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Competition, Excess Capacity, and the Pricing of Port Infrastructure

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The pricing of infrastructure, such as this of commercially competing ports, is one of the most controversial aspects of the global economy of the 21st century. The controversy arises from the need to reconcile the economic development impacts of infrastructure investments with the, under commercial terms, recovery of investment costs. In developed countries and regions, the role of 'public investment' is thus re-evaluated, while the concept of 'competition on infrastructure' is increasingly challenged by the need to establish a level playing field among competing ports. The paper shows how Marginal Cost Pricing of port infrastructure can be a powerful 'pricing discipline' towards achieving cost recovery and fair competition among ports. To succeed in this, the paper advocates for stronger policy intervention in order to ensure greater transparency of port accounting systems, better and more harmonised port statistics, a meaningful set of state aid guidelines, and stricter application of Competition Law in port infrastructure investments.
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INTRODUCTION

In ports, as in many other industries, prices – port dues and cargo-handling charges as they are often called – can 'make' or 'break' a port. The right prices can lead a port to prosperity and growth; the wrong ones can guide it to extinction or to the proliferation of subsidies and inefficiency. High prices would normally

deprive a port of part of its patronage (vessels and cargo owners) and thus reduce demand for port services. Since, once a port is built, it has few alternative uses if any, ie its investments are largely sunk[1], excess capacity will ensue as a result and resources and infrastructure will become underutilised. Even when ports have some degree of monopoly power over their customers, and thus demand for port services is not reduced much, high port prices would still hurt the very trade the port is supposed to serve.

Low port prices, on the other hand, may bring clientele to the port but congestion could ensue, investment costs may not be recovered in the long-run and the port's competitors may grudge about unfair competition, particularly when low prices are the result of subsidies.

In competitive industries, a producer has no influence on the price he sells his product or service; he either adjusts his costs to the externally determined price or he vanishes. A port, however, operates in an oligopolistic industry where pricing refers to 'strategic pricing', ie the ability of the producer to influence or set prices in order to achieve certain objectives. Such objectives, many of which simultaneously pursued albeit in conflict, include profit maximisation; throughput maximisation; generation of employment and economic activity; regional development; minimisation of ship time in port; and, last but not least, the promotion of trade.

However, the pricing strategy of a port is dependent on the way the port is financed and, ultimately, on the ownership status of the port: should, thus, a publicly owned and financed port be allowed to compete on price, for the same custom, with a privately owned port that has to charge higher prices in an effort to recover its investments? What if these ports are in the same, economically interdependent[2], geographic area? What if the effects of strategic pricing of different ports are, at the end of the day, felt by the same consumers or taxpayers? Should ports primarily engaged in commercial operations, such as container terminals, be publicly financed or should the port user pay in full for the port services he buys? Do ports need to recover infrastructure costs through pricing? And what happens if some do and others don't while all have to compete for the same hinterland? Is there such a thing as 'efficient port pricing' and is there scope for policy intervention to ensure a level playing field? These are some of the pertinent questions in port pricing that this paper aims to address with special emphasis on container ports.

THE PRODUCTION OF THE PORT SERVICE

There is no such single thing that could be adequately described by the mere word 'port' and no two ports are alike. A port could be from a small sheltered patch of

sea that protects fishermen from the roughness of the sea, allowing them to moor their boats and trade their wares in safety somewhere in the south pacific, to the huge industrial complex of the city-port of Rotterdam, embracing in its expanse hundreds of companies, roads, railway lines, distribution centres, refineries and other industrial and manufacturing activity.

Regardless of how it is developed and organised, however, a port's main function is to enable, hopefully in a safe and cost effective manner, the transfer of goods from sea to shore and *vice versa*. As such, a port is an interface between sea and land; a node in a transport chain; a point where goods change mode of transport. Cargo-handling is thus a port's core business. In order to do this, a port has to organise a large array of other services, all equally important in the facilitation of cargo transfers: it has to provide (dredge) sea channels and turning basins of adequate depth (draft) to enable the approach and manoeuvres of vessels; navigational aids, breakwaters, pilots, tugs and linesmen to allow vessels to moor and unload safely; equipment to handle goods in port and move them around; warehouses to store them until they are picked up by their owners; electricity; water; security; customs; administrative offices and many more.

The paramount good a port has to provide, however, in order to facilitate all this is *land*. A port is a land-intensive industry. Here is the first issue where *port pricing* encounters its major stumbling block: what is the value of land? What is its opportunity cost? Under what terms should port land be made available to private port operators, stevedoring companies and others?

In many places in the world, land, particularly land close to the sea, is a scarce good with high opportunity cost and many potential claimants. Cities can use it for residential and office space; offshore industries have to be located in its proximity; tourism and recreation industries would naturally consider it as prime location; fishermen would also value it highly, while nature lovers would tend to preserve it, and its ecosystem, at all costs. This is why port management, or the supervision of port activities and expansion, is often entrusted to municipal authorities who strive to steer a balanced course and reconcile harmoniously the various interests at stake.

More important than the land itself, however, is how, and by whom, land is developed to become ready to provide the port service. Often, land has to be reclaimed from the sea, it has to be paved, reinforced, roads and rail trucks have to be constructed on it, while to extend a port, even by just a few hundred metres of quayside, would require massive investments. The way these investments are financed, ie publicly or privately, in other words the ownership status of a port, bears the most upon the way port services are priced. Simply, a publicly owned port infrastructure does not have to recover (through prices) investment costs and thus its prices could be quite low and competitive *vis a vis* a privately owned port that has to recover investment costs and, other things

being equal, would thus be at a competitive disadvantage had it to compete with a public port.

PORT COMPETITION

In the past, particularly after WWII, the development and provision of infrastructure was largely in the hands of the State. Often, infrastructure was considered as a public good, serving the collective interest of the nation by increasing social cohesion as well as by expanding markets for inputs and output, ie bringing people to work and goods to consumers. This allowed for mass production, low unit costs and international competitiveness. With the exception of some developing countries, infrastructure was thus invariably developed ahead of existing demand – on the part of the industry, agriculture and commerce – in the hope that the latter activities would expand in the wake of the former (infrastructure) (Rosenstein-Rodan, 1943). A notable example of this was the case of the North American railways, particularly those of Canada. Furthermore, large capital indivisibilities in infrastructure development, coupled with substantial financial requirements and long gestation periods until demand picked up, had made infrastructure development the prerogative of the public sector.

With regard to ports in particular, in the past, general cargo traffic was less containerisable, regional port competition was less of an issue, and ports were comprising a lot of labour intensive activities, generating considerable value-added and a multitude of direct and indirect impacts on the national economy, including of course the facilitation of international trade. They were thus seen by governments as growth-poles of regional and national development and, as a matter of fact, they were often used as instruments of regional planning. Around the world, countries have done so by steering public investment, through regional policies, towards ports, in order to encourage national development. Thus, investment costs did not have to be recovered, being financed by the taxpayer through the general government budget or similar local or municipal sources.

Ports were fairly insulated from competitive forces, each serving its own, more or less captive, hinterland. This was due to trade barriers, national borders and inadequate land transport infrastructure. No matter how inefficient the port, the ship would still have to go there. Most ports were badly run, disorganised, bureaucratic, inefficient and expensive; a shipowner's nightmare and worst enemy!

Nowadays, however, the picture is considerably different. Trade liberalisation, helped by the remarkable developments in transport, logistics and communication technologies, have drastically weakened the link between

manufacturing and the location of factors of production and have stimulated a most noticeable shift in manufacturing activities towards countries with a comparative advantage.

Developments in international transport have been instrumental in shaping these processes. Containerisation and multimodal integrated transport have revolutionised trading arrangements of value-added goods and have given traders and global managers more control and choice over their 'production – transport – distribution' chain. Furthermore, transport efficiency is necessitated by the very same nature of value-added goods whose increasing sophistication requires fast transit times from origin to destination in order to increase traders' turnover and minimise high inventory costs. Today, these costs have been brought down significantly by the use of logistical concepts and methods and also by the increased reliability and accuracy of international transport that allow manufacturing industries to adopt flexible *Just-in-Time* and *Make-to-Order* production technologies. *Inter alia*, these technologies enable companies to cope with the vagaries and unpredictability of the seasonal, business and trade cycles and plan business development in a more cost effective way.

Trade liberalisation, land infrastructure development, and new logistical concepts in the organisation of international transport of containers have had an equally profound effect on the port industry. Port hinterlands have ceased to be captive and have extended beyond national boundaries. Governments are increasingly realising that, from mere interface points between land and sea, ports have become the most dynamic link in international transport networks and, as a result, inefficient ports can easily wither gains from trade liberalisation and export performance. Convinced about this, governments have often taken drastic steps to improve the performance of their ports: new capacity and labour-saving cargo-handling equipment have replaced outdated facilities; port workers training intensified; customs procedures simplified; information technology widely adopted; and management structures commercialised.

In addition, the port industry is moving noticeably from one in which predominantly public funds were used to provide common user facilities, to one where capital – public and private – is being used to provide terminals which are designed to serve the logistical requirements of a more narrowly defined group of users. Indeed, they may be designed to serve the needs of a few or even one firm (Dedicated Container Terminals).

At the same time, economies of scale in liner shipping and the sophistication and capital-intensity of modern containerships have limited the number of ports of call to only a selected few transshipment ports or load centres. These very important ports (such as Rotterdam, Hong Kong and Singapore) have become the *foci* of international trade and goods are moved by land (road and rail) and water

(barge) from inland centres and feeder ports to these global hubs. The hub-and-spoke system that has ensued in this way has made transshipment traffic lucrative business to be had at all costs.

The 'mobility' of the transshipment container, however, together with intertwined land transport networks and extended hinterlands, have intensified competition among container ports immensely. Today, it makes little difference if a Hong Kong container destined for Paris will pass through the port of Rotterdam, Antwerp or Hamburg. This container has little 'loyalty' to any given port and it switches between ports with relative ease. The price elasticity of demand for container handling services has thus become rather high[3] (Table 1).

In this way, each port's development, financing and pricing decisions can have marked effects on its neighbours, nationally and (most importantly) internationally. Often, this raises strong voices for 'market driven' investments, a more harmonised approach in the financing of port infrastructure, as well as pricing policies that will have to allow for full cost recovery.

These are most complex and often political issues that, as a result, have not allowed much progress to be made in terms of port policy formulation in economically interdependent areas. In all our discussions with port managers (see below), no one would question the importance of 'market driven' investments and pricing for cost recovery. However, in all such discussions, there has always been an implicit 'from now on' assumption and no port would seriously consider that pricing for cost recovery should reflect the costs of past (public) investment.

However, in the past, investments were not always market driven. Massive amounts of public monies have in the past been funnelled into port development, enabling many ports to consolidate such a strong market position that makes it rather easy for them, now, to advocate for the need for market driven investments. This should be kept in mind and the market-driven investments argument should not become a 'limit pricing[4]' policy of incumbent ports, deterring market entry of smaller and peripheral ports who also aspire to develop and serve *themselves* their rapidly growing regions.

