

## THE ROLE OF USER CHARGES FOR INFRASTRUCTURE MAINTENANCE COSTS<sup>1</sup>

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The increasing importance of maintenance has led to research questions on ways of charging infrastructure users and mobilisation of funds for maintenance activities. Technological developments help to bring advanced and differentiated schemes of infrastructure charging closer. For long distance transport, charging road use in one country may well lead to changes in competitive positions of countries.

The system of road user charges introduced in one country might change the competitive position of the neighbouring country. The other dimension of competition is between various transport modes. Depending on the various origin-destination submarkets, there may be substantial competition between transport modes. This calls for an integrated approach to infrastructure charges in order to avoid equity problems. This article focuses on these problems from the European point of view.

**Key words:** Transport User, Transport User Charges, Infrastructure maintenance Costs

### 1 Introduction

Economic and transport objectives are always important in policy considerations, and sometimes the most important. In much general discussion, it is assumed that improvements in transport - almost always perceived as reductions in transport costs- will assist economic growth. Many countries experienced a rapid increase in their infrastructure stocks in last 50 years. Following the evolutionary path, the infrastructure growth rates gradually decreased that implies a shift away from new infrastructure construction towards maintenance and renewal. The importance of maintenance increased and it has led to research questions on ways of charging infrastructure users, and mobilisation of funds for maintenance activities.

Not only maintenance, but also the problem of congestions showed some sources for transport users charging. It is common experience that congestion is widespread, and there are methods of calculating economic costs of congestion, so policies which reduce congestion should be good for the economy. For many years, it was the case that the interest groups which expressed these views most forcefully were the business interests for whom economic growth was directly relevant, and these groups often took it for granted that “transport improvement”

meant “road building”. So politicians at national or local level were often faced with arguments that “businessmen” (who surely know all about the economy) were in favour of constructing major road

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projects to improve the economy, in contrast with environmentalists” (who often reject economic reasoning) being against these projects. This simple picture is no longer true.

For a number of reasons the argument has been turned on its head and there are views that (in some circumstances) road building can be bad for an economy, not good for it, and traffic restraint can be good for an economy, not bad for it. These conceptions are not nearly so obvious, and it is sensible to consider why the shift has happened, and whether it is valid. This is especially true when considering the case of congestion charge, where the argument is used that increasing transport prices and reducing traffic may be the optimal way of improving economic efficiency.

## 2 User Charges and Traffic Management

The term ‘Traffic Management’ represents the process of adjusting or adapting the use of an existing road system to meet specified objectives without resorting to substantial new road construction. Thus the topic is related with a large field involving both traffic systems and urban development issues. It is also working area with strong links with both Civil Engineering and Urban Planning.

Transport Planning and Land-use is rather complex since it covers various aspects related to it. The two main aspects are the general spatial and land-use patterns that have an impact on transport volumes and the spatial/land-use requirements of transport infrastructure. The first aspect is related to the growing sub-urbanisation and urban sprawl, which have led to increasing dependencies on the private car and to substantially increased trip lengths. Widespread ownership and use of cars is also related to this phenomenon. The second aspect requires us to distinguish between different transport modes, which have varying land-use requirements. In urban areas, spatial needs of transport infrastructure are usually considerably higher than in rural areas and rise up to around 10%-15% of total land-use.

Transport infrastructure networks constitute essential means via which city functions (centres of economic activities and citizen services) can be performed while at the same time serve the communication between the cities and their suburbs, outlying regions and other urban areas. In the current Module particular emphasis is given to the presentation of the implications on Traffic Management (TM) of the recent trend towards the adoption of more sustainable, environmentally friendly, transport policies. The adoption of more sustainable, environmentally friendly, transport policies has created new challenges for Traffic Management.

Ever more, new traffic management solutions must contribute to a safer, cleaner and more efficient transport by reducing hazardous environments, better controlling potentially dangerous situations, reducing environmental pollution, helping travellers to avoid congestion and unnecessary trips, gaining extra capacity from existing infrastructure and encouraging the use of more sustainable modes of transport.

