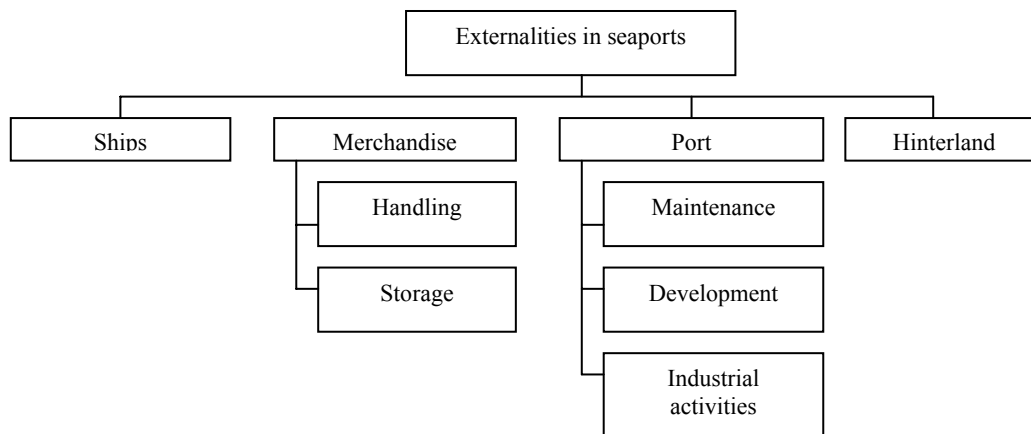


Figure 1: Sources of externalities in seaports.
Source: Adapted from UNCTAD (1993).

Given their position in coastal areas and the great variety of substances handled there, ports (especially those of a certain size) are now considerably complex systems from an environmental point of view. They tend to be associated with water and air pollution, soil contamination, problems related to dust and noise, the generation of waste, dredging operations, movement of ships, lorries and trains, warehouse storage of hazardous substances, etc.

In addition, ports are usually close to urban centers. That means that the impact on the environment, including people, of certain accidents can be very serious. Given the properties of some substances that pass through ports (chemical products, hydrocarbons, fertilizers, etc. (Planas-Cuchi and al., 1997) and the operations that are carried out on them (loading and unloading, storage, transport) the possibilities of there being an accident are not negligible. In fact, there are periodic fires, explosions and toxic releases, with possible consequences of financial losses, etc. In addition to these direct consequences, another quite important aspect of these situations is the negative image

they give to the port, with the possible creation of a feeling of rejection among the population (Planas-Cuchi and al., 1998). All this justifies the importance of taking into account external costs when fixing prices.

The economic consequences of the economies of scale and externalities have justified for a long time public intervention into port activity. Considering their geographical position and the network of transportation, several European ports form, for a very big part of their traffic, a natural monopoly, notably when they constitute the necessary passage for a maritime company between two links. Between competition and monopoly, and with the evolution of the role of the port (from regional economic interest to a multiproduct firm), the literature of port pricing has focused on the pricing systems based on costs but also on other systems like strategic and commercial pricing.

3.2. Port pricing: literature review

Optimal pricing, although discussed considerably less in the economic theory for ports than for the other transportation infrastructures, remains the most controversial question concerning port economics. The first discussions on optimal pricing for port infrastructure and services began in the 1970s with Heggie (1974) and Walters (1974) and continue until now with Goss and Stevens (2001) and Haralambides (2002).

The current ideas on port pricing didn't have any theoretical foundations and just expressed points of view and recommendations. For Gardner (1977) for example, port tariffs traditionally based on ships and goods characteristics, should only be based on the nature of goods themselves. Whereas Thomas (1978) notes that port tariffs could form a meaningful proportion of the ocean freight rates. According to him, these charges must take into account several factors such as the nature of the commodities, their volume, the elasticity of demand and the type of the ship.