Table 1: Price elasticities in selected north European container ports

Port	Elasticity
Hamburg	3.1
Bremen Ports	4.4
Rotterdam	1.5
Antwerp	4.1
Le Havre	1.1

Source: *ATENCO*

Cost recovery and limit pricing

The above point can be brought out more clearly with the following simplified example (Figure 1). Port A (incumbent) of country X has a dominant market position. This has been established over many years of public expenditure both in the port itself and its related infrastructure (roads, maritime access, etc). As such, the port is able to meet a substantial part of the trade of country Y through transshipment. Port A is a strong proponent of cost recovery policies in port development in general but, at the same time, it is allowed to consider 'bygones as bygones' and thus its prices, current and future, do not have to include the recovery of its past investments. The demand for its services is given by DD′.

Port B (entrant) in country Y is much smaller. Although in a favourable geographic position, the port never developed its own container facilities, as a result of both lack of funds and because it was adequately served (feedered) by port A. The trade of country Y, however, is rapidly increasing and port B feels that it is now time to develop its own facilities and 'claim back' its traffic – and all that comes with it – from port A. The government of Y sees the importance of such an action and it is prepared to fund the required investments.

Once developed, the demand for port B services is expected to be dd′; dMR gives its marginal revenue line. Its average cost (without recovery of infrastructure costs) and marginal cost curves are given by AC_0 and MC, respectively. The port maximises economic surplus (ABCP) by serving OQ′ level of throughput at a price of OP. Only Q′Q of total traffic is now left to port A.

Naturally, port A is rather unhappy with these plans. Its port policy department mounts a very strong campaign, together with other ports in the same

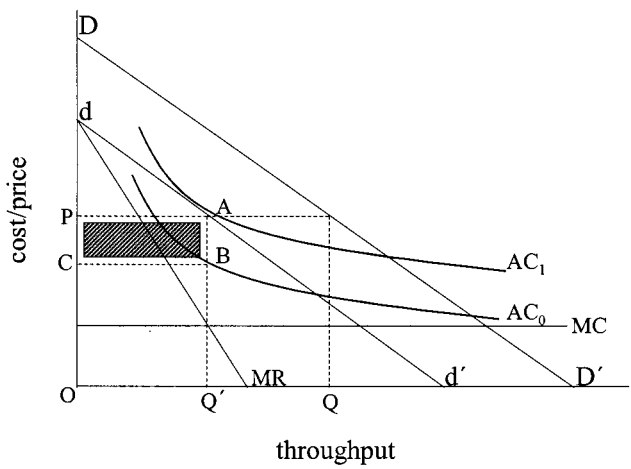

Figure 1: Cost recovery and limiting pricing

predicament, lobbying regulatory authorities on unfair competition from a to-be-subsidised port that, if it materialises, would deprive it of much of its traffic. It claims that, by not charging for infrastructure costs, port B will be producing at prices below costs and thus antidumping and competition laws should be applicable.

Were port A to succeed in demanding full cost recovery pricing, port B's average cost curve would shift upwards to a new position AC_1 or even further. At this level, there is no single price that would enable port B to break-even, let alone realise a positive surplus. In such a situation, port B wouldn't even consider expanding, leaving the whole market to port A. By insisting and achieving a policy of full cost recovery, port A has been successful in maintaining its dominant market position.

THE PRICING OF PORT INFRASTRUCTURE

As it was mentioned above, strategic pricing can pursue a multitude of objectives and can take various forms such as marginal cost pricing (MCP), average cost pricing (ACP), Ramsey Pricing (Ramsey, 1927) and two-way tariffs. Whatever the pricing method, or combination thereof, it is becoming more and more apparent among competing ports and those who fund them that prices should be cost-related and, in the long-run, they should allow for cost recovery, including infrastructure development costs.

There are cases however of ports that face, or pose, little competition. They serve local industries and are important centres of regional development. Often, the port is the only major economic activity and employer in the area. Such peripheral ports could still be considered as 'public investment', without a need to recover infrastructure development costs. In this case, the public sector should assess, through *social cost-benefit analysis*, the relative merits from regional development impacts *vis a vis* the costs – and alternative uses – of public resources required to develop and maintain the port. If the former exceed the latter, prices could be set below costs in order to promote regional development. Ensuing deficits could then be seen as the 'cost of regional development'.

In all other cases, particularly in the case of container ports amidst intense regional competition, the setting of prices below costs, in order to attract traffic from competitors, is not an advisable strategy.

First, this would lead to a misallocation of resources (and taxpayer money). Intensified inter-port competition, combined with automated labour-saving cargo handling systems, reduces the local economic impacts of port investments and the value-added of port activities. In such a situation, the beneficial impacts of low port prices are not localised but are dissipated from the country in question to the

foreign consignor/consignee. This issue causes considerable concern to governments contemplating the continuation of their public investment programmes, as it deprives them of the basic *rationale* of doing so, namely, that the port provides a public service to the benefit of the whole nation[5]. Such concerns have become noticeably 'loud' nowadays when governments have to reduce in size, cut down on spending and taxes and allow for more private sector participation in some 'strategic' sectors that, until recently, were jealously guarded as government prerogative.

Second, in economically interdependent regions, such as for instance the EU, such pricing would lead to complaints for unfair competition and competition law would in principle be applicable, particularly as deficits would have to be covered from public funds, often seen as State Aid.

