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HOUSE OF COMMONS SELECT COMMITTEE ON TRANSPORT INQUIRY INTO URBAN CONGESTION CHARGING

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Summary

(i) The principal objectives of congestion charging are congestion relief and environmental enhancement. Revenue generation is also increasingly seen as an important output (paras 3-5).

(ii) Effective congestion relief and environmental improvement may require reductions of between 15% and 25% in car traffic in urban areas. Congestion charging is able to achieve such reductions. Parking control could potentially achieve similar reductions, but only if new legislation is obtained to control private parking. Regulatory controls could also do so, but would not be able to generate revenue (paras 6-12).

(iii) Congestion charging could be imposed by charges to cross cordons, or charges based on time spent travelling, time spent in congestion or distance travelled. Time-based and congestion-based charging would have the greatest impact on congestion, but may encourage unsafe driving behaviour. Distance-based charging is unlikely to be very effective. Cordon charging can be effective, but requires careful design to optimise its impact; it is the only method for which technology is currently available (paras 13-19).

(iv) The main disadvantages of congestion charging are potentially its impact on the urban economy, which is extremely difficult to forecast; its equity implications, which bear most heavily on low income car users; and underlying unacceptability to the public (paras 20-27).

(v) The combination of congestion charging with other measures in a package provides a means of overcoming these disadvantages. Public transport enhancements will help to encourage a reduction in car use and make it more acceptable. Traffic calming and priorities for buses, pedestrians and cyclists can help to reallocate the benefits. Such packages are likely significantly to increase the acceptability of congestion charging. The revenue from congestion charging will provide a means of financing these measures and demonstrating the benefits of the policy (paras 28-32).

(vi) A trial scheme is needed to confirm that the benefits predicted from congestion charging can be realised. Such a trial needs to be carefully monitored, and operated flexibly so that problems can be resolved if and when they arise. The trial should be in a free standing but congested provincial city, and should be of a package of measures, rather than of congestion charging alone. Crucially, the local authority should have the freedom to use the revenue in the most appropriate way, and government should be prepared to underwrite any infrastructure projects to be financed from the revenue. The trial could employ time-based, congestion-based or cordon charging, but in any case should take advantage of the technology being developed for motorway charging (paras 33-38).

Introduction

1. This evidence, submitted to the Select Committee for its inquiry into Urban Congestion Charging, is based on my research into the subject, and professional involvement in studies of methods for managing the demand for urban travel, over the last twenty years. In the 1970s I was responsible, within the Greater London Council, for their studies of the use of comprehensive parking control, physical restriction of road space, and supplementary licensing (a low technology method of congestion charging) as methods of traffic restraint. At the same time, I was an adviser to the World Bank in its study of Singapore's area licensing scheme which is still the only congestion charging system in operation. In the 1980s I was an adviser to the US Transport Research Board in its investigation of appropriate methods for managing urban traffic, and to The MVA Consultancy in its study of electronic road pricing for Hong Kong. Since 1987 I have been involved, as a director of The MVA Consultancy, in a series of integrated transport studies in London (for the London Planning Advisory Committee), Birmingham, Edinburgh, Bristol and Merseyside, each of which has investigated the role of congestion charging as part of a wider transport strategy. I am currently directing a programme of research, funded by the Engineering and Physical Sciences Research Council, which is assessing the relative impact on urban road networks of different methods of imposing congestion charging, on their own and in combination with traffic signal control and bus priorities. This research has used Cambridge and York as case studies. In addition, I am currently acting as one of the technical advisers to the Department of Transport's study of congestion charging in London.

2. Since the Department has already submitted evidence on its study for London, it has been agreed that it would be inappropriate for me to provide evidence on congestion charging in London. Instead, I have been asked to make suggestions on the most appropriate basis for introducing a trial of congestion charging in a provincial conurbation. I have done so, below, by answering in turn a series of questions:

- what are the principal objectives of congestion charging?
- what alternatives to congestion charging are available to meet these objectives?
- which methods of congestion charging are potentially available, and how do they compare in terms of potential impact on travel patterns?
- what are likely to be the main advantages and disadvantages of congestion charging?
- how could any disadvantages be reduced by combining congestion charging with other policy measures?
- given the balance of potential advantages and disadvantages, what are the principal requirements for selecting and establishing a trial of congestion charging in a provincial conurbation?

Objectives

3. As its name suggests congestion charging has been developed primarily as a means of reducing urban congestion. This was the focus of the Smeed Committee's report (1) in 1964, which drew attention to the problem that, in congested conditions, drivers only perceive their own costs (primarily the time spent travelling) but do not appreciate that, by their presence, they are imposing delays on other drivers. Smeed estimated that, at a speed of 13 mph, each driver imposed a delay equal to his own journey time on other traffic, and that at 10 mph, this rose to double his own journey time. Charging drivers directly for the delay they imposed on others would, it is argued, encourage some not to make the journey, thus reducing congestion. Since Smeed's report, congestion in the peaks in Central London has not worsened; instead it has spread to other areas and other times of day. A report by the Institution of Civil Engineers in 1989 tentatively estimated the cost of congestion in the UK at £10 billion pa (2). Because delays rise rapidly at higher flows, it is possible to achieve substantial improvements in travel conditions by quite small reductions in traffic. For example, as our own research has indicated, a 15% reduction in traffic in a provincial centre might increase speeds by around 35% (3).

4. The second major objective of congestion charging is environmental protection. At a local level, congestion leads to greater emission of certain pollutants, particularly carbon monoxide. It also encourages the use of 'rat runs', thus extending environmental intrusion over a wider area. More widely there is growing concern over the impact of traffic levels generally on atmospheric pollution, and hence health, and on carbon dioxide emissions, and hence climate change. The Royal Commission on Environmental Pollution's recent report has, somewhat arbitrarily, advocated a reduction in car use in urban areas from 65% of all travel now to 50% in 2020, primarily with these considerations in mind (4). Congestion charging is one potential means of achieving this. In this way the charge could be thought of as representing the combined cost of the delay and environmental impact caused by urban journeys.

5. Other objectives which are sometimes cited include reduction of accidents, redressing inