TIME IS MONEY: AN ENQUIRY INTO THE EFFECTIVENESS OF ROAD TRAFFIC MANAGEMENT SCHEMES AND CONGESTION CHARGES

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This project attempts to highlight the economic arguments for road pricing and its application: the congestion charge. The theoretical case for congestion charging is outlined and a look is taken at the application of this theory in Hong Kong, Stockholm, and London. It is concluded that road pricing seems to be the way forward in transport economics.

Introduction

The last few decades have seen the advent of deregulation and competition in bus, rail and air transport worldwide. Increased pressure from consumers has ensured that a better service is available through competition and market forces in these areas. The case of road transport is however quite different. Indeed, government intervention is still regarded as necessary to secure investment in road infrastructure. In parallel, increased wealth and employment has seen the number of passenger cars increase phenomenally. This has put increased pressure on the roads and the public transport system. The latter being in most cases under-funded and inefficient has resulted in a definite switch to passenger cars. For instance, between 2003 and 2004 the number of new cars licensed in Ireland grew by 6.9% (CSO 2004). Infrastructure has not kept up and serious congestion problems are now widespread in major urban hubs.

The road congestion problem was underlined in the field of economics as early as the 1960s in the Smeed Report, which stressed the need for road pricing in London. So why has road pricing taken so long to be accepted by the general public and implemented by the government?

I will first take a look at the economic background of road pricing and study the effects of marginal costs. Next, I will attempt to underline the theoretical concepts of road traffic management and then road pricing. The problems associated with the implementation of congestion charges will then be emphasized.

Finally, through the examples of the cities of Hong Kong, Stockholm and London I will investigate whether road pricing has stood up in practice.

The problem: Marginal Costs of Passengers

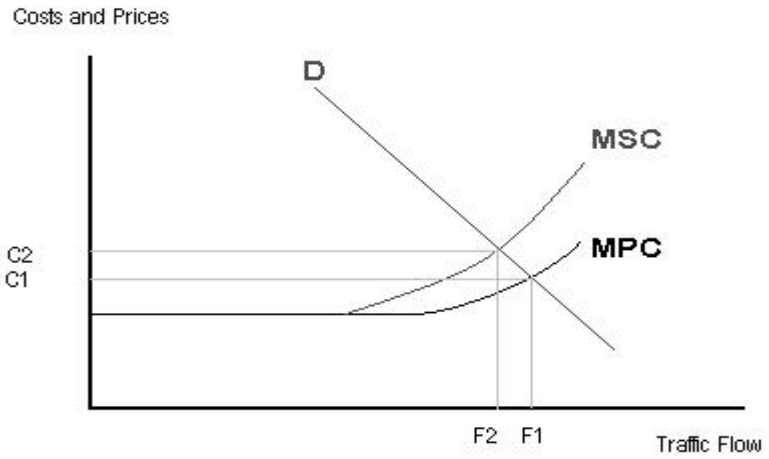
The following description of the costs behind the congestion problem follows that of Professor P.J. Drudy in *Transport in Dublin: Policy and Practice* (O'Sullivan 1991).

Congestion appears when too many passenger cars attempt to take the same route at the same time. Each traveller has a marginal private cost (MPC) of travelling. This accrues only to him and represents his costs in terms of time, petrol and insurance etc. for a single trip. However, as more and more people use the same road, congestion slows down these individual travellers and their personal additional costs increase. The demand curve (D) on the graph represents the demand for "travel" and is a decreasing function of traffic flow. People will travel more when the flow is lower. Thus the intersection between the demand curve and the marginal private cost is the final traffic flow, F1, with associated costs, C1.

Up to now we have only taken into account the private cost to the traveller. However, his trip is also imposing costs on other people. First there is the time cost to other transport users due to the additional car on the road as well as their increased safety costs. There are also externalities or neighbourhood effects on third parties not availing of travel. These include noise and visual nuisance as well as air pollution. If we take these costs into account we must include a marginal social cost (MSC) curve. The MSC diverges from the MPC when traffic flow is high[1]. Public welfare is thus maximised when the demand curve intersects the MSC and consequently when traffic flow is at F2 (below F1) with the cost and price of travel at C2 (higher than C1).