The end of the 1970s were characterized by the development of these rather simplistic thoughts and pricing systems toward the recommendation of more suitable pricing policies based on costs and efficiency objectives. With the recent participation of the private sector in port activity, other pricing principles, such as commercial or strategic pricing, have emerged. The presence of several actors in the port and the conflicts of interests between them are the main reason for "There is no single solution to the port pricing problem" (Strandenés and Marlow, 2000). The principles of port pricing can be classified in two categories: cost based pricing and alternative pricing methodologies.

3.2.1. Cost based pricing

Port authorities must have at least minimal knowledge of short and long-run costs of infrastructure use. This knowledge is necessary for an efficient running of the port activity, to adopt the best financial and administrative techniques and to take the appropriate investment decisions. As the scheduling of investments and the evaluation of the demand elasticity pass by prices, tariffs must correctly reflect the level of costs. This principle must be applied separately for all the activities in the port (infrastructure and services). The debate on cost based pricing turns mainly around marginal cost pricing (MCP) which is efficient and fair from an economic view and the methods of costs recovery.

Marginal cost pricing and congestion pricing

Marginal cost pricing in ports found its justification in public economy. In fact, most authors consider that ports are public goods, like road infrastructure, and that users should pay for the marginal social cost (MSC). This approach that privileges users who are ready to pay for the totality of the costs including the external costs, has been supported by some economists. However, the only externality that was considered was congestion.

Button (1979) set out to assess the viability of an economic-based pricing system arguing also that the users of a port (when viewed as a public utility) should be charged the full marginal social opportunity cost of the resources that they use. Using a simple model dealing with the economic allocation of car-parking places, he demonstrates that once the port capacity is not optimal, port authorities must levy a congestion charge to eliminate the excess of demand.

Bennathan and Walters (1979) conclude that, under perfect competition hypotheses, optimal port pricing is the one based on the short-run marginal cost if port capacity is optimal. They also note that there are economies of scale both in the supply of port infra and superstructure. So, short-run marginal cost pricing leads to a budget deficit and the port activity must be subsidized. These authors recognize additionally that these perfect conditions don't hold in reality. In general, ports are organized as a monopoly or cartel. The capacity is rarely optimal and the port must always face quay and hangar congestion. Bennathan and Walters (1979) show, supposing that port activity is monopolized, that it is more advantageous for the port authorities to increase the prices once the demand exceeds the supply. First of all, it constitutes an opportunity to appropriate the surplus caused by the growth of the demand. Secondly, these resources can constitute a self-financing for future investments. The third advantage is that congestion taxes encourage a more efficient use of the infrastructure. The main problem of congestion taxes remains administrative difficulties. Moreover, when some port charges are combined, it becomes difficult to fix the optimal tax.

Goss and Stevens (2001) join Bennathan and Walters (1979) in giving some arguments in favor of the short-run marginal cost pricing. They note that, under some conditions, this pricing system maximizes social welfare. The first condition is that all costs must be taken into account including those that don't appear in the accounting. These are externalities like congestion, pollution and noise. The second condition is to use a definition of marginal costs adapted to the accounting system. The last hypothesis is that all prices in the economy must be set to a marginal level. The exclusion of some externalities and the existence of some monopolistic pressures and taxes are barriers to the validity of this theory.

The defendants of MCP distinguish between long-run and short-run marginal cost pricing⁵. At this level, the points of view are different enough. By explaining the consequences of short-run and long-run marginal cost pricing under three different hypotheses (optimal capacity, sub-optimal capacity, and over-capacity in ports),

⁵ Long-run marginal costs also include the capital costs of increasing capacity to accommodate an increase in output but have proven rather difficult to measure. It is only where capacity is non-optimal that the issue arises. Short-run MCP is seen as offering optimal use of existing capacity, whereas long-run MCP offers appropriate incentives to invest, although it may require regulatory action to ensure that the investment takes place.

