

## **Barriers to Efficient Cost-based Pricing of Rail, Air and Water Transport Infrastructure in Europe**

Nicole Adler,

School of Business Administration, Hebrew University of Jerusalem, Israel.

e-mail: msnic@mscc.huji.ac.il

Chris Nash

Institute for Transport Studies, Leeds University, United Kingdom.

e-mail: cnash@its.leeds.ac.uk

Esko Niskanen

Institute for Transport Studies, Leeds University, United Kingdom,  
and adpC, Belgium.

e-mail: eniskane@its.leeds.ac.uk, niskanen@adpc.be

The EC White Paper (2001), which defines the direction for future transport policy within the EU, advises a shift in the balance between modes, in particular from road to rail and water modes. Efficient cost-based transport pricing is seen as one of the measures needed to bring about this shift. Currently the pricing practices on rail, air and waterborne transport in Europe are very different, partly due to different institutional arrangements regarding ownership and regulation. Traditionally, one vertically integrated company has provided both rail infrastructure and service provision. More recently a degree of separation in rail has occurred in order to promote competition within rail and across modes. In air and waterborne transport, the separation of these two sets of activities has been standard practice.

The three modes are at different stages of implementation of marginal cost pricing of infrastructure. Rail is the most advanced, though frequently watered-down versions of marginal cost pricing have been implemented, due to political, legal, institutional and acceptability barriers. The large number of tariffs that already exist in air transport are not designed to deal with the current level of demand, although some airports have already begun changes in the pricing process. Waterborne transport is the furthest from potential implementation. As emphasised by the EC, it is important to ensure that although price levels can be different across countries, the methods by which they are computed should be similar across countries and modes (including road). Open for discussion are several major issues, including the incentives short-run marginal cost pricing can create with respect to investments in the future, privatisation versus regulation as ways of achieving marginal cost pricing and the relationship between pricing on the different modes. Scarcity costs in particular remain a priority for further research.

*This essay was prepared for the fourth seminar of the IMPRINT-EUROPE Thematic Network "Implementing Pricing Policies in Transport: Phasing and Packaging" Brussels, 13<sup>th</sup> - 14<sup>th</sup> May 2003*

## **1. Introduction**

The European Commission's Common transport policy led to a White Paper in 2001 (European transport policy for 2010: time to decide), which defines the direction for future transport policy within the European Union (EU) and across the borders into countries that will shortly be part of the EU. The White Paper suggests plans to shift the balance between modes by revitalizing railways, controlling the growth of road and air transport, adapting the maritime and waterways system and improving quality in the non-road sector. One of the specified goals of the EC has been to activate modal shift from road to rail and to optimise rail efficiency by concentrating investment on the creation of a rail network giving priority to freight, including port connections, the development of a high-speed network for passengers and integrating rail and air into intelligent transport systems. The pricing policy is widely seen as one of the measures needed to bring about this shift in modal split.

This paper considers the issues that arise in seeking to implement the Commission's efficient pricing policy on non-road modes of transport. It discusses the current pricing mechanisms in air, rail and water transport within Europe, and investigates the needs and possibilities for wider implementation of marginal cost pricing (MCP). We cover both passenger and freight transport. The major drivers or motivations behind the pricing policies and approaches in transport are to improve efficiency and generate revenues, both in the short and longer term. The former goal, in particular, translates into the internalisation of various externalities (congestion, scarcity, noise, environmental emissions and accidents). With respect to the latter goal, clearly the bigger the private sector involvement, the more important is the revenue generating aspect. Other important issues that affect the pricing policy and its implementation include the market characteristics and industry profiles of the respective transport modes. However, significant barriers and constraints currently exist that may prevent or delay the implementation of MCP, including institutional (organisational), legal, technological and acceptability-related issues. In this paper, such barriers and constraints are identified and possibilities for their removal or amelioration are discussed.

The paper is organised as follows. Section 2 presents a literature review on efficient pricing in the three modes of transport. Section 3 discusses the current organisational structures and pricing situations for each mode including existing policy plans at both the EU and national levels and section 4 discusses barriers to the introduction or further development of MCP. Section 5 provides broad conclusions, including potential steps required to encourage the introduction or furtherance of efficient pricing policies in rail, air and water transport within the E.U.

## **2. Literature Review**

The economics literature has led to two basic models or approaches to achieving MCP: through a competitive equilibrium given constant returns to scale and through state ownership and control or regulation given a natural monopoly. Clearly, these models or approaches are simply theoretical extremes on a continuum of other possible – and more realistic – cases. In reality, for example, the range of output over which technology exhibits increasing returns to scale can fall short of total industry output, resulting in an oligopoly. On the other hand, regardless of the technology and nature of returns to scale, it is always possible for governments to attempt to implement MCP, although acceptability may then become an issue.

Another ongoing argument in the literature is between short run and long run MCP. Where capacity is optimal, it is well known that the two are equivalent. It is therefore 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. Short run MCP therefore tends to be associated with regimes where government bodies take investment decisions on the basis of social cost benefit analysis, and long run MCP 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. In the reverse situation, long run MCP has advantages. Transport infrastructure is generally seen as being closer to the former than the latter, so that short run MCP is the most appropriate approach. This is indeed the approach taken by the EC, although not all economists agree.

There is little literature discussing efficient pricing in rail, air and water transport modes, certainly much less than that of road. The issues with respect to implementation of efficient pricing for these three modes are also very different to those of road pricing. These modes are network-based, with stations, airports or ports, and generally consist of a hub-and-spoke system. Within these modes, transport services are produced by a limited number of specific firms, in contrast to the road sector with typically atomistic infrastructure users. Therefore, central to the analysis of each mode is the distinction between infrastructure and services provision. In this respect, however, there are also significant differences across the three modes.

As a generalisation, it is often believed that the natural monopoly element of transport networks relates largely to infrastructure construction and maintenance, whilst the competitive equilibrium model may be applicable to transport operators using the network. However, this is a simplification, since there is a potential for competition between shipping lines and airlines and amongst themselves, whilst the promotion of on-track competition between rail operators remains problematic. Moreover, provision of scheduled transport services typically experiences economies of scale, both through the use of larger vehicles (buses, trains, planes, ships) and because of the improvement in services that follows expansion of traffic, often referred to as the Mohring effect (Mohring (1972)).

Railway pricing has proved to be a contentious issue in the literature at least as far back as Acworth's book on the Elements of Railway Economics of 1905. The belief that railways experienced a high level of fixed costs meant that MCP would result in the railways incurring a loss. Unless governments are willing to meet this loss through the provision of subsidies, this is not a sustainable position, and railways needed to depart from pure MCP. An early approach to this problem was to base charges on the value of the commodity being transported, arguing that more valuable commodities could bear higher charges since the proportionate effect of transport costs on their delivered price was less. In other words, this could be seen as a primitive form of Ramsey pricing. This basis for price differentiation relied very heavily on the railway having a transport monopoly, and with the growth of road transport, rail demand collapsed as road transport attracted the more valuable commodities, which also tended to be the more sensitive to service quality.

The issue of MCP for railways remains as hotly debated today, in the light of the proposals of the European Commission White Paper on Fair Payment for Infrastructure Use (1998), as it was when Hotelling's well known defence of the principle appeared (Hotelling

(1938)). The view taken in current European legislation (Directive 2001/14), echoing that of a famous group of economists led by Baumol in 1962 (Baumol et al. (1962)), is that marginal or incremental cost should be the minimum charge, but that mark-ups above this figure may be necessary and acceptable. However, such mark-ups should be determined by market conditions rather than by arbitrary allocations of total cost. The Baumol et al. paper provides a concise account of how to use cost information and how to determine appropriate mark-ups in such circumstances.

In recent years, there has been a growing literature on how to apply MCP to rail infrastructure, with contributions from academics, consultants working for government and industry and from the industry itself. The European Commission of Ministers of Transport (1998) emphasised the conflicting objectives of rail infrastructure charges, including efficient use of infrastructure, appropriate incentives for infrastructure development, promotion of competition between train operators and cost recovery. The European Commission (1999) argued that marginal social cost for the use of rail infrastructure needed to include wear and tear costs, accident and environmental externalities as well as noise, congestion and scarcity charges. Gibson (2000) presented the result of an attempt to estimate congestion costs for the British Rail network, whilst Office of the Rail Regulator (2000) presented the comprehensive results of the recent British review of rail infrastructure charges. A succession of consultants (Coopers & Lybrand, 1998; NERA, 1998) have advised on how to reconcile these objectives through various, second-best pricing approaches, including Ramsey pricing and two-part tariffs, whilst Baumol (1983) is the classic reference on charging the trains of one operator for running over the tracks of another. Baumol introduced the efficient component pricing rule, whereby the operator is charged marginal cost plus the loss of profit to the owner. Caillaud and Tirole emphasise the need for rail infrastructure funding to be compatible with long-term incentives for dynamic efficiency (Caillaud and Tirole (2001)). A comprehensive review of this area may be found in Nash et al. (2001).

Few papers in the air transport literature have considered replacing the existing weight-based airport charges with a congestion-based charge in an attempt to alleviate delays, which are growing on a yearly basis. Some work was undertaken in the 1970s, namely Carlin and Park (1970) and Borins (1978). None of their ideas have really been implemented, as administrative allocation techniques were introduced instead. Renewed interest amongst the academic literature has arisen in the 1990s, based on Oum and Zhang (1990), Oum et al. (1996) and Daniel (1995, 2001). Greater interest on the part of the European Commission over the past five years (the EC White Papers (1998, 2001)) has also fuelled research in the area, both on the pricing issues and externality charges.

Carlin and Park computed marginal costs for LaGuardia airport in New York, based purely on congestion costs, hence ignoring all other externalities. They then argued that it was very unlikely that airlines would be willing or able to pay the true social marginal cost. Several suggestions were put forward as to how MCP could be introduced at airports in general and LaGuardia specifically. They suggested that efficient pricing could be introduced proportionally over time, in other words in a revenue neutral manner in the shorter term. Finally, they suggested a combination measure of both proportional MCP and administrative limits on airline schedules, with the former excluding low-value general aviation (i.e. non scheduled passenger) users and the latter increasing airline load factors.

Oum and Zhang (1990) found that in the case of airports, where capacity is not perfectly divisible at least in the short-run, MCP may not lead to full cost recovery. They then argued

that imposing a financial break-even constraint leads to a Ramsey pricing scheme. Oum et al. (1996) assessed socially optimal pricing of airports in a hub-and-spoke environment and argue that pricing the hub and spoke airports jointly achieves welfare gains over an independent pricing regime due to the complementarity of demand.

Daniel (1995) modelled first-best peak-load congestion pricing and the capacity of large hub airports using a bottleneck model with stochastic queues. The algorithm searches for an equilibrium in which schedule delays and layover times are balanced against actual delays in order to compute congestion fees. Daniel argued that congestion pricing would improve capacity utilization by spreading the arrival and departure schedules over a longer peak thus reducing delays and future capacity requirements. Based on an analysis of the Minneapolis-St. Paul airport, the research concluded that existing capacity could serve 30% more traffic under congestion pricing, at the same average social cost per aircraft as applies today. Whilst his research concentrated on a single airport, clearly the spreading of traffic would have network wide effects, which need to be considered in future work.

Brueckner (2001) argued that Daniel's research may have overestimated the appropriate congestion fees due to the latter's assumption (carried over from the road MCP literature) that competition is atomistic. Brueckner suggested that airlines might in fact internalise some delay. Indeed, at airports dominated by major carriers theoretically the vast majority of the congestion is internalised. However, under a Cournot oligopoly, only self-imposed congestion is internalised and delays to other carriers will need to be priced. This means a positive charge, but still lower than the results shown in Daniel's work.

Daniel (2001) studied the distributional consequences of airport congestion pricing by adapting his 1995 model so that the net gains and losses resulting from the introduction of a new pricing mechanism can be evaluated for different user groups. By using heterogeneous layover, queuing time values and operating time preferences, the research shows that net gains to commercial aviation, travellers and airport authorities exceed the losses incurred by general and regional aviation i.e. those parties using smaller aircraft that will be moved to the off-peak time slots. The paper then considered the redistribution of revenues in order to achieve a pricing policy that is strictly better for all parties, without losing the efficiency gains of the introduction of congestion pricing.

Two recent papers have also begun to consider the pricing of environmental externalities at airports. Nero and Black (1998) analysed environmental externalities associated with extensive hubbing and examined two scenarios, namely a passenger and an aircraft related tax. They conclude that a sufficiently high environmental tax will induce airlines to move from the economically efficient hub-spoke network design to a fully connected network. Lu and Morrell (2001) analysed the social costs of an aircraft noise and engine emissions environmental charge and applied it to a case study of Schiphol Amsterdam airport. The average noise social cost per landing, according to the model, ought to be €623, which is higher than the current charge of €520, whilst the engine emissions charge (currently not in existence) ranges from €244 to €4,967 depending on the scenario. The estimated increase in airfares to cover the additional charges ranged from 0.4 to 4.1%.

To our knowledge, there is not much literature about pricing let alone MCP as applied in waterborne transport. The general consensus appears to be that pricing in water transport is a very under-researched area. As was the case for airports, port pricing issues were first discussed in the 1970's, see for example Heggie (1974) who investigated cost-based tariffs for port facilities. Walters (1974) stated that long-run marginal costs presented the most

appropriate basis for efficient pricing, because of the presence of economies of scale that would systematically cause port deficits, as marginal cost was likely to be well below average cost. Bennathan and Walters (1979) considered Ramsey pricing or two-part tariffs as appropriate in the context of cost recovery. Button (1979) contended that pricing of ports can and should be based on costs, whilst a more recent paper by Talley (1994) argued that *“in attempting to apply MCP to ports, a practical problem arises – the inability of ports to determine the marginal costs of their services”*.

Bergantino and Coppejans (2000) presented a pricing mechanism, based on a game-theoretic “ratio” equilibrium, to allocate maritime infrastructure costs at ports. Their paper presents an example, showing that it is possible to balance a port budget with a fair and efficient allocation, given sufficient yet minimal data. Haralambides et al. (2001) claimed that efficient pricing of ports is possible and simply requires *“compilation of better and more harmonized statistics on port costs, adoption of standardized port accounting systems, greater transparency of port accounts and... a common glossary of terms”*. They also argued that the E.U. must attempt to achieve a level playing field amongst competing commercial seaports in order to account for each port’s specific characteristics and enable long-run MCP to lead to expected welfare effects. Goss and Stevens (2001) claimed that cargo dues are essentially taxes levied on the movement of goods through ports, with no connection to port costs, and are currently not levied on competing modes such as long distance trucking. They then advocate a change to port pricing practices, to include charging for externalities, thus allowing marginal costs to take account of differences in the timing of port investments.

### **3. Current Status of Rail, Air and Water Transport in Europe**

Since publication of the Green Paper on Fair and Efficient Pricing in Transport in 1995, and the subsequent White Paper in 1998, the policy of the European Commission towards transport pricing has been that it should be based on marginal social cost, including all externalities. Most of these ideas have yet to be fulfilled in the majority of E.U. member states. Currently, the pricing practices in rail, air and waterborne transport in Europe are very different between themselves and across countries, partly due to different institutional arrangements regarding ownership and regulation. Also, the Commission’s existing directives on these three modes seem to focus on different issues and policies: the important directives on rail clearly focus on MCP, whilst the directives on airports and air transport, and seaports and maritime, still seem to emphasise total cost recovery rather than marginal social cost pricing, perhaps because the issue of preventing the use of state aids to give unfair competitive advantage has long been a major issue in these sectors.

Infrastructure and transport services, based on organizational structure, are also different amongst the modes under discussion. Traditionally rail infrastructure (track provision) and service provision have been provided by one vertically integrated company. In air and maritime transport, the separation of these two sets of activities has been standard practice. This has important historical implications on pricing. More recently, as a result of E.U. policy, a degree of separation in rail has occurred in order to promote competition within rail, to encourage rail to compete actively with road and to account for the increasingly international (cross border) nature of transport. In some countries this separation has been in the form of separate subsidiaries for the same holding company, whilst in others, notably Britain and Sweden, infrastructure has been entirely separated from services provision.

In the rail sector, a wave of major reforms occurred in the 1990s. The reform included actions and measures both on the EU and national levels. However, there are still a diversity of approaches in terms of institutional arrangements, competitive structures and charging in the European rail industry. The first Directive requiring a degree of separation of infrastructure from operations was Directive 91/440, which required at least accounting separation, with an explicit tariff for the use of the infrastructure and limited open access for international rail freight operations. The provisions of this Directive have been gradually extended until the so-called infrastructure package set of Directives of 2001 (2001/12-14), which require accounting separation of passenger, freight and infrastructure sections of all main line railways, with separate bodies responsible for charging for and allocation of track capacity where the infrastructure manager also provides transport services, and with a tariff based on marginal social cost. The Directive on rail infrastructure charges (2001/14) permits deviations from marginal cost in certain circumstances, for instance where marginal social cost pricing is not implemented on other modes. It also permits non-discriminatory mark-ups above marginal costs in order to recover the costs of specific investments.

Pricing rail services to the final users is generally seen as a matter for train operating companies, either commercial or public entities, though it is typically thought that some degree of regulation is needed. Train-operating companies are clearly closest to the end users and therefore have the greatest ability to discriminate between different types of traffic according to price elasticity of demand and customer type. Price regulation is typically confined to commuter and other local services and to concessionary fares to certain groups of users, both of which are subsidised by the state. Commuter fares are often regulated and held below marginal costs, on second-best grounds, reflecting under-pricing on roads. Inter city fares show an increasing degree of differentiation, perhaps on Ramsey pricing principles. Something approaching perfect price discrimination is practised in freight markets, where negotiations with each individual customer are the norm. However, no country has attempted a policy of MCP for rail services, as opposed to rail infrastructure.

A key question appears to be the involvement of the private sector versus the responsibilities of the public sector. In the 1990s, in both Britain and Germany, railway reform was discussed and designed. Strongly held fears that a subsidised public infrastructure manager would lead to X-inefficiency and excessive investment led in both countries to a commercial infrastructure manager funded largely by payments from train operating companies. Moreover, in Britain the infrastructure manager was privatised. However, even a commercial infrastructure manager can receive direct funding from the state to cover costs. In Germany, the state funds DB Netz's investment, whilst currently also in Britain because of the crisis in Railtrack's finances that led to its bankruptcy, the state funds a substantial part of Railtrack's maintenance and renewal costs directly.

Rail infrastructure pricing is very variable. In some countries, such as Sweden, charges are based solely on (short run) marginal cost whilst in others, including Britain, there is a two-part or multi-part tariff with the fixed element recovering some or all costs not met by MCP. A third approach, that of Germany, is much closer to average cost pricing. In some cases, schemes include penalty payments/bonuses based on performance criteria, accident charges, congestion charges and information charges. As to internalising environmental costs, currently only Sweden explicitly includes environmental costs within its tariffs. No

country, other than Britain, explicitly estimates and includes congestion costs in its tariffs and no country includes pure scarcity costs.

To the extent that train-operating companies are required to pay the total cost of rail infrastructure, or a major part of it, two solutions have been popular: two-part tariffs and Ramsey pricing. Under the two-part tariff structure, train-operating companies (already in the market) make their decisions, e.g. concerning the frequency of service, on the basis of true marginal costs. On the other hand, this approach permits the operating companies to freely exercise their power to implement e.g., Ramsey pricing, in the final passenger and freight markets in order to raise the revenues needed to cover costs, including the fixed part of the tariff. The principal objection to the two-part tariff structure has been in terms of its potential impact on current and potential competition (by discouraging new entry), which has led to its abandonment in Germany. Ramsey pricing for rail infrastructure is favoured in many reports e.g. NERA (1998). However, no country, except to a limited degree France, has attempted to implement such pricing in practice. Ramsey pricing for infrastructure, an intermediate good, is problematic because the degree of differentiation that would be practicable is very limited and because it distorts train operating companies choice of frequency of service.

The air transport industry consists of many players, including airlines, airports, ground transport authorities, the travelling public, and cargo. In general terms, airlines are the users of airports, with passengers and cargo representing derived demand. The airlines within Europe are owned by a variety of institutions. Some are fully privatised, such as British Airways, others are entirely government owned, such as Olympic, and some are a public-private partnership, such as Air France. In general, airlines aim to maximise profits and consequently desire to minimise charges paid to airports and EUROCONTROL (for en-route sector usage). Airports within Europe are generally publicly owned with one or two notable exceptions, for example the British Airport Authority (BAA) owns and runs the four London airports and three airports in Scotland. There are also strong government interests in the employment opportunities provided by the air transport industry, through which they collect both labour and transport taxes.

The directive on airport charges (CEC, 1997b) sought to establish principles for airport access charging based on the underlying costs of airport operations and the need to ensure fair competition between airports. Airlines developed strict, single-hub networks due to the bilateral agreements between each country, up until 1997 when the complete implementation of the Third Package of Liberalisation Measures (1993-1997) came into effect. Since liberalisation and the introduction of cabotage rights between E.U. countries, the European airlines are now freer to develop their most preferable networks. Based both on experiences from current practice and research in both the U.S. and Europe (see for example Adler and Berechman (2001) and Button (2002)), it would appear that the hub-and-spoke system is efficient due in part to the aggregation of demand along fewer paths and the reduction in costs due to centralisation. However, hub airports suffer from major congestion, which is a direct result of demand patterns. Travellers flying via a hub prefer to minimise layover time and airlines therefore choose to fly in over an hour or two and then fly out over an hour or two in approximately two or three waves over a 24 hour period. Capacity needs to be sufficient to meet this peak need and slot allocations need to be organised to enable such network patterns. Without the ability to fly in waves, a more fully connected network will develop with the resultant loss of efficiency and higher prices for passengers. One potential method for encouraging efficient use of airport capacity is

through the pricing of slots, which are currently unpriced. Slot allocation is instead determined according to 'grandfather' principles. This principle specifies that an airline using its slots more than 80% of the time in the previous year have automatic rights to the same slot allocation in the coming year.

Airport pricing currently includes landing fees according to maximum take-off weight of aircraft, transfer and non-transfer passenger departing fees, air traffic control tariffs, parking fees, freight loading/unloading charges, security and control charges for passengers and freight and at certain airports, night charges, noise fees, peak fees and aircraft engine emission charges. Separate concessions and gate fees are collected for landside operations. The additional peak charges are currently very low and are implemented only by BAA, Schiphol Amsterdam and nominally by Dublin, Hamburg, Athens and Madrid. Some airports charge additional night tariffs, whilst others are cheaper and yet others shut down entirely. Schiphol Amsterdam, Belgium, Charles de Gaulle Paris, many of the German airports, Fumicino Rome, Arlanda Stockholm, Zurich and BAA initiated noise related charges to fund noise abatement schemes but the rest of the airports in Europe have yet to initiate such charges. Only airports in Switzerland and Sweden have implemented aircraft engine emission charges. No congestion or scarcity charges have yet been implemented. In the U.S., scheduled airline flights must report the percentage of delayed flights, based on historical data, but neither this, nor pricing, have yet to be implemented in Europe.