[1] However, in theory the MSC curve is always going to be slightly higher than the MPC curve as noise, visual, and pollution nuisances occur whenever a car is taken onto the road.

Figure 1:



So, in order to maximise social welfare, the cost and prices of road travel must increase and traffic flow must be reduced. There are two ways of achieving this. The former can be achieved through road pricing and the latter through increased supply of road infrastructure. We are now going to examine these two solutions.

Traditionally, the government's view on congestion has been to view it as an infrastructural problem. Thus increasing construction of roads was seen as a way to reduce congestion (on the graph, this would amount to shifting the MPC and MSC outwards to the right). However, in practice, you must also take into account the change in consumers' behaviour. Indeed, with increased road space, traffic volumes are likely to increase as consumers view the loss in congestion as an incentive to switch to road travel. They thus cause a shift in the demand function. Congestion would then reappear and more roads would have to be built to alleviate the problem and so on. Consequently road construction would only be a short-term solution. The provision of more roads increases the service but does not apply the price to go with it. This is not only extremely costly but it also encourages welfare degrading behaviour. Indeed, the environmental and social externalities involved will also increase. Moreover, this type of policy can also have a negative effect on the use of public transport as people switch to personal car use deeming it more efficient.

The provision of additional road space as a solution to congestion was a policy adopted in many countries during most of the 70s and 80s. In Ireland, the

National Development Plan of 1989-1993 planned a total investment in transport infrastructure of 1427.2 million pounds or 1.06% of GDP (Barrett 1991). Looking back it is now evident that such a self-defeating strategy was not the solution and proves Anthony Downes' "fundamental law of traffic congestion"[2] (1992).

What is traffic management?

From the previous analysis, it would thus seem that road traffic requires a certain amount of management and pricing. Traffic management schemes are various and involve administrative policies and road pricing. I will first take a look at various existing road management schemes.

Traffic calming involves reducing the speed of traffic in residential areas with speed-bumps, special paving, indirect routes, and wider pavements. This is an attempt to tackle safety issues, usually in residential areas. It can however induce congestion in urban areas as travellers converge to the same routes in order to avoid the "slower" residential ones. The benefits are nonetheless improved safety and environment for residents.

Traffic bans are becoming more topical. They are used to reduce to total amount of traffic in a designated area. They can be applied according to the type of vehicle, time of day, (peak times) or type of movement (through journey or access) (Elsom 1996). Probably the most famous type of traffic ban is that of the cities of Athens and Mexico. There, cars are banned from the city centres depending on whether their license plates end with an odd or even number. However, as with any type of regulation, consumers can try and deviate. The problem in this case is that people will decide to buy an extra car in order to circumvent the ban. The fact that the policy is hence inefficient and causes more cars to be on the road is not the only problem. Indeed, the additional cars will generally be cheaper ones and consequently older and more polluting thus increasing the externalities due to road traffic as well as congestion.

Bypasses and tunnels are another way of redirecting traffic from the city centre. This was the original goal of the Dublin Port Tunnel which was constructed to bring heavy goods vehicles from the outskirts of Dublin directly to the Port thus avoiding unnecessary traffic in the city centre. Obviously the effectiveness of such a policy depends on engineers' accuracy at estimating the appropriate height of the tunnel!

Cleaner fuel car incentives are quite common in Scandinavian countries. They involve subsidising electric or hybrid vehicles. This deals with the problem

[2] Which is that it is impossible to reduce city centre traffic jams and other vehicle externalities by investing solely in road and transit infrastructure (Downs 1992).

of externalities but also, in some cases such as Norway, owning an environmentally friendly car can help you avoid congestion. Indeed, these cars are allowed to drive in the bus lanes and moreover do not need to pay certain road tolls. Obviously, this is still only feasible as electric cars are a minority but providing incentives to buy them is a good way of reducing the externalities of car travel. They do not, however reduce the number of cars on the road and this type of incentive can actually be deemed contrary to road congestion policies as it entices consumers to buy cars.

Finally, *parking* has been deemed an issue when it comes to traffic management. Several schemes exist in relation to parking, these include parking meter systems, ticket issuing parking meters and disc systems. However, these may render a small income but do not solve the problem of congestion. Indeed, even if on-street parking is limited by policies, this will not necessarily have an effect on through traffic. In Ireland,

> "builders of new offices were required to include a high minimum number of parking spaces so as to reduce the competition for on-street parking. Since congestion can be caused by moving as well as parked cars the high minimum policy had a built-in contradiction which was not realised until the late 1960s" (Barrett 1991).

The conclusion we can draw from these various traffic management schemes is that although some of them might lead to a reduction in externalities, it would still seem that the most efficient way to reduce congestion would be to give motorists an incentive to not take their cars into town. This leads us to the case of road pricing.

Road Pricing in Theory

It would now be the general consensus that congestion is a price problem and not an infrastructural or supply problem. Following conventional neo-classical economic theory, solving this problem should thus be left to the price mechanism. However, left to itself the market produces too much urban motoring. An increase in general wealth induces an increase in car ownership and consequently, through increased congestion, a decrease in welfare.

Thus the main idea behind road pricing is to seek to increase welfare by internalising externalities and as a result include the social costs of urban motoring in the price charged. What are the gains to be made by reducing the externalities of

road traffic? These have been calculated in a number of different ways by different agencies but the basic theory stays the same: shadow-prices.

Shadow-prices are a way to correct market prices in order to reflect social costs (Barrett 1991). In the case of congestion the following would have to be taken into account: time savings which could be related to earnings gained by time saved, the spill-over effects of air pollution on health and infrastructure, as well as noise and visual nuisances on the population living in the surrounding areas. This last point is characteristic of neighbourhood effects as the people affected by the problem are not necessarily the ones using the product.

Other taxes on transport such as petrol tax and car tax are not efficient in reducing the externalities involved as, in the case of car taxes, the tax is not related to use at all. Thus the price mechanism needs to directly target the cause of the congestion, i.e. the people that are using their cars in certain zones at peak times.

As a consequence, an efficient congestion charge would be one that takes into account all these negative spill-over effects and charges motorists the true cost of their journey. Making them aware of this price would lead them to evaluate the marginal utility of their trips and consequently force them to postpone their less urgent travel needs to off-peak times. It would transfer taxation from those who purely own vehicles to those who use them the most.

To summarize, the basis of a congestion scheme is to charge all drivers entering the city centre or even charge them for the amount of time spent in the city centre. The cost of the charge would have to be high enough to deter unnecessary trips and would represent the true cost of a journey to society. Graphically depicted as the difference between the MPC and the MSC at the latter's intersection with the D curve.

Difficulties related to the implementation of a congestion charge

As early as the 1960s, road pricing was already being discussed in the United Kingdom. Indeed, the Smeed report calculated the cost of congestion at 88 pence per mile which was deemed very high. G. William and B. Mackie referred to its "impeccable academic pedigree". So why then has it taken so long to actually emerge? While in theory a congestion charge might have an "impeccable academic pedigree", in practice it faces a number of difficulties.

The first is *technical*. Indeed, how do you collect the charge? Smeed proposed to have meters in cars. However, these could be subject to tampering and the cost of installing them could be quite high. There are also manual and electronic methods possible, the latter making it necessary for cars to be equipped with a charge card. Theoretically, these methods would be able to vary the charge according to the time of day or level of congestion. Electronic road pricing permits

were introduced in Singapore in 1975 and Austria also experimented with electronic cards in 1994 in Salzberg. The administrative issues of road pricing are still rife and care must be taken to avoid using a method that will be easily taken advantage of.

There are also *equity* issues at stake. Indeed, people believe they are already paying too much for their personal transport use. Car tax, fuel tax, insurance costs and on top of it all congestion charges are likely to make car use extremely expensive. But as Elsom put the question, "will this congestion charge simply create less congested roads for better-off motorists?" (Elsom 1996). This is the equity issue at hand. Certainly, if only better-off motorists can make the journey into the city centre the charge would be deemed discriminatory. The issue of urban road pricing was controversial in Switzerland when the Touring Club Suisse claimed the proposed urban toll in Bern was *antisocial* (Böbel & de Rahm 2004).

Granted, the lower income brackets may be unfairly disadvantaged by a road charge. However, this brings us to the issue of what the generated revenue will be used to finance. In Norway, for instance, the revenue, by law, may only be used to finance the building of road infrastructure and remedy environmental degradation caused by the transport system itself. Consequently the revenue is being used to correct another anti-social aspect of transport that hits motorists and non-motorists alike: decreased welfare due to externalities. The general public does not tend to appreciate what it cannot measure and therefore if the revenue were used to subsidise public transport the aforementioned equity effect could be eliminated in the public eye.

Road traffic management and congestion charge schemes are never going to work if sufficient and efficient *public transport* is not made available to the public as an alternative to personal car use. A congestion charge acts as a disincentive to use a personal car and a major shift to public transport would undoubtedly be induced. Thus, a combination of bus and rail transport as an alternative is necessary for a congestion charge to work. This involves a major investment in public transport that in certain cases can be deemed too costly. But when all external costs are accounted for it is usually beneficial to the population as a whole. Moreover, the charge itself might be a good source of income that could allow some of the investment to be recouped. Nevertheless, politicians must be wary of emphasizing this fact as the primary purpose of a congestion charge is *in theory* to alter behaviour and not gather revenue.

Public and academic interest in this matter have made it more publicised in the media and the success of certain experiences has helped change mentalities and improved the view the general public has of road charges. This is crucial, as political commitment is needed to make a road pricing project feasible. Public dislike of what is seen as another tax is usually a deterrent in the political arena.

But, heightened problems in the past few years in relation to pollution in big cities have resulted in the public opinion agreeing that something must be done.

Case Studies

It is now accepted worldwide that measures to alleviate urban traffic difficulties need to be implemented in order to remediate externalities such as noise, air pollution, visual intrusion, safety, and congestion. Over the last few decades major cities have implemented different road management schemes. The methods used vary widely and with retrospect have had differing conclusions. I am going to concentrate on projects put into practice that have either failed or succeeded.

Road pricing gone wrong: Hong Kong and Stockholm

Hong Kong is an interesting case of a congestion scheme gone wrong. In 1983, Hong Kong experimented with

> "electronic license plates which were recorded by an inductive loop installed in the road at the toll collection points. A central computer registered each time the vehicle passed and a bill was sent to the vehicle owner each month" (Elsom 1996: 149).

This caused problems, not at an administrative level as cars without the special plates were identified and fined, but with the public. Indeed, citizens were concerned about the amount of information on their movements this gave the government. A 'big brother' scare ensued and the authorities were forced to cancel the scheme. This problem can now be remedied by the use of prepaid cards for the charge as those used in Austria. But the problem remains that public support of a governmental proposal must exist.

The second road pricing experience gone wrong is that of the city of Stockholm. In this case the project was not even implemented as the objections came from within the government! In 1992, the Dennis agreement was put forward in Parliament. It was comprised of a combination of different congestion charges (different rates along different 'rings' around the city) and a system of road tolls (Böbel & de Rham 2004). Political disagreement over the use of the generated revenue caused the bill to be revoked. Some parties wanted the revenue to be earmarked for road investment while others preferred to use it to decrease the general level of taxes. A new proposal was submitted in 2004 and will be subject

to referendum in 2006. This is a sign that the need for a congestion charge does exist and hopefully the new proposal will be passed.

These two cases show how important it is to have both public and political support for a congestion charge scheme to work. These are also two of the factors explaining the success of the London congestion charge.

The London congestion charge: a phenomenal success

As with most major urban capitals, London, over the past 2 decades has experienced major growth in population employment and business. This has put increasing pressure on the public and private transport systems. Alongside insufficient investment, these phenomena have increased overcrowding and unreliability in public transport, as well as congestion.

On the 17th February 2003, a congestion charge of £5 came into effect in the centre of London. The London congestion charge applies to vehicles entering the Central London district on weekdays from 7am to 6.30pm. They are charged electronically. It is part of a much larger Greater London Authority scheme that seeks to restructure the city of London's transport sector.