Bennathan and Walters (1979) conclude that in all these cases, it is worth fixing prices at short-run marginal cost. Contrary to these two authors, Haralambides (2002) and Bromwich (1978) think that pricing must be based on the long-run costs in order to ensure the economic viability of the port. We can see clearly the difference between the two concepts by taking a look at the following graph, adapted from Haralambides (2002).

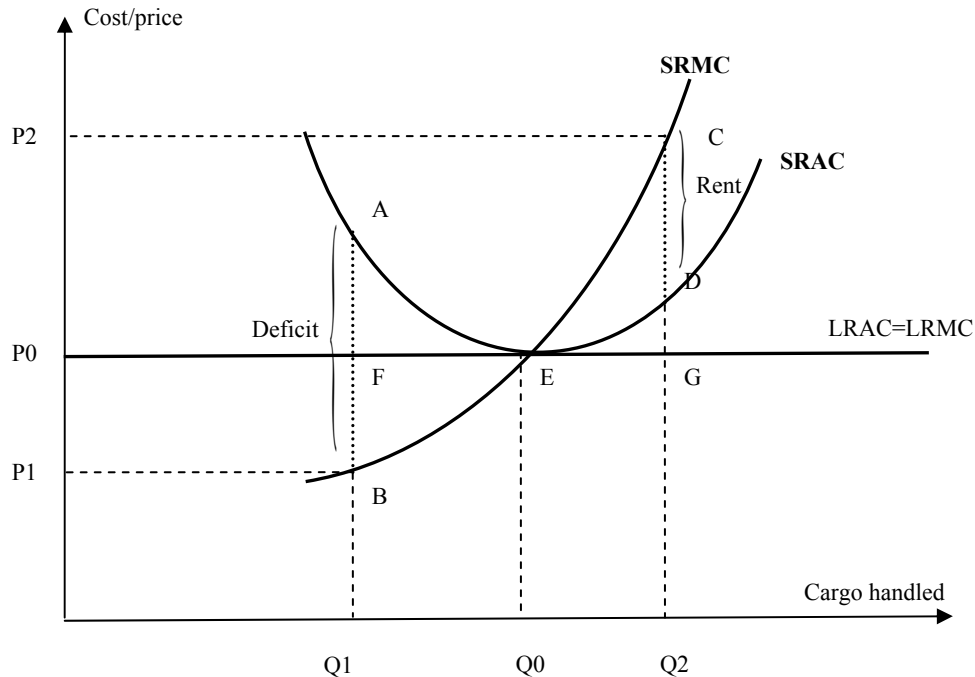


Figure 2: Marginal cost pricing in ports.
Source: adapted from Haralambides (2002, p333).

Assuming that the seaport operates under perfect competition, we suppose that the production structure is adequately described by SRMC (the short-run marginal cost), SRAC (the short-run average cost) and LRAC and LRMC (respectively the long-run average and marginal costs). Suppose first that the port operates under economies of scale and then the level of demand it has to satisfy is Q_1 , which is smaller than Q_0 . Pricing at short-run marginal cost (P_1) will lead to a deficit of AB . However, pricing at long-run marginal cost (P_0) will reduce this deficit to AF . For Haralambides (2002), if the port pursues a cost recovery objective, pricing at long-run marginal cost is more appropriate⁶. Public funding in this case is allowed given that it is temporary and declining. Indeed, given economies of scale, in the long-run (the point F gives the long-run equilibrium), the quantity of output Q_1 will be produced by a much smaller port. On the contrary, if the capacity is suboptimal, the port exhibits diseconomies of scale. The demanded quantity of output is given by Q_2 and congestion is a chronic problem for the port. At the same time, the port realizes economic rent given by CD . For Haralambides (2002), this situation is not sustainable in the long term. Attracted by the supernormal profits, the port's competitors will invest and expand to capture part of the economic rent, what gives the long-run equilibrium position of the port at the point G . In the case of constant returns to scale (the equilibrium is situated at point E), long-run and short-

⁶ However, for Bennathan and Walters (1979), low prices ($SRMC < LRMC$) reflect the excess of capacity and encourage the use of the infrastructure. Short-run marginal cost is then more appropriate.

run marginal costs are equal. Pricing at marginal cost will attract just enough traffic to cover the port's cost. This was the spirit and philosophy of the European Commission's White Paper on fair payment for infrastructure use which ascertained that "the entire infrastructure complex of the EU as a whole may not exhibit economies of scale". This means that, at least, at an aggregated level, it should be possible to recover total costs through pricing at marginal cost (Haralambides, 2002).