It is very difficult to ascertain the formula that lies behind current airport charges, though the levels of charges are fairly well known. It may in fact be that rather simple accounting rules are being followed in which last year's tariffs are increased by at least the level of inflation, considering also the competitors' levels, namely other airports around Europe.

Maritime transport is very important to international trade, carrying approximately 90% of all cargo worldwide (Haralambides and Veenstra (2000)). The shipping industry can be categorized into four separate sectors, namely bulk shipping (transporting raw materials such as oil, coal etc.), liner shipping (transporting work-in-progress and final products), short sea shipping (transporting mostly passengers) and inland waterways that transfer goods from major ports to countries within Europe. Bulk shipping is highly competitive and utilizes tankers to work on a contract basis. Liner shipping, on the other hand, provides scheduled services between specified ports and has much more extensive infrastructure requirements than bulk shipping. The introduction of containerization in the 1960s led to substantial improvements in port productivity, permitting ships to achieve economies of scale. This led to the development of hub-and-spoke networks, similar to that of aviation, with hubs such as Singapore, Hong Kong and Rotterdam feeding the regional ports in Asia and Europe. The market structure of liner and short-sea shipping appear to be dominated by capital concentration, carrier coalitions through the use of conferences and alliances, monopoly power and related pricing strategies. However, there is a paucity of research on the subject in part due to the lack of time-series data of reasonable length and consistency.

The European Commission's 1997 Green Paper on seaports and maritime infrastructure (CEC, 1997a) established the E.U.'s intentions to introduce the user-pays principle to cover maritime infrastructure costs, in a manner similar to that of any other port or station transport mode, although perhaps on a slower track. It sought a similar system of charging to that for airports, again based upon underlying cost structures and a desire to ensure fair competition between ports, particularly those in adjacent countries. ATENCO, an E.C. 4<sup>th</sup> program research project, argued that pricing in ports can and should be based on costs. They state that the costs included in the analysis would be dependent on the type of port

organization, namely service or comprehensive ports versus landlord ports. ATENCO also showed that there are substantial differences between the respective funding and pricing practices currently applied in ports across Europe. A recent report by the SEC (2001) on public financing and charging practices in the community seaport sector states that efficient functioning of ports as part of the door-to-door intermodal chain is an essential prerequisite to stimulate the development of maritime transport. The report concludes that financing or charging practices in the European port sector are linked to the level of public or private involvement in the ownership and/or the operation of a port as well as on the ports competitive position in the market of transport services.

Current port pricing practices have been mainly based on empirical intuition and past trends. Unfortunately, current pricing would appear to have a tenuous connection to the cost structure and levels of both port operators and port users. Meersman et 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. In general, port pricing today differentiates according to the following main criteria: vessel types and destination, location of operations in the port territory, total time of service use (i.e., processing time) and season. These tariff levels do not reflect the actual costs levied by the port operations and they do not recover costs, thus creating severe inefficiencies such as congestion as well as sources of significant financial loss. However, due to the wildly differing conditions under which major and short sea shipping ports are working, some ports suffer significant over-capacity, whilst others are lacking in infrastructure. Inland shipping charges, paid by inland vessels, are based on harbour and lock dues. The extent to which port and inland shipping charges cover construction or maintenance costs are not clear, but evidence suggests that the charges are often below cost (see for example Psaraftis (1998)).

#### ***4. Key Barriers to Implementing Efficient Cost-based Pricing in Rail, Air and Water Transport<sup>1</sup>***

The key barriers to implementing efficient cost-based pricing are different in rail from air and waterborne (ports, short sea shipping, inland waterways, maritime) transport, mainly because Directives already exist requiring implementation of MPC based pricing for rail infrastructure and a start has therefore been made in most countries. The other two modes have not yet implemented such policies and would appear to be pushing towards long rather than short-run MCP. Marginal costs are specific variable costs related to the provision of a service or the use of infrastructure. 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. Long-run marginal costs include also the capital costs of increasing capacity to accommodate an increase in output but have proven rather difficult to measure. Linking charges to long-run marginal costs would lead to significant inefficiencies where excess transport capacity exists. Below, we discuss the barriers to implementing full, short-run, marginal social cost pricing in rail, air and waterborne transport.

In the rail sector, the situation is very diverse between countries. In some cases existing prices are below MCP, in others above it. Thus the key barriers to the implementation of

---

<sup>1</sup> This section draws heavily on EC DGTREN Project MC-ICAM: Marginal Cost pricing in transport - Integrated Conceptual and Applied Model analysis (<http://www.mcciam.net/>)

marginal social cost pricing vary from country to country, but the most common appear to be:

1. *Governments are unwilling or unable to provide necessary subsidies.* While under short-run MCP there is a clear need to subsidise (in the static perspective, given scale, density and/or scope economies), this may not be acceptable or possible politically. To the extent that in many European countries rail passenger services may be used predominantly by better off segments of society, rail subsidies are often seen as inequitable. Furthermore, governments may fear X-inefficiency resulting from subsidisation. Thus subsidies are often limited to particular types of service or user, and not adequate to support full MCP.

2. *Failure to provide correct incentives for investment.* Whilst application of short-term MCP is almost by definition, practical implementation issues aside, efficient as far as short term, static perspectives are concerned, an often presented fear is that its application may provide poor incentives for capacity expansion, where needed, and also more generally may not guarantee efficiency in the long term.