Cost-relatedness of prices and full cost recovery are things, however, easier said than done. A port is a multi-product firm and prices for many of its services are often bundled in port dues. Cross-subsidisation is also common. For instance, in order to attract transshipment cargo, a port may cross-subsidise feedering operations by trunk line charges. The *joint cost* problem in economics is therefore present here too, together with the difficulty, if not inability, to allocate such costs to different port services.

The difficulty of this problem is often accentuated by our inability to accurately measure port costs, especially marginal costs. Reliable and comparable port statistics do not exist, port accounting systems diverge and, finally, the financial flows between the port and its institutional owner (municipality, State) are not always known or transparent.

Many of the above difficulties, however, are often exaggerated. What follows is an attempt to demonstrate how the consistent application of *marginal cost pricing* (MCP) in ports could eventually eliminate deficits and the need for public funding, lead to an efficient allocation of scarce resources and achieve a level playing field among competing ports.

The issue of excess capacity

As a result of substantial excess capacity, container ports are declining cost industries or, in economic terms, industries with *increasing returns to scale* (liner shipping is another good example of such an industry, familiar to the student of maritime economics). In such industries, short-run marginal cost pricing (SRMC) results in deficits, for marginal costs are always below average total costs.

Excess capacity in competing container ports has a number of causes. As a matter of fact it could be shown (Haralambides *et al*, 2002a) that the higher the competition, the higher the need for excess capacity.

First, as already mentioned above, ports are often seen as pivots of regional development and, thus, infrastructure is built far ahead of demand in order to

promote economic development. Second, managerial 'ego-boosting' is often not innocent of its responsibilities for the creation of excess capacity. However, the real economic culprits of excess capacity ought to be found in capital indivisibilities (lumpiness of investments), economies of scale in port construction, and over-optimistic demand forecasts.

In competing container terminals, furthermore, excess capacity is also an 'operational necessity', being the only way to provide quick turnaround times to ships and thus maintain or increase patronage. It can be easily shown through simple single-channel-multiserver queuing theory (Haralambides *et al*, 2002a) that once a port reaches 70% capacity utilisation, congestion ensues in terms of unacceptable waiting times in today's organisation of liner shipping. With this in mind, 'operational' excess capacity ought to be seen as another unavoidable cost rather than an indication of inefficiency and wastage of resources. However, in their appeals to public funding agencies, port managers have not been very convincing in bringing this point out and, as a result, governments have been reluctant to see excess capacity in this light.

The problem of 'operational' excess capacity is exacerbated with the increasing deployment of ever larger containerships. As has been shown earlier (Cariou and Haralambides, 1999; Cariou, 2000a), in general, the cost per TEU of ship-time in port is an increasing function of ship size. This has mainly to do with the limited availability of cargo-handling equipment (cranes) that can be put to work on a ship, and the problem of course intensifies at higher levels of terminal capacity utilisation. Still, four and sometimes five crane operations are standard today in many major ports for post-Panamax ships. One cannot envision however eight or ten cranes working a concurrent sustained operation on a 10,000 TEU vessel in Hong Kong, Singapore, Rotterdam or Los Angeles any time in the near future (Haralambides *et al*, 2002b). Thus, other things being equal, the utilisation of larger vessels requires more excess capacity in ports.

Finally, creation of excess capacity can also be seen as a form of *limit pricing* (see above) and this often explains the reluctance of both governments and regulatory authorities (eg the European Commission) to sanction and finance ambitious port development plans that go beyond what would normally be regarded as 'realistic' demand forecasts. Here, hub-port strategies and port investments that encourage the construction of larger and larger containerships increase the sunk costs of new entrants to the competitive port arena, consolidating the incumbent ports' market power on the one hand, and making new entry unprofitable on the other.

Competition and excess capacity mix an 'explosive cocktail'. Competition pushes prices down to marginal costs, not allowing full cost recovery (and often survival). In liner shipping, this problem has been solved – at least so far –

through self-regulation and the organisation of carriers in conferences and similar forms of cooperation (including shipping alliances).

Short- and Long-run Marginal Costs

Let us try to see the above through the use of a simple graph (Figure 2) that will also be our vehicle for showing how MCP can have the positive effects mentioned above. In order to do this, a brief elaboration on the concepts of short- and long-run marginal costs is necessary; particularly of the latter which is a most crucial, albeit misunderstood, concept in maritime economics.

In the short-run, the size of the port is considered as constant. Fixed capital assets, such as quays, yards and rest of infrastructure, are invariant to output, and variable costs mainly relate to those of cargo-handling and nautical services (eg pilotage). In the short-run, marginal costs (SRMC) consist of the increment in variable costs required to produce an extra unit of port service, eg the handling of an additional container, when all other costs are kept constant.

In the long-run, all costs are considered variable. The concept of long-run marginal cost (LRMC) is similar to before with the difference that, now, LRMC is the increment in *total* costs required to produce an extra unit of port service. By considering total costs, ie by including infrastructure costs as variable ones, LRMC becomes a planning concept. In principle, it gives the *long-run equilibrium* (LRE)

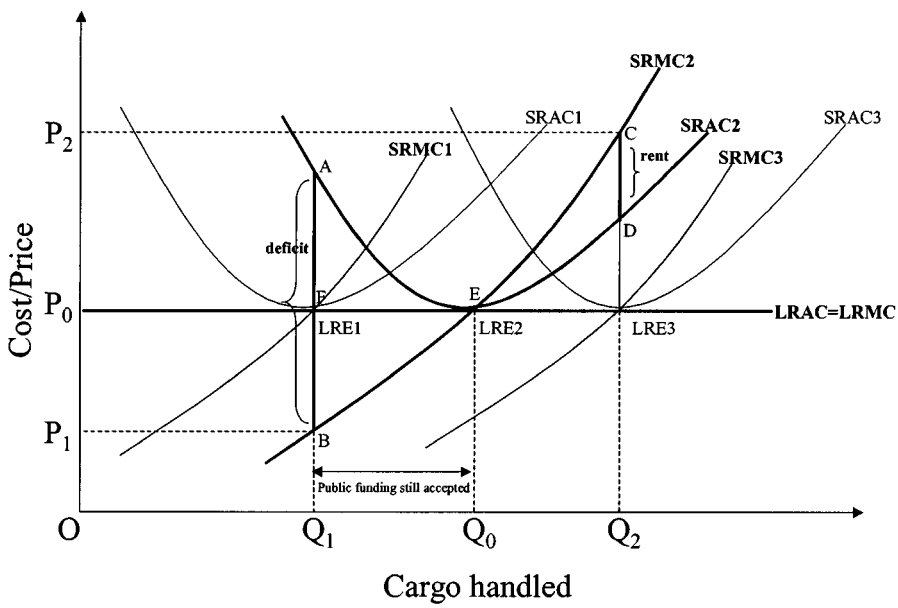

Figure 2: Marginal cost pricing in ports

port size, able to satisfy a given level of demand at minimum average total cost, without incurring deficits or realising *economic rent* (ie supernormal or monopoly profit). In the absence of rapid technological change, we often assume that LRMC = LRAC = Constant (Figure 2).

Increasing returns to scale

The above could be better grasped by looking at Figure 2. Assume that the size, organisational structure and 'operational' excess capacity of our port can be adequately described by its short-run average total cost curve SRAC2. The port faces intense regional competition from neighbouring ports, its investments are publicly funded and, at present, the level of demand it has to satisfy is Q_1. Increasing returns to scale are thus present.

As a result of competition and the lack of a need to recover (publicly funded) infrastructure development costs, our port will be tempted – if not forced – to set prices equal to marginal costs, ie P_1. (SRMC2 is our port's short-run marginal cost curve). A deficit of the order of AB is thus created and MCP does not allow the port to recover its costs in full. Apparently, our port is too large for that level of throughput (Q_1).

Unless demand picks up considerably far beyond Q_1, such a situation is not sustainable in the long-run without continuing public support. Taxpayers, however, will become increasingly sceptical and competitors abundantly vociferous, in whichever way they can, on unfair competition. In long-run equilibrium (LRE), that level of throughput (Q_1) ought really to be produced by a much smaller port (LRE1/SRAC1) whereby SRMC pricing would allow the recovery of full costs. At that size, the port would exhibit *constant returns to scale* and it would be able to produce its services at minimum average cost.

Diminishing returns to scale

Let us now see what would happen if our port was faced with a situation where demand for its services was substantially higher, say Q_2. Here, the port exhibits *diminishing returns to scale* (diseconomies of scale) and although State coffers cannot complain in terms of revenues, congestion is a chronic problem and ship waiting times unacceptably long. Port capacity is over-utilised, accidents in cargo-handling very likely, and carriers impose surcharges on shippers. Demurrages are claimed. Such a situation, common in many ports during the pre-containerisation era, can still be found in some general cargo ports in developing countries.

Here, MCP is not only appropriate but recommended as a pricing strategy that rationalises demand and allocates scarce port capacity according to carriers' willingness to pay. Apparently, balking (carriers refusing to call at the port) and reneging (existing carriers leaving the port) are at this point the least of our port's concerns.

Setting price equal to marginal cost in this case means that our port charges a price of P_2 for the last ton of cargo it handles and this price is over and above (line CD) what on average costs the port to handle a ton of cargo when the total amount of cargo handled in a certain period of time is Q_2 tons. Now, the port realises *economic rent*, or supernormal profit, ie an economic surplus after all factors of production have been paid for, including entrepreneurship as well as a normal return on capital. Total economic rent accrued to the port beyond the minimum cost production level Q_0 is thus equal to the area ECD.

Here too, the situation is not sustainable in the long-run. Clearly, the port is too small for that level of throughput. Eventually it will have to expand to its long-run equilibrium position LRE3/SRAC3 where it will only earn normal profit, producing and charging at minimum average cost. The port will be helped in this by its competitors who will also invest and expand in an effort to capture part of the economic rent.

Constant returns to scale

However, port development and contraction are dynamic processes and rarely, or by accident, would a port be found on its LRE position. As said earlier, lumpiness of investments, economies of scale in port construction and wrong demand forecasts would see to it. This is why we stressed above that LRMC is a planning, ie normative, concept; a snapshot of a dynamic process. At any point in time, a port could diverge markedly from the idealised situation of LRE.

Having said that, however, if all competing ports within a certain economically interdependent geographical region were to be taken together, it would be reasonable to assume that the industry as a whole demonstrates constant returns to scale and, therefore, LRMC pricing, if ever achievable, would lead to efficient resource allocation, maximisation of social welfare and a level playing field among competing ports. 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 aggregate level, it should be possible to recover total costs.

Cost recovery through MCP

But let us, for the time being, return to our example of Figure 2 and the case where our port faces the limited demand of Q_1. The port management remains optimistic that their plans and forecasts will eventually materialise and demand will pick up to the level of Q_0, if not further. However, costs have now to be recovered through port charges. If at the level of Q_1 the port charges a price of P_1, equal to its long-run average and marginal cost, there would still be a deficit but now reduced from AB to AF.