The choice between short-run and long-run marginal costs depends on economies of scale and the efficiency of the investment policy (capacity). The marginal cost determination is complicated, in particular for port services and infrastructures. In fact, several costs are common which make the differentiation between variable and the fixed costs associated to every service difficult enough.

The approach of marginal cost pricing, which is a merely theoretical approach, has been criticized because of the difficulty of the evaluation of marginal costs and the application of this system in the real world. This has led some economists, who recognize all the same that port pricing must be based on costs, to recommend other more convenient pricing systems that permit the recovery of the costs such as the Ramsey pricing and two-part tariffs.

Ramsey pricing and two-part tariffs

In his paper, Button (1979) evokes the drawbacks of marginal cost pricing and suggests three methods to recover the costs. The first consists in subsidizing the port activity, the second consists in applying discriminatory charges between users and the last method intends to apply the two part tariff. In order not to diverge from a marginal cost pricing, Button (1979) suggests that the first tariff component equals the marginal social cost and that the second consists of a fixed charge levied for the right to use the facility.

Walters (1974) also thinks that marginal cost pricing constitutes an appropriate basis for port pricing. But when the port is congested or when there are economies of scale, it is necessary that port authorities set prices higher than average cost (which is not the marginal cost in most cases). Through examples of dredged channels supply, congested ports and cargo handling, Walters (1974) argues that two part tariff is more appropriate for ports than marginal cost pricing. Two part tariffs have the advantages (based on costs) and not the disadvantages (budgetary deficit and subsidies) of a marginal cost pricing.

Heggie (1974) was also one of the first economists to put forth some arguments in favour of cost based pricing. For him, the achievement of the port objectives and fairness are the most important reasons for which pricing must hinge on social costs⁷. Heggie (1974) opposed discriminatory and non transparent subsidies in particular and suggested the revision of the pricing system after every new investment. For Heggie (1974), in the case of congestion, excessive demand requires an intensive use of the infrastructure that should come with an investment. Fairness requires the spent capital to

⁷ For Heggie (1974), social costs include environment and accident costs. But these are difficult to estimate.

be collected from the users through pricing rather than local taxpayers⁸. Therefore, it is necessary to apply a suitable pricing system by taking costs into account.

Jansson and Rydén (1979) developed a theoretical model of optimal pricing based on the costs of the inputs. Their proposition is different from the two-part tariff system used in the ports. Indeed, their model divides the port charges into two parts. The first component is a charge per ton of cargo that would be differentiated with respect to the elasticity of demand. And the second component is a charge levied on the carrier to reflect the opportunity cost of using the facility that is, optimal occupancy charges. It is the Value of Service Principle (VSP) that is similar to the Ramsey pricing (Ramsey, 1927) where the costs allocation permits the reflection of the elasticity of demand and recovery of the costs. In this case, the common costs are allocated reflecting differences among different users in elasticity of demand for the specific port services. Monopoly port services tend to be inelastic as long as port costs make up a fairly low share of the price of the cargo though even in monopoly ports there may be alternatives for storage outside the port. Elasticity of demand therefore may be lower for cargo handling services than for the navigational aids offered by the port. If so, this difference should be reflected in the allocation of common costs.