Managers involved in transport and land use should develop an understanding and skills about the following:

- To develop an understanding of the interrelation of land-use and transportation needs.
- To realise the transport planning problems within urban and suburban areas.
- To be informed about latest trends, policies and practices in this field, forming a valuable background for their future work.
- To develop and exercise their critical skills that will help them in the evaluation, assessment and (later on) the design of transportation plans in urban and suburban regions.

Although many of the techniques, strategies and global solutions are applicable to rural environments, the focus is on urban transport and traffic problems.

Urban and suburban development has considerably decreased transportation efficiency in the European cities as a result of a high concentration of inhabitants in confined areas along with the high use of the private car and the lack of space for the development of infrastructure that will support public transportation. Hence transport planning is challenged to provide solutions in order to minimise traffic congestion and to make transportation in urban and suburban areas more efficient, safer and environmentally friendlier, improving, thus, the living and working conditions within the cities, as well as, enhancing economic growth. In order to meet this challenge existing knowledge as well as new ideas and solutions have to be integrated when designing new urban areas in order to develop an infrastructure that will facilitate the transportation needs of the area (considering spatial arrangements, location of residences, working areas, shopping centres etc. as well as consideration of transportation infrastructure that will support the use of different transportation modes. On the other hand in existing urban and suburban areas, where infrastructure is given, new transportation policies and practices (i.e. better integration of transport modes) have to be developed in order to catch up with the socio-economic changes that affect transport patterns.

A re-framing of transport planning is now emerging. The new logic consists of five main approaches:

- from transport engineers to transport planners;
- from road schemes to integrated packages;
- from gravity models to accessibility indices;
- from developer contributions of highways to public transport improvements and
- from structural to managerial technologies.

The ‘new realism’ which characterises transportation planning is part of a wider shift away from ‘predict and provide’ planning, and towards Demand Side Management (DSM) which is slowly emerging across all infrastructure sectors. The common thread linking these diverse services are the attempts by network operators to work with users to reduce demand on the most stressed parts of the network.

The ‘new realism’ as a solution centres on several key themes, including:

- a commitment to significantly improved public transport;
- the introduction of traffic calming and measures for pedestrians;
- advanced information technology based systems to get the most out of the existing infrastructure;
- road pricing and
- a reduction in the building of new roads.

The new transport planning discourse then no longer revolves around the spreading of the network as far and as fast as possible. There is now a clear priority to balance supply and demand as far as possible. Consequently space has become a much more differentiated concept. Rather than being homogenised as a backdrop to the spread of transport networks space is being customised to cater for the actual needs of transport users and in light of the potential for demand management and integrated network planning in particular areas.

That urban land-use and transport are closely inter-linked is a common wisdom among planners and the public. The spatial separation of human activities creates the need for travel and goods transport is the underlying principle of transport analysis and forecasting. Following this principle, it is easily understood that the sub-urbanisation of cities is connected with increasing spatial division of labour, and hence with ever increasing mobility.

However, the reverse impact from transport to land-use is less well known. There is some vague understanding that the evolution from the dense urban fabric of medieval cities, where almost all daily mobility was on foot, to the vast expansion of modern metropolitan areas with their massive volumes of intra-regional traffic would not have been possible without the development of first the railway and in particular the private automobile, which has made every corner of the metropolitan area almost equally suitable as a place to live or work. However, exactly how the development of the transport system influences the location decisions of landlords, investors, firms and households is not clearly understood.

### 3 Congestion Control

Congestion control is a proposed alternative to congestion charging, which is common practice in a number of cities around the world. The aim of the Congestion Control is to use the road to maximum efficiency while reducing user and system operating costs by comparison to the costs of congestion charging. It requires drivers to register for places within overlapping timeslots during rush hour, where each timeslot has a maximum capacity that is defined by the road network. Once capacity within a timeslot has been reached no new places can be booked (exceptions are made for emergencies). Any non-registered driver identified on the road at rush hour receives a fine similar to that of a speed camera ticket, where the fine is self financing. Congestion control lead to reduce user and operating costs by using the fine size as a deterrent. With congestion charging all vehicles must be identified so that payment can be enforced. Thus cameras must be located at every entry/exit point. Congestion control operates in a similar way to that of automatic traffic surveillance, such as speed cameras. At rush hour travelers drive within agreed timeslots (e.g. timeslots could be 6.30-7.30am, 7-8am, 7.30-8.30am, 8-9am and 8.30-9.30am). Where companies/schools and individuals register in advance for places within these timeslots. These are either on a one off ad-hoc or regular time basis. The ad-hoc places are allocated on a first come first serve rule and are free, while for regular places priority is given to specific jobs/roles/classes which don't allow flexible hours (i.e. shop floor workers, hospital shifts or lesson start times). A local council or other controlling authority evenly distributes the registered traffic to the maximum capacity of each timeslot and the road network. Thus traffic load is evenly spread out during rush hour and at the optimum capacity of a road network without creating congestion. There is also the alternative called Congestion pricing, based on the same principals, but basically focused on environmental aspects of congestions.