In so doing, ie by consistently charging at LRMC = LRAC, and as demand picks up, the port will eventually reach its LRE level of throughput where costs will be fully recovered. In the range of output Q_1 to Q_0, public funds are gradually and increasingly recovered until the deficit is phased out completely at point E.

Such public funding is and should be allowed given its digressiveness (temporary and declining) and the private sector's frequent reluctance to finance chunky investments of long gestation periods. The understanding now however is that these funds will have to be eventually recovered, irrespective of whether they are ploughed back to the public sector or used for further development by the port itself. In an era of reduced public spending, such an understanding may also help in enticing private funds to the port sector, as well as in giving an answer to the important question as to whether the pricing of port expansions should also reflect the cost of past (public) investments.

Despite the elegance and desirability of MCP, a lot of questions still remain open. Could this be done in practice? Could a port voluntarily and single-handedly charge prices higher than its competitors? Is there scope for policy intervention in pricing matters? Can we measure LRMC? Is MCP economically efficient when applied by some ports only, while the rest of the infrastructure connected to these ports (eg roads and railways) does not follow suit? Let us take these questions in turn.

Measuring marginal costs

With a given level of technology and organisation, fairly standard aspects in modern ports today, the measurement of long-run average or marginal costs simply boils down to forecasting future demand for port services (Figure 2). Once this is established, the LRE size of the port can be established too and the only cost element required for the measurement of LRMC is the construction cost of an additional metre of quayside and all that comes with it (aprons, yards and possibly organisational costs as a result of bigger size). Port engineers have fairly accurate data on these.

Forecasting port throughput

But can demand for port services be forecasted with any degree of confidence? This is one of the trickiest and most complex questions in maritime economics and one that can only be treated rudimentarily in an introductory chapter such as this.

In a closed economy, forecasting port demand is straightforward: observe population, agglomeration, consumption, personal income and international trade trends and translate them – mostly through regression analysis – into required port capacity; a popular exercise for students of maritime economics.

In an open and economically interdependent economy, however, things are very different. As a result of intertwined and extended hinterlands; abundant land infrastructure and short-sea feedering networks; continuously evolving liner

shipping networks; and the infamous 'mobility' of the container, demand is very volatile and unpredictable. Port market shares are unstable; investments in one region or country have an impact on another (eg a dedicated railroad line connecting Rotterdam with the Ruhr area in Germany will impact north sea German ports; new container capacity in Antwerp will take away traffic from Rotterdam; the port of Tanjung Pelepas in Malaysia has stolen Maersk from Singapore; Korea invests tremendously in order to compete, as a hub, with both Japan and China); carriers are diverting traffic to their own dedicated container terminals.

In such a 'fluid' environment, how could one forecast port demand with any degree of credibility? Should ports, regions and countries compete or cooperate when it comes to infrastructure? In principle, cooperation among producers is not to the benefit of the consumer but, on the other hand, does the latter benefit when he pays taxes to develop 'competing' infrastructure while knowing that he is due for reprisals in a never-ending vicious circle of public spending? Shouldn't such public spending be also liable to the same international anti-dumping laws as with other goods and services? In terms of trade policy, is there a difference between a subsidised shipyard and a subsidised port? If not, why do we shout about the former but turn a blind eye to the latter?

Answers to such questions belong to the realm of public rather than maritime economics. One could however start fathoming the answers by looking at the role of *public investment*; a concept that, surely, globalisation will redefine before too long. A road that connects a container terminal to the national motorway system is in principle open to all citizens and as such the road is a public good. In practice, however, the road is only used by the operator who exploits the terminal. The access channel to a port is dredged down to 15 metres. In principle, every floating craft can go through the channel but, surely, the channel wasn't dredged to that depth with the fisherman in mind! Are such investments public or private? And should their costs be paid for by the taxpayer or those who directly benefit from them?

The kinked demand for port services

Another question we posed above was whether a port would, voluntarily and single-handedly, charge a price higher than that of its competitors. The answer here is '*no, unless it has to*', ie unless it has to recover costs. As we have mentioned above, ports operate in an oligopolistic market and individual upward price moves tend not to be matched by competitors who will maintain prices in an effort to benefit by capturing a larger market share. A port's demand curve is thus a *kinked* demand curve such as dD′, depicted in Figure 3.

Assume that, originally, the demand for the services of our port is given by DD′. The port is at equilibrium, charging a price of P per ton of cargo for a total

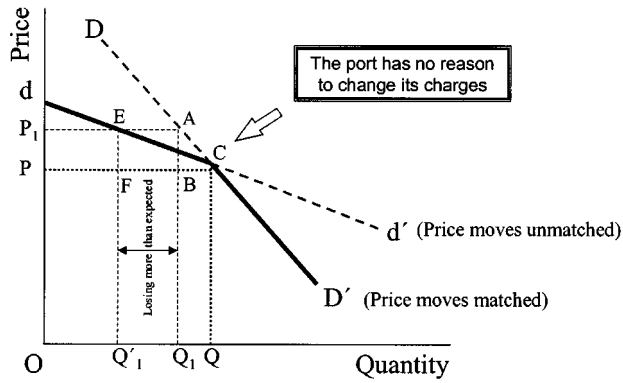

Figure 3: The kinked demand for port services

throughput of Q. The port, believing that its competitors will follow suit, plans to raise prices to P_1. Knowing its price elasticity of demand, the port calculates that the increase in revenue as a result of higher prices ($ABPP_1$) will more than compensate the loss in revenue due to lower (Q_1) throughput ($BCQQ_1$); that is $ABPP_1 - BCQQ_1 > 0$.