3.2.2. Alternative methodologies

Strategic port pricing

According to this approach, pricing is a strategic issue that must be guided by the port objectives. In his paper, Meyrick (1989) had considered that "insofar as the focus in pricing is on costs at all, it is on the average cost of service provision rather than the marginal cost" and that typically "port accounting systems are incapable of providing a basis for pricing on anything other than an average cost basis". He concluded his paper by suggesting several axioms for port pricing. He argues in particular for full cost recovery and that those costs arising from services or facilities provided for an identifiable user or group of users should be recovered from that user or group of users.

A similar axiomatic approach has been proposed by Talley (1994). He showed that this method can avoid the conflicts which might emerge between marginal cost pricing and full cost recovery in ports. He defines the axiomatic approach of pricing as "a pricing mechanism which determines the prices of the outputs of multi-product firms by allocating the full cost of production to all the outputs". Supposing that the demand for port services is relatively inelastic with respect to port prices and taking the pricing mechanism of Aumann-Shapley (that respects the following five axioms: cost sharing, rescaling, consistency, positivity and additivity), Talley proposes four axioms applicable to port pricing. These are rescaling, attributability, allocating and additivity which he then applies to container terminals. This methodology can help port authorities to determine prices that allow for full cost recovery without having to estimate marginal costs.

Finally, UNCTAD (1995a) mentions that pricing is a strategic question. Port authorities have to choose between the economic method based on marginal cost pricing and the financial method based on cost accounting. The chosen method can serve to

⁸ Heggie proposes a pricing formula that takes into account operational costs (including the costs of capital replacement). See Heggie (1974) for more details.

accomplish the different objectives of the port. It is the CPV approach (Cost, Performance, and Value) that determines an interval for prices. Its pillars are as following:

- A cost based pricing for the port use.
- Pricing based on performance maximizes the output and reduces the congestion.
- Pricing based on the value of the services sufficiently generates income to cover the costs.

In order to improve the competitiveness of the port sector, Strandenes and Marlows (2000) proposed a pricing system based on the quality of the services that is, commercial pricing.

Commercial pricing

In most sectors of the economy, prices depend on the quality of the good or service. For Strandenes and Marlow (2000) port tariffs must be based on the quality of the services since it is quantifiable. The dimension "quality" includes some elements such as the time in port, punctuality, handling with minimum of damages, etc. The authors recommend a two-part tariff system. The first component doesn't depend on the quality of the service. The second one increases with the level of quality (reflected by the duration of port stay, the waiting time etc.). Such a pricing system sensitizes the port authorities and the ship-owners with respect to time (delays of transportation and handling). It also permits the improvement of the competitiveness of maritime transportation in relation to road transportation.

The ratio equilibrium

The ratio equilibrium can be interpreted as a competitive equilibrium of a market economy for which each agent receives a price signal, that consist in paying a share of the total cost personalized in such a way that each agent demands the same quantity of the good (Bergantino, 2002). The solutions obtained fall within the stand alone core: in other words, if each agent has the possibility of constructing the infrastructure that he needs, with existing technology, he would pay more than the share of the cost that he would have been assigned through the ratio equilibrium allocation criteria. Bergantino and Coppejans (2000) apply this concept to allocate maritime infrastructure cost and determine the optimal tariff structure for calculating the usage fees for the access channel to the port of Antwerp.

The general conclusion that one can draw from the review of the literature on port pricing is that "the prices must be based on the costs" (Button, 1979). However, the choice of an optimal "basis" for pricing, in spite of its theoretical interest, hasn't found the necessary attention when it concerned its implementation. The financial results are the privileged objective of the port authorities and the principles of social welfare are little known by decision-makers. The systems of pricing have remained complicated and have rarely reflected the structure of costs (Meyrick, 1991). According to Goss and Stevens (2001), it is in part the economists who excessively complicated the concepts and don't explain the direct relation between the economic theory and port activity. They rarely explain the difference between long-run and short-run costs and the

importance to go beyond the costs to include social costs. With regard to social costs, very few authors have noted the importance of internalizing the costs of accidents and the environmental costs (see Heggie, 1974; Button, 1979). The following section intends to investigate the possible implementation of MSCP in European seaports.