3. *Anti-trust problems related to small new entrants.* Currently there are anti-trust legal problems with the implementation of two-part tariffs. It is feared that this may not preserve terms of competition between operators. If the fixed charge refers to access to the network as a whole, then it may be prohibitively expensive for a small operator; even if it refers to a particular route, it will disadvantage operators with a small amount of traffic on that route, as large operators will get an overall lower price per train kilometre.

4. *Absence of strategy at European level to encourage and secure efficient pricing and competition across modes.* Currently there exists no strategy at a European level to encourage and secure efficient pricing and competition across modes. The forthcoming EC's Framework Directive (2003) could be a first concrete step into this direction. The goal of this Directive appears to be to establish the same pricing principles and rules across all modes and countries. If MCP is applied in the rail sector but other competing modes of transport, road in particular, charge less than marginal cost, this may cause rail to lose competitiveness. Thus, where MCP on rail would lead to increased charges, this is strongly resisted by the industry, at least until road and air transport are also appropriately priced. For this reason, the current rail infrastructure charging Directive does not require rail to be charged for environmental externalities, until other modes are so charged.

5. *Problems of measurement.* Though estimation methods and, in most cases, estimated values for most cost components of marginal external costs exist, lack of data on congestion, scarcity, noise, air pollution and accident externalities leads to problems of computation of optimal marginal cost prices. In particular, studies of congestion and scarcity costs are very few in number.

In air and water transport sectors, the key barriers to the implementation of marginal social cost pricing (MCP) at airports and ports appear to be very similar:

1. *Lack of transparency involved in the entire charge-setting approach.* This appears to be the biggest barrier today to implementation of MCP at airports and ports, making suggestions for appropriate tariff setting very difficult. Without knowing the actual marginal and average costs or demand elasticities, it becomes very difficult to analyse the short and long term effects of any changes to the current pricing regimes.

2. *The lack of harmonisation (of pricing principles) across different countries within the EU.* There is no agreed pricing formula defined at EU level or E.C. Directive, as there is

currently for rail. However, the 1998 E.C. White Paper does actively encourage a transparent pricing process in both modes.

3. *The power of monolithic companies to prevent change.* The monopoly powers of hub-based flag carriers and airports in air transport and oligopolistic shipping lines and hub ports are likely to cause serious political barriers to implementation of MCP. Lobby power on the part of the directly interested parties and the political organisation is such that it will not be simple to change the pricing mechanisms.

4. *The airports and ports have little interest in collecting additional data that will be required to accurately charge new tariffs.* The relevant authorities or private companies fear annoying their customers, the airlines or shipping lines, and causing them to move to other geographically close entities, without such requirements. Hence, the local and state governments will probably need to pass new legislation in order to implement the new pricing regime. Some legislation has already been passed, but this is not true in all countries and tends to be partial at best.

5. *Delay data is currently very difficult to compute and scarcity (data) is not considered at all.* Currently, delays occur at the major airports in Europe and some ports, such as the port of Piraeus, however data is at best sketchy. Expansion of airport and port infrastructure, i.e. the building of additional runways, terminals and/or berths, needed to overcome the delay and congestion issues, presents political, acceptability and legal problems that will need to be overcome. The political problems lie in land use and environmental issues. It should also be noted that true demand is not reflected in the current delays due to the administrative agreements that reduce demand accepted at the airports and ports in the E.U.

For inland shipping / 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.

## **5. Concluding Comments**

The unequal growth in the different modes of transport is a major concern of the European Commission, as reflected in the White Paper (2001). The same question, and its implications for the goal of sustainable transport, are questioned beyond the borders of Europe e.g. the United Nations research entitled "Sustainable Transport Pricing and Charges: Principle and Issues" (2002). The EC's White Paper (2001, p.7) summarises the current shares of the different modes in the EU: "road transport represent 44% of the goods transport market compared with 41% for short sea shipping, 8% for rail and 4% for inland waterways. The predominance of road is even more marked in passenger transport, road representing 79% of the market, while air with 5% is about to overtake railways which have reached a ceiling of 6%." The White Paper sees efficient cost-based transport pricing as one of the measures needed to bring about a sustainable modal balance.

The issues surrounding implementation of marginal cost pricing (MCP) appear to be reasonably similar in nature across all three modes. Also, the modes in many cases compete with each other, and with road transport too. High-speed trains are a serious competitor to the air transport industry within Europe, as well as autobahns to a lesser extent. Average air trip lengths within Europe are 750 kilometres, a distance over which high speed trains in countries such as France and Italy can compete. Furthermore, air transport and short sea

shipping are direct rivals for passengers, amongst the Greek Islands for example, as are rail and inland waterway transport for cargo. Obviously, if prices in one mode increase substantially, a modal change is likely.

Therefore, it is important to secure – as is emphasised by the EC – that although price levels can be different across countries, the methods by which they are computed should be similar across countries and modes (including road). Currently, the three modes are at different stages of MCP implementation. Rail is the most advanced, though frequently watered-down versions of MCP have been implemented, due to political, legal, institutional and acceptability-related barriers. The large number of tariffs that already exist in air transport remain to be adapted to meet the current level of demand, although some airports have already begun changes in the pricing process. Waterborne transport is the furthest from potential implementation.

An important issue with regard to rail transport is the separation of infrastructure and services operations. This has been proposed, and also implemented in many countries, in order to encourage rail to achieve equal status with other modes (road, air and waterborne transport), and also to allow for the cross border nature of traffic, including cabotage rights. But separation is still questioned as there is a widespread belief that the interaction between vehicles and infrastructure in the rail sector is so complex that only an integrated management can operate it efficiently.