To its bad luck, however, the competitors of our port maintain prices at the same level hoping to capture a greater market share. This does of course happen and our port's demand curve flattens to dd′. At the higher price of P_1, our port is only able to serve a Q'_1 level of throughput. It loses revenue much more than what it was expecting ($FBQ_1Q'_1$ more), while its extra revenue due to the price increase is only $EFPP_1$, less by ABFE from what it was originally anticipating. Had our port known, as it should, that its competitors would not follow suit in raising their prices, it would have no good reason to raise its price single-handedly, as this would make it worse-off in the end. This is the more so when ports and governments are aware that LRMC pricing can lead to allocative efficiency only as long as other markets are also efficient (Pareto optimality). If the latter condition is not satisfied because of institutional restrictions, then, according to the *Theory of Second Best* (Lipsey and Lancaster, 1956), '*it is in general neither necessary nor sufficient to satisfy the remaining conditions*', ie to endorse MCP in ports when roads, railways and the rest of the infrastructure do not do the same.

In the context of the European Union, a voice is often loudly raised, by both the Commission and the port industry, arguing that MCP in ports only will make port services 'unilaterally' more expensive thus penalising the Union's efforts to check road traffic and promote short sea shipping; a most valid argument indeed. Under this light, efficient port pricing cannot be seen in isolation but only through

a general equilibrium approach where the rest of the port related infrastructure and its pricing are also being considered simultaneously.

POLICY INTERVENTION

If ports are not, naturally, individually prepared to disadvantage themselves by charging higher prices, in order to recover costs, is there scope for *policy intervention*? Could a 'pricing discipline' be imposed on competing ports in economically interdependent regions that would alleviate their own misgivings about unfair competition?

In the European Union, this was the objective of the Commission's *Green paper on ports and maritime infrastructure*[6]. The paper set out the broader context of Community port policy, with a focus on the issue of state aids and infrastructure charging. The main question was whether, and how, an efficient pricing system leading to cost recovery could be implemented in practice in the port sector, taking into account a variety of relevant objectives and constraints including higher market based efficiency; increased cohesion; distributive goals; the development of short sea shipping; the improvement of safety and environmental protection, etc. Other, more recent policy documents at the European level have also addressed this issue; *cf* Final Report by the high level group on transport infrastructure and charging concerning options for charging users directly for transport infrastructure operating costs.

The Green Paper attracted growing industry attention on the desirability and scope of a more harmonised European seaport financing and pricing strategy. A large scale, pan-European research study for the European Commission (DG Transport and Energy), known under the acronym 'ATENCO' (***A***nalysis of the main ***T***rans-***E***uropean ***N***etwork ports' ***CO***st structures), was subsequently carried out[7], with the main goal to provide input for an in-depth reflection at the European level on (a) the design of a strategy to achieve efficient pricing and (b) the possible impacts of a cost recovery approach on the functioning of ports.

The study came up with a number of conclusions, the most important of which were: (a) The high sensitivity of demand for port services to changes in prices (Table 1). As an example, the study calculated that if the port of Hamburg were to recover the dredging costs of river Elbe from user charges, this would add Euro10 (or roughly 5%) to its terminal handling charges per TEU. According to Table 1, such a price increase would lead to a 15.3% (roughly half a million TEU) reduction in container traffic[8]. (b) No policy intervention on pricing matters would ever be acceptable by the industry, who strongly felt that pricing policies are solely for the firms themselves to decide (the argument here was that even

when full cost recovery is sought as an overall objective, ports apply a variety of pricing principles simultaneously in order to achieve managerial effectiveness at the micro-level). (c) However, it was unanimously agreed, by every port management team interviewed, that *cost recovery* – regardless of how this was to be achieved by each individual port – should be pursued and, for that purpose, better port statistics, accounting systems and transparency of port accounts are required[9].

Following the ATENCO results, the Commission came up with what has become known as its 'port package' (European Commission, 2001a and 2001b). In this, the EC, convinced now about the desirability of cost recovery in ports, takes a fresh look at two most important issues: (a) the need for greater transparency in the efficient allocation (leases/concessions) of port land to service providers on an equal opportunity basis and in a way by which leases reflect better the opportunity cost of port investments; and (b) the no longer indiscriminate treatment of port infrastructure investments as 'public investment'. Particularly with regard to the latter, although the Commission continues to remain neutral on the public or private ownership status of a port, and it does not dispute in any way the fact that public investments are the prerogative of Member States, it nevertheless attempted to have a say in whether a certain investment, that in theory is open to all users indiscriminately but in practice it is intended for a few or even one user, could, in the spirit of the Treaty, be considered as 'public investment'.

CONCLUSIONS

Cost recovery and the pricing of port services are complex and controversial issues, both technically and conceptually. This is so because they deal with the development and provision of infrastructure; economic development; public investment; fiscal policy and the role of the State in economic activity. Before too long, economic analysis of this type takes one into the realm of *moral philosophy*. Indeed, the type of *economics* we accept as valid reflects nothing more than our philosophical inclinations as regards the evolution of society, the desirability of equity, and the importance of production.

The issue of port pricing in maritime economics has not arisen only out of academic interest but as a response to the need felt in the port industry itself for a self-discipline 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, it is no longer acceptable to indiscriminately and without a

formal economic *rationale*, spend taxpayer money on port investments, often aimed at increasing market share at the expense of other ports, particularly within the same economically interdependent area.