4. Implementation of MSC pricing in ports

4.1. The European Commission point of view

On a European level, the question of pricing in transport has often focused on the debate concerning budgetary balance versus marginal social cost. This debate results from the theoretical arguments in favor of the two approaches. The preoccupations of the EC have evolved toward the integration of environmental costs into its pricing policies. In its Green Paper (1995), the EC underlines the importance of setting an efficient and equitable pricing system. The Green Paper indicates that a very clear shift exists between the prices paid by the users and the real costs. In particular, the costs related to accidents, to congestion and scarcity and to pollution are partially covered. The European Commission's 1997 Green Paper advocates a general framework requiring charges to be linked to costs. Different approaches are possible with regard to infrastructure costs: average cost pricing; charging for operating costs only and marginal cost pricing. Outside the port area, the Commission advocates a user-pays policy for all modes of transport, which would make for fair competition and affect the distribution of cargo flows among European ports. In 1998, the European Commission's common transport policy led to a White Paper which established the EU's intentions to apply short-run marginal social cost pricing to all transport modes. The major motivations behind this pricing policy are to improve efficiency, generate revenues and internalize the various externalities (congestion, scarcity, noise, environmental emissions and accidents).

Short-run marginal costs are the additional operating and maintenance costs associated with a marginal increase in output without any increase in physical capacity. If external costs are also included, this is referred to as marginal social cost (Alder and al., 2003). When capacity is optimal, short-run and long-run marginal costs are equivalent. The first one tends to be associated with regimes where government bodies take investment decisions and the second with regulated private infrastructure managers. However, another important issue is the time lags both in the adjustment of demand to price and of capacity to demand. Where capacity is slow to adjust and where demand adjusts reasonably quickly, short-run MCP is likely to be more efficient. This is indeed the approach taken by the EC, although not all economists agree. However, the issue of port pricing and the commission's involvement in it has not only risen from an academic basis but also as a response to the need felt in the port industry itself for a self disciplining mechanism that, if consistently applied, would eventually lead to the recovery of port investments and to future investments that are largely demand driven. This requirement has been the result of the recognition that, in the intensified regional port competition of today and the increasingly tightened fiscal constraints of an integrated Europe, it is no longer acceptable to discriminate and without a formal economic rationale spend taxpayer money on port investment, often aimed at increasing

market share at the expense of the other ports, particularly those in neighboring member states (Haralambides and al., 2001). Nevertheless, the question which arises is whether the adoption of any financing or pricing system, or set pricing principles at the European level would be a valid policy option, given the significant constraints that exist and that may prevent or delay the implementation of MSCP in ports. These constraints include economic, organizational and acceptability-related barriers.

4.2. Barriers to the implementation of MSC pricing

4.2.1. Economic constraints

The analysis of present pricing policies in European ports, conducted as part of the ATENCO study, demonstrated the substantial diversity prevailing among EU ports with regard to their financing, accounting and charging practices. This diversity is deeply rooted in various judicial and cultural traditions, as well as in the divergent port management styles, related responsibilities and degree of autonomy. Current port pricing practices have been mainly based on empirical intuition and past trends. These tariff levels do not reflect the actual costs levied by the port operations and they do not recover all the costs, thus creating severe inefficiencies such as congestion as well as sources of significant financial loss. Meersman and al. (2002) argue that outlining a typology of current port pricing schemes is not possible due to the complex, untransparent and archaic systems in existence at present.