In the initial scheme it is underlined that "in central London, in particular, increasing the capacity of the transport system cannot be based upon the private car – the necessary road building program would be financially and environmentally unacceptable" (Mayor of London 2001).

Hence increasing the supply of infrastructure is not feasible to solve the congestion problem. Road pricing cannot, however, be introduced as a stand alone measure. Other policies need to be implemented in order to make it more efficient. Indeed, the goal here is to change consumer behaviour and not to make a profit (although that is a favourable side effect). In order for consumers or passengers to agree to give up their cars there must be an efficient public transport system in place as a substitute. This fact seems to have been well understood in the Mayor of London's proposal as the 10 year strategy will also seek to "increase the capacity of the road system by up to 40% over the next ten years" and "increase the capacity of the bus system by 40% over the next ten years" as bus services are considered an efficient use of space (2001).

Effects

So what has happened since the congestion charge was put in place? After 8 months, it was noted that "traffic speeds had increased 37%, congestion had dropped 40% during charging hours and round-trip journey times reduced by 13%" (Deloitte and Touche 2003). There seems to have been a small diversion from walking to buses and a large diversion from cars to buses. The Scheme seems

to have generated significant traffic benefits and decreased congestion has improved bus reliability. It has also generated gross revenues of £160-180million per annum as well as

> "journey time savings, reliability improvements, accident reductions and other direct travel benefits that amount to the equivalent of some £150-210 million per year across London, excluding any secondary benefits that might accrue from the use of the scheme revenues and amenity benefits" (Mayor of London 2004: 9).

Hence, the Scheme seems to have avoided the pitfalls presented earlier. Indeed, residents within the zone are entitled to a residents' 90% discount thus avoiding complaints from local residents. Significant investment has been made in the bus and underground services in order to avoid overcrowding which would cause objections from new and existing public transport users.

In relation to the equity problem and the impact on lower income households, it seems that the proportion of lower income households that have made a change in their travel arrangements after the scheme is 17% compared to more than 30% of higher income households (Mayor of London 2004: 28). The equity issue, from a political standpoint is thus no longer valid.

Finally, by law, the net revenues from the charge must be spent on proposals that conform to the Transport Strategy for 10 years from the date on which a scheme comes into force. This will further calm public opposition to the charge as it is public knowledge where the revenue is going.

The Scheme was carefully planned and implemented and the first condition, public support, was present from the beginning as Londoners were tired of long waiting times and anxious to avoid the historically terrible effects of excessive pollution in London. All these factors explain the success of the London Congestion Charge and why numerous other countries are now looking to imitate it.

Future Plans

In August 2004, a Revised Transport Strategy was issued which laid out the plan to further extend the congestion charge zone to the west of the current zone. If the plan was accepted it would take effect in late 2006. The Transport Authority believes it can meet its supplementary target of reduction in absolute traffic levels of 15% on weekdays. It has also planned to further increase bus capacity in order to cope with demand. The announcement of a rise in the charge to £8 by Ken Livingstone (Blitz 2004) has caused some concern. The Mayor

believes it would cut congestion by a further 5-13% and increase revenues. However he is now facing increased opposition from retailers who are facing a rise to a £7 charge for commercial fleet vehicles and a potential loss of custom. Londoners have also called for improvements in registration and payment methods. There is also inevitably going to be a limit on what people are willing to pay. The success of the Scheme to date does not shield it from potential problems in the future and looking at past international experience, Ken Livingstone should probably be wary of disgruntled electors if he is to be allowed to finish his ten year plan.

Conclusion

The success of the London congestion charge has prompted cities such as Paris and Barcelona to look into the effectiveness of a congestion charge in their cities. However, problems remain as to the implementation of road pricing as we saw through the cases of Hong Kong and Stockholm. The purpose of a charge is to make people aware of the true cost of a trip and thus forcing them to travel only at non-peak times or when absolutely necessary. This rationale of road pricing is clear to economists who are aware of the importance of the external costs of transport. It is now up to the politicians to convince the public that implementing a congestion charge is not their way of simply boosting revenue by imposing another tax.

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