As example here are some information of the London model:

London is one of the world's economically most successful and well-performing cities. It is motive power of Great Britain economy and is also international financial, cultural and entertainment centre. On February 2003 London introduced the largest congestion charging system so far seen in the world based on a cordon round the central area and a £5 (7 euro) flat charge per day a vehicle. Proposed charging area constitutes the real heart of London. It is bounded by station Kings Cross in the north, Tower Bridge in the east, Elephant & Castle in the south and Marble sheet on the west. It represents surface of about 8 sq mil, which means 1,3% London's general surface. Main purpose of the congestion charging is to reduce transport in the centre of London and reduce congestions. Anyone going through this area from 7a.m. to 7p.m. from Monday to Friday (except holidays) must fee 5 pounds. This charge can be booked up ahead or at the latest the same day, whereas price rises up after 7p.m. to 10 pounds. The charge can be paid daily, weekly, monthly or annually by phone, by post, through the Internet or in the bank.

The driver just alleges the number plate. The network of about 230 cameras registrate number licences of cars, which steer into charging area and proceed in it. This cars are notated into database. An owner of the car identified in charging zone who don't pay charge is penalized aloft 80 pounds. As well as with parking fines, the fine is reduced to 40 pounds if the owner pays instantantly. In a case that penalty is not booked up in time, it increases to 120 pounds. As far as it is not booked up nor then the vehicle is translocated or gets so-called "wheel clamp".

There are two types of timeslots in this system:

- Ad-Hoc – for drivers who rarely need to use the road at rush hour but have a one off requirement (e.g. catching a flight)
- Regular – daily commuters traveling to/from work/school, it is envisaged the majority are of this type (e.g. 90%)

Timeslot place are booked over the internet or by phone. However regular timeslots have to be requested and paid for on behalf of the individual by companies and schools. This payment can be passed onto the individual. However by taking the responsibility away from the individual, places are more likely to be canceled when not required. The monthly administration fee (fraction of the cost of monthly congestion charging commutes) required for the regular user pays for the booking service, while all other costs (e.g. fines issued, camera maintenance) are reclaimed by the fines.

Advantages and disadvantages of this model

Congestion control aim to provide the following advantages over congestion charging:

- Only drivers creating congestion pay
- Reduced cost operating costs, thus reduce cost to users and the economy as a whole
- Less infrastructure to maintain
- Reduced/removed congestion and related reduction in CO2
- Encourages companies to offer flexible hour polices to employees
- Encourage use of public transport which is less restrictive on travel start times

But there are of course also some disadvantages of congestion charging:

- Congestion control is a theory and has not been proven
- Restriction on private motor vehicle travel times during rush hour

The benefits of this system are widespread and led to enlargement of this system, so we can say this is a successful model. The vision was simple, that it would tend to build up over a period, rather than all happening instantaneously: research on other pricing effects suggests that about 50 per cent of the full benefits will develop in the first two or three years, and probably with 90 per cent of the benefits within five years, though some impacts continue developing over a much longer period. Although this dynamic process of build-up is not allowed for in the computer models used, one way of interpreting these figures is that the “£100m a year” commonly quoted is broadly an estimate of the partial, short-term benefits, which then build up to double this figure over a small number of years. If an underestimate of benefits had put the scheme at risk and with it, not only a major part of the Mayor’s strategy but also a large and essential component of the Government’s congestion targets this would not be caution, but a waste of opportunity.