European ports work under widely different conditions. Some ports suffer significant overcapacity, while others are lacking in infrastructure. Indeed, it is difficult to say that short-run MCP is an efficient pricing basis for all ports. Another argument, is the one that "in attempting to apply MCP to ports, a practical problem arises – the inability of ports to determine the marginal costs of their services" (Talley, 1994) and the difficulty to estimate external costs. Mayers and Proost (2003) showed that efficiency, equity and acceptability of any reform in pricing, depend not only on the change in transport prices, but also on the way the extra revenues are used. Here, one can wonder if implementing MSCP in privatized or semi-privatized ports is appropriate. Applying the polluter pays principle in seaports must be highly regulated to ensure that private operators use efficiently tax revenues to reduce port externalities. Furthermore, efficient pricing in the port sector will not be able to bring about the expected welfare effects if the rest of the related infrastructure is not priced accordingly. The issue thus appears to be reaching a standstill, particularly in view of the fact that in most countries, ports are considered as part of the country's infrastructure and thus State investment in ports is considered as 'public investment' outside the reach and mandate of the European Commission. In this particular context, Haralambides and al. (2001) note that, a voice that is often loudly raised, by both the commission (recently) and the port industry, argues that MC pricing applied to ports only, will make port services 'unilaterally' more expensive thus penalizing the union's efforts to check road traffic and promote short sea shipping.

Some authors note that pricing matters (at least in a liberal economic environment such as that in the EU) ought to be, ideally, left to the producers (ports) themselves (Haralambides and al., 2001). They argue also that greater private sector interest in the port industry, as well as in the rest of the Europe's infrastructure, necessitates some form of cost based pricing that would allow the recovery of port investments. This could,

however, disturb the existing "equilibrium" among ports that has been established over the years as a result of each port's particular characteristics such as geographical location, proximity to markets, navigational constraints, subsidies and types of financing. Among competing container ports, like those of Western Europe, such a "disturbance" can have marked impacts on ports' market shares, as a result of the ease with which carriers can nowadays switch between ports. Swahn (2002) argues that port infrastructure pricing, given certain boundary conditions of accounting and transparency, could be left up to ports as market actors without causing any significant distortions.

Finally, Matthews and al. (2002) state that "MCP is clearly much easier to implement where the infrastructure manager is a public body, funded largely from general taxation, as in Sweden". On the other hand, Jansson and Shneerson (1982), Verhoeff (1981) and Dowd and Flemming (1994) think that it is more difficult to allocate costs in *Public Ports* in a way that is largely arbitrary compared to costs in *Landlord Ports* where more clear lines of responsibility and accountability exist.

4.2.2. Organizational constraints

If the aim of a global European policy is the establishment of a "level playing field" among competing European ports, it should be recognized that any assessment of potential improvements cannot be solely undertaken in terms of purely market based considerations. In contrast to many other sectors where liberalization and market based rules have been widely credited as instrumental to the creation of better and best practices, the diversity of the port sector requires uniform methods of accounting and cost recovery using a step-by-step approach. Undoubtedly, such an approach should consider, at least in the short-run, national perception on the appropriate role of public investment, still the prerogative of member states. However, considerable progress could be made through efforts aimed at harmonizing definitions and classifications of port infrastructure. Current classifications (eg. investment inside or outside the port area) often lack an economic rationale and are instead based on technical or geographical considerations aimed at determining whether investment costs should be allocated directly to users or to society at large (Haralambides and al. 2001).

Pricing external costs will need to establish some organizational structure to ensure that taxes are effectively used to reduce congestion and environmental damage. Given the different port models, this seems to be relatively complicated. The lack of data and the lack of harmonization of pricing principles across EU countries is also not considered. Both parameters imply that, to make some headway in formulating institutional change, substantial attention should be devoted to historical trajectories and path dependencies associated with specific (sub)national port financing and pricing routines. If not, the danger exists that substantial unintended policy effects might arise.

Alder and al. (2003) note also that, for ports, there is no agreed pricing formula defined at the EU level or EC Directive, as there is currently for rail. "For inland shipping and waterways, the major barrier to the implementation of any pricing scheme on the river Rhine is the Mannheim convention (1868), as one of its main principles is exemption from navigation duties. However, this does not prevent the introduction of port related charges, but rather will cause difficulties in introducing en-route charges to account for emission externalities" (Alder and al., 2003).