Naturally, pricing for cost recovery looks at the 'user' rather than the 'taxpayer'. This is just as well, given that ports (at least container terminals) are being transformed from public to private enterprises. The allocative and income distribution effects of such a switch in direction are obvious: investments are recovered, and port revenues generated, from the user of a (private) facility, who will have to somehow pass these costs on to the final consumer. The latter 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 less taxes (for infrastructure investments). Obviously, such issues are highly complex and have yet to be researched.

In principle, pricing for cost recovery should mean that depreciation of port infrastructure is included as a cost in the port's pricing system. Something like this would undoubtedly raise the level of port prices, but the overall effect of this on consumer prices and traffic diversion may not be as large as some might at first sight expect. This effect depends on the percentage of port costs in final consumer prices; the import and export elasticities of traded goods; the level of competition in transport markets (especially liner shipping) as well as all other markets along the door-to-door chain (ie distribution, wholesaling, etc). It could well be argued that higher port prices are not necessarily passed on to consumers but are instead absorbed by transport operators and other market intermediaries.

But even if higher port prices are, to some extent, passed on to consumers, the overall effect on society could be ascertained by comparing the loss in consumer surplus, as a result of higher port prices, to the welfare gains had the public funds in question been invested in other sectors of the economy or led to lower taxes in general.

This chapter has argued in favour of pricing for cost recovery among competing commercial ports and it has shown how long-run marginal cost pricing can be a powerful pricing discipline that can eliminate subsidies and establish a level playing field among ports.

However, a 'pricing discipline' imposed on ports through policy intervention would be unacceptable. The objectives often pursued by ports are so divergent that any uniform approach to pricing becomes meaningless and politically unfeasible. Pricing matters on the other hand, at least in a liberal economic environment, ought to be, ideally, left to the producers (ports) themselves.

The ATENCO study has demonstrated that, however controversial the issue of port pricing itself may be, there is general consensus on the importance of cost recovery. And this was an important development and step forward. Indeed, as long as this objective is respected, the specific pricing policy of the individual port

becomes of secondary importance and only in so far as crowding out effects and efficient allocation of resources are concerned.

Once cost recovery is generally accepted as a guiding principle in port investment and pricing, the way forward is much simpler. It involves the compilation of better and more harmonised statistics on port costs, adoption of standardised port accounting systems, greater transparency of port accounts and of financial flows between the port and its institutional master and, perhaps, a common glossary of terms. And these are objectives not so difficult to achieve.

In conclusion, therefore, port policy is reorienting its attention from the idea of adopting uniform cost based pricing principles, towards: (a) more indirect incentives promoting cost based thinking in ports (eg by defining more clearly what constitutes acceptable public support in port infrastructure); and (b) rethinking how conventional competition rules (related, *inter alia*, to market access; abuse of dominant position; collusive behaviour, etc) should be applied to the port sector.

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ENDNOTES

[1] Often there is some confusion between the concepts of 'sunk' and 'fixed' costs. The former are costs that cannot be recovered once the firm decides to leave the market; a breakwater could be a good point in case here. Fixed costs, naturally, are those that do not vary with output. A sunk cost could thus well be variable, eg marketing and advertising expenses, while a fixed cost, such as that of a gantry crane, does not necessarily have to be sunk, as the asset could be sold to another port.

[2] The concept of an economically interdependent geographic area or region, as employed here, has both a spatial and an economic dimension. It refers to a spatially delineated geographic area in which 'binding' arrangements (laws) of direct economic impact are 'jointly and institutionally' put in place – such as for instance competition, labour and fiscal laws – with the aim of maximising collective welfare. Apart from an individual country (with its constituencies, States, etc) that would obviously qualify under such a definition, a good example of such an area is the European Union as well as other regional blocs depending on the strength of their institutional ties over and above trade policy.

[3] Whether the absolute level of the elasticities in Table 1 is correct is a much less important issue than the observation of a very substantial divergence of the elasticities among the various ports. Hence, variation in prices, as a result of the adoption of alternative pricing systems, would, at least in the case of containers, lead to fundamentally different impacts on individual ports, even when engaging in similar price increases.

[4] In industrial economics, 'limit pricing' refers to strategic behaviour by which incumbent firms raise costs, through a multitude of ways, to a level that makes new entry unprofitable.

[5] This was in broad terms the position of the Dutch government on the issue of Maasvlakte II terminal in Rotterdam.

[6] The author had the privilege of being member of the then EU Transport Commissioner, Neil Kinnock's group of experts that drafted the Paper. The Commissioner opened the first meeting of the group with a statement that took everyone aback: '*if countries want to spend public money to develop their ports, so be it and there is nothing we can do about it*'. A lot has changed since then.

[7] The author was involved in this exercise as Chairman of the Academic Group of Experts.

[8] Such estimates have to be viewed with utmost caution and full understanding of the assumptions underlying them. For instance, this impressive percentage assumes that other ports in the region would be able to absorb smoothly the extra traffic without difficulty or additional cost. It is also assumed that no changes take place in the pricing of the rest of the infrastructure (roads, etc).

[9] Surprisingly, most port authorities expected that the adoption of full cost recovery pricing would have little impact on pricing levels. It is believed here that, although in private ports such as those of the UK this may well be the case, this is far from true in all others, and this conviction of many port managers can only be explained by their inability to grasp in full the notion and implications of long-run marginal costs.

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