#### **4 Marginal cost pricing and its problems**

An important question in the discussion on pricing for infrastructure use is the concept of social marginal costs pricing. This pricing principle means that users pay the additional costs they impose on infrastructure providers, in case the infrastructure is owned by the public sector and also part of the external costs of transport. The social marginal cost pricing principle has been formulated as the cornerstone for pricing in the EU, as formulated among others in policy documents on fair and efficient pricing (EC, 1995).

It is well known that marginal cost pricing has a number of problems that obviate a simple application. During last decade progress has been made in the valuation of various cost components such as accident costs, various types of environmental costs and the cost of infrastructure use. Nevertheless, substantial problems remain. The nature of the estimation problems remains varied: in some cases it concerns the valuation aspect, in other cases it is the estimation of marginal versus the average costs, or long-run, versus short-run costs. It should be admitted that substantial uncertainties still do exist, but the progress made in the meantime has been considerable, and there are promises of further progress. Transport infrastructure is characterised by increasing returns to scale. Hence marginal costs are lower than average costs, and this implies that marginal cost pricing will lead to incomplete cost coverage. Policies to improve cost coverage imply that pricing starts to depart from the simple marginal cost pricing rule.

Fairness of pricing is an issue that tends to attract decision makers attention more than efficiency. However equity is characterised by a good number of interpretations that go into sometimes conflicting directions. Equity can be applied to individuals affected, but also to collectives of transport mode users, and this may not lead to identical results. For example “the polluter pays”, “the congestion charges”, etc. Each transport mode should pay its way and in the principle should also find the level playing field between transport modes. It is clear that the former interpretation remains closer to the efficiency principles than the latter.

But there are also some other concerns on marginal cost pricing that deserve attention. For example, when distortions in other markets are evident, the application of marginal social costs in transport may have counterproductive effects. Further, marginal cost pricing may lead to very complex pricing structures that are too demanding for the infrastructure users, so that the intended effect is not realised. In addition, implementation costs of strongly differentiated charges based on marginal cost pricing may be high compared with simple charges. Therefore, simplistic use of marginal cost pricing should be avoided.<sup>1</sup>

## 5 User-dependent infrastructure maintenance costs

Usually maintenance costs are calculated by analysing government expenditures. A problem here is that these costs may be and are often biased, since government maintenance expenditures may have been suboptimal. Calculating maintenance costs under an optimal maintenance level, where optimal is defined as the level of maintenance that is needed to preserve the current state of the infrastructure, physically as well as functionally. Cost dependent solely on vehicle kilometres are cost from traffic regulation measures, boarding, cleaning of roads and disposal of garbage, etc. Variable costs dependent on noise production of a vehicle are costs of maintaining noise prevention measures alongside roads. These costs are traffic-dependent because if traffic volume or the number of relatively noisy vehicles increases, so will the number and size of noise prevention measures, and thus also their maintenance. A small part of variable costs are dependent on the number and severity of traffic accidents. Unfortunately, no data are available on this variable, so we used the number of fatal traffic accident victims as a proxy, since their variable can be expected to be correlated with both the number and the severity of traffic accidents. The methodology of the imputation of the different types of variable costs is fairly straight forward. Costs that are imputed on the basis of vehicle kilometres only, will produce identical costs per vehicle kilometre for each road user. Costs that are imputed on the basis of vehicle weight factors and on the basis of noise weight factors and noise weight factors, respectively. Presentation and discussion of the data that are needed for imputation are beyond the scope of this paper.

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<sup>1</sup> RIETVELD, Piet; BRUINSMA, Frank B.; KOETSE, Mark J. *The Management and Measurement of Infrastructure: Performance, Efficiency and Innovation*. Cheltenham: Edward Elgar publishing Limited, 2007. ISBN 978-1-84542-643-9.

## 6 Conclusions

We can say that the infrastructure maintenance costs are relatively high. The contribution of transport to the costs of construction and maintenance is relatively low in the various sectors. The charges paid by inland navigation are almost zero, due to “Convention of Mannheim”. Marginal cost pricing would imply that transport sectors pay for the user-dependent costs of infrastructure maintenance. Marginal cost pricing is in harmony with basic principles of economic theory, but the maintenance marginal costs are still considerably lower than average costs, this may still lead to substantial cost coverage problems. Transport charging, congestion charging and other methods are first steps to future transport maintenance costs independence.

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