4.2.3. Acceptability

The increasing transformation of ports (at least for competing regional container terminals) from public to private enterprises raises the issue of the desirability and fairness of pricing methods focusing on the "user" rather than the "general taxpayer" (Green Paper, 1997). Cost recovery implies that port revenues will be generated from the user of a facility, who will have to somehow pass these costs on to the final consumer. This consumer will in all likelihood have to pay higher prices for the goods he consumes but, at least in efficient markets, he is compensated by correspondingly paying fewer taxes (for infrastructure investments). Obviously, the problem that arises is the acceptability of such a switch. By changing prices, port authorities and private companies fear that users will move to other ports.

The power of oligopolistic shipping lines and hub ports are likely to pose serious political barriers to MCP implementation. Indeed, in the seaport sector, several actors may be involved in the vertical port activities chain and the horizontal port activity cluster. Because of the potential of unintended policy impact, different financing disciplines externally imposed on ports may disturb the effective horizontal and vertical linkages among the various port actors.

5. Conclusion

We have witnessed in recent years a significant change in the organization of the port industry in the EU. The British port sector is a very good example in this respect. Private sector intervention has affected all the port services and activities, even those that were considered as public goods and those that must be controlled by the public authority for security and environmental reasons (aids to navigation, pilotage, dredging, etc.). While such sweeping change has not occurred in the case of continental ports, there has been an unmistakable trend towards greater autonomy and a more substantial private stake in goods handling. We can find different management models in EU ports where the involvement of the private sector varies widely (*Public Service port, Tool Port, Landlord Port and Private Service Port*). In spite of these changes, the European legislation seems to lack precision when it concerns identifying and financing public goods in ports.

Neither is the situation clear concerning pricing. The Green Paper (1997) suggests several pricing methods (marginal cost pricing, average cost pricing, etc.) to ensure cost recovery and to apply the user-pays principle. To establish a common European transport policy, the White paper (1998) recommends the application of marginal social cost pricing (MSCP) to all transport modes. This pricing approach will improve efficiency and ensure free and fair competition in the transport sector. Nevertheless, the EC has not specified which costs should be taken into account in the port sector. Although MSC constitutes a first best in economics, its application seems to be controversial in the port sector. We can find economic, organizational and acceptability related barriers to its implementation.

On the one hand, if there are economies of scale, MSCP leads to a financial deficit. Therefore, port activity needs to be subsidized. On the other hand, subsidies hinder competition, especially in some economic regions like the EU. So, free and fair

competition and MSCP in European seaports are two incompatible goals. Even if we suppose that the port authority may let several private operators do a bid to acquire the port operation where the private operators also mention the prices they will charge to the users and the subsidy they wish to receive from the port authority, several organizational constraints will form a barrier to the application of MSCP. Moreover, this will certainly create inefficiencies and acceptability problems in the port sector. The lack of European harmonization in what concerns accounting, financing, the physical infrastructure limits and the costs to take into account are also barriers to the implementation of MSCP. Other reasons are related to the difficulty of estimating marginal costs, both internal and external. Finally, there are acceptability constraints. For the users, port prices and dues will be higher if they have to pay for external costs too. Ports authorities and operators fear that they will move to other ports. For the consumer, the price of goods will be higher. Here, the problem arises whether they will agree to pay higher prices for goods and less tax for infrastructure investment.

Therefore, although some aspects of MSCP are important and appreciable (attention to environment, necessity of a cost based pricing and for harmonization to improve efficiency, etc.), this pricing principle does not seem appropriate to meet the objectives of the European commission. We think that MSCP permits the application of users/pays principle only if marginal costs are calculated for each activity when analyzed individually. Given the economic characteristics of seaport costs and the diversity of port activities, this seems to be very difficult. Moreover, European Commission objectives concern the development of a level playing field between ports and the reduction of public financing in port infrastructure. MSCP is not, by definition, consistent with all these objectives.

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