Another issue, relevant to all three modes, is the involvement of the private sector versus the responsibilities of the public sector in the provision of transport infrastructure and services. The reasons usually presented for privatisation, in the case of airports, ports and rail track infrastructure, are to help avoid X-inefficiency and provide for private funding of investment. On the other hand, it is understood that privatisation can lead to monopoly power, so there is a trade-off between monopoly power and X-inefficiency. However, the role of privatisation is a highly controversial issue. For instance, within Project MC-ICAM, opposing views on this subject were put forward, reflecting both theoretical reasoning and practical experience. Matthews and Nash (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.*" This argument can also be seen in the light of the Railtrack (private infrastructure company) bankruptcy this year in Great Britain. Alternatively, Adler and Berechman, (2002) argue that airport privatisation would still enable implementation of marginal cost pricing whilst reducing some of the inefficiency invariably existing in public institutions. They refer to the observation that large airports, as opposed to rail track, appear to operate under constant returns to scale (Adler et al. (2002) and Oum and Zhang (1990)). 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.

Obviously, in relation to privatisation of airports, two issues need to be emphasised. First, even after privatisation, some regulation of tariff setting may still be needed in order to ensure that major hub airports, such as Frankfurt and Heathrow, do not abuse their position (Starkie (2002) argues that even this would be unnecessary). Secondly, the privatisation option exists for airports due to the constant returns-to-scale that appear to exist (ignoring the issue of fixed costs) as opposed to rail track provision, which appears to enjoy strong increasing returns-to-scale (Pels (2000)). It should also be pointed out that it may well be preferable to privatise or deregulate networks of airports i.e. hubs and spoke airports together, in order to permit cross-subsidisation of complementary demand.

Based on the literature and past experience and reflecting the identified barriers and constraints, we suggest the following ways forward for the different modes. For rail transport, existing legislation already requires the implementation of marginal cost based pricing, with mark ups as necessary. Further progress depends essentially on two developments – research to improve cost estimates, particularly for congestion and scarcity costs, and progress with the implementation of marginal social cost based pricing on other modes. The existing rail legislation does not require rail to be charged for its environmental costs until other modes are also charged for them. Thus appropriate charging for infrastructure maintenance and renewal should be implemented immediately, but charging for congestion, scarcity and environmental costs will be medium to long run developments. Where privatisation policies are pursued, it is necessary to ensure that, through a combination of regulation and/or franchising, there is still a body that can ensure marginal social cost based pricing is pursued.

For air and water transport, appropriate policy steps would appear to be: (i) to encourage free competition for end users; (ii) either continuation of state or regional-owned ports and airports, with greater transparency in order to set tariffs at marginal social cost levels, or privatisation of ports and airports with price capping or regulation setting infrastructure charges through an independent administrative body such as the British Civil Aviation Authority; and (iii) imposition of taxes, for example on fuel, needed to reflect other externalities, such as noise and air pollution.

The privatisation issue will probably be decided in the medium to longer term, and is a possibility in airport infrastructure (at least to the extent that constant returns to scale in the provision of infrastructure and services are true), as opposed to rail track. Market mechanisms for slot allocation, to account for delays and scarcity, will probably be decided in the longer term as they first require more theoretical analysis, data collection and agreement at the E.U. and national levels. Further research is needed on the quantification of certain aspects of marginal social cost. It should be noted that the European Commission (1999) emphasised scarcity as compared to problems of congestion and delays. The scarcity problem is important because it is related to the new entrants' problem and hence to the problem of guaranteeing sufficient competition (congestion is more an issue between incumbents).

Open for discussion are several other major issues too, including the kind of incentives short-run MCP can create with respect to investments in the future. Another key issue is the relationship between pricing on the different modes. Appropriate charges for e.g., rail infrastructure, will hang on the far more politically difficult issue of implementing corresponding charges for road users, most of whom fall a long way short of covering their external costs.

## ***Bibliography***

- Acworth W.M. (1905). *Elements of Railway Economics*, Oxford University Press, Oxford.
- Adler N. and Berechman Y. (2002). Marginal Cost Pricing Approach to Setting Airport Charges, *MC-ICAM Task 5.3*.
- Adler N., Oum T.H., Yoshida Y. and Yu C. (2002). Airport benchmarking: A comparison of total factor productivity and data envelopment analysis, *Working Paper, University of British Columbia*.

- ATENCO (1999). Analysis of the cost structure of the main TEN ports. European Commission, Fourth Framework Research Programme.
- Baumol W.J. et al. (1962). The role of cost in the minimum pricing of railroad services, *Journal of Business*, 357-66.
- Baumol, W.J. (1983) Some subtle issues in railroad regulation. *International Journal of Transport Economics*, 10, pp. 341-55.
- Bennathan K.J. and Walters A.A. (1979). *Port pricing and investment policy for developing countries*, Oxford University Press: Oxford.
- Bergantino A.S. and Coppejans L. (2000). Ship-owner preferences and user charges: Allocating port infrastructure costs, *Transportation Research* 36E, pp. 97-113.
- Borins S.F. (1978). Pricing and investment in a transportation network: The case of Toronto Airport, *Canadian Journal of Economics*, 11, pp. 680-700.
- Brueckner J.K. (2001). Airport congestion when carriers have market power, *Working Paper*, University of Illinois at Urbana-Champaign, United States.
- Button K.J. (1979). The economics of port pricing, *Maritime Policy and Management*, 6, pp. 201-7.
- Button K.J. (2002). Debunking some common myths about airport hubs, *Journal of Air Transport Management*, 8, pp. 177-188.
- Caillaud B. and Tirole J. (2001). Essential facility financing and market structure. In C. Nash and E. Niskanen (eds) Helsinki Workshop on Infrastructure Charging on Railways. VATT Discussion Paper 245, Helsinki.
- Carlin A. and Park R.E. (1970). Marginal cost pricing of airport runway capacity, *American Economic Review*, 60, pp. 310-319.
- Coopers & Lybrand. (1998). Phase 2 of "Le Peage" study, Final Report, UIC, Paris.
- Coto-Millan, P., Banos-Pinos, J., Rodriguez-Alvarez, A. (2000). Economic efficiency in Spanish ports: Some empirical evidence. *Maritime Policy and Management* 27, pp. 169-174.
- Daniel J.I. (1995). Congestion pricing and capacity of large hub airports: A bottleneck model with stochastic queues, *Econometrica*, 63 (2), pp. 327-370.
- Daniel J.I. (2001). Distributional consequences of airport congestion pricing, *Journal of Urban Economics*, 50, pp. 230-258.
- European Commission (1995). Green Paper Towards fair and efficient pricing in transport policy: Options for internalising the external cost of transport in the European Union, COM(95)691, Brussels.
- European Commission (1997). Green Paper on Sea ports and maritime infrastructure, COM(97)678, Brussels.
- European Commission (1997). Proposal for a Council directive on airport charges, COM(97) 154 final. Brussels.

- European Commission (1998). White Paper on Fair payment for infrastructure use: A phased approach to a common transport infrastructure charging framework in the EU, DG Energy and Transport, Brussels.
- European Commission (1999). Calculating Transport Infrastructure Costs, Final Report of the Expert Advisors to the High Level Group on Infrastructure Charging (Working group 1).
- European Commission (2001). Directive on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification. Brussels.
- European Commission (2001). White Paper on European transport policy for 2010: time to decide, DG Energy and Transport, Brussels.
- European Conference of Ministers of Transport (1998) Round Table 107 User Charges for Railway Infrastructure. OECD, Paris.
- Gibson S. (2000). Charging for the use of railway capacity. In C. Nash and E. Niskanen (eds) Helsinki Workshop on Infrastructure Charging on Railways. VATT Discussion Paper 245, Helsinki.
- Goss R. and Stevens H. (2001). Marginal cost pricing in seaports, *International Journal of Maritime Economics*, 3, pp. 128-38.
- Haralambides H.E. and Veenstra A.W. (2000). Modelling performance in liner shipping. In: *Handbook of Transport Modelling* by Hensher D.A. and Button K.J. (eds), Pergamon, Amsterdam.
- Haralambides H.E., Verbeke A., Musso E. and Benacchio M. (2001). Port financing and pricing in the European Union: Theory, politics and reality, *International Journal of Maritime Economics*, 3, pp. 368-386.
- Heggie I.G. (1974). Charging for port facilities, *Journal of Transport Economics and Policy*, 8, pp. 3-25.
- Hotelling H. (1938). The general welfare in relation to problems of taxation and of railway and utility rates, *Econometrica*, 6, pp. 242-269.
- Koh, Y. (2001). Optimal investment priority in container port development. *Maritime Policy and Management* 28, pp. 109-124.
- Lu C. H-Y. and Morrell P. (2001). Evaluation and implications of environmental charges on commercial flights, *Transport Reviews*, 21, pp. 377-95.
- Matthews B. and Nash C., (2002). Railway Infrastructure Charging in Britain - the Process of Re-Organisation and Reform, *MC-ICAM Task 5.2 part 2*.
- Matthews B., Nash C., Nilsson J-E. and Farkas G. (2002). Institutional and Technological Barriers to Implementation - Rail Transport, *MC-ICAM Task 5.2 part 1*.
- Meersman H., Van de Voorde E. and Vanelslander T. (2002). Port pricing issues: Considerations on economic principles, competition and wishful thinking. Paper presented at 2<sup>nd</sup> IMPRINT-EUROPE Thematic Network, Brussels.
- Mohring H., (1972). Optimisation and scale economies in urban bus transport, *American Economic Review* 62, 591-604.

- Nash C.A., Matthews B., and Whelan G. (2001). Rail infrastructure charges in Europe - principles and practice, Paper presented at the World Conference on Transport Research, Seoul, 2001.
- NERA (1998) *An Examination of Rail Infrastructure Charges*, NERA, London
- Nero G. and Black J.A. (1998). Hub-and-spoke networks and the inclusion of environmental costs on airport pricing, *Transportation Research*, 3D, pp. 275-96.
- Nilsson J-E. (2002). The Case for Using a Market Mechanism for Slot Pricing, *MC-ICAM Task 5.3 Part 2*.
- Office of the Rail Regulator, (2000). Periodic review of Railtrack's access charges: final conclusions, ORR, London.
- Oum T. H., Zhang A. and Zhang Y. (1996). A note on optimal airport pricing in a hub-and-spoke system, *Transportation Research*, 30B, pp. 11-18.
- Oum T.H. and Zhang Y. (1990). Airport pricing: Congestion tolls, lumpy investment and cost recovery, *Journal of Transport Economics and Policy*, 22, 307-17.
- Paixao A.C. and Marlow P.M. (2001). A review of European Union shipping policy. *Maritime Policy and Management* 28, pp.187-198.
- Pels E. (2000). Airport Economics and Policy, Ph.D. Dissertation, #222 Tinbergen Institute Research Series, The Netherlands.
- Psaraftis H. (1998). When a port calls...an operations researcher answers, *OR/MS Today*, April, pp. 38-41.
- SEC (2001). *On public financing and charging practices in the community sea port sector*, SEC (2001) 324, 14/02/2001, Brussels.
- Starkie D. (2002). Reforming UK airport regulation, *Journal of Transport Economics and Policy* 35, pp. 119-135.
- Swahn H. (2002). Marginal cost pricing in the maritime sector: Cost calculation, acceptance and Swedish infrastructure charging practice. Paper presented at 3<sup>rd</sup> IMPRINT-EUROPE Thematic Network Seminar, Brussels.
- Talley W.K. (1994). Port pricing: a cost axiomatic approach, *Maritime Policy and Management*, 21 (1), 61-76.
- Walters A.A. (1974). Marginal cost pricing in ports, *The Logistics and Transportation Review*, 11, pp. 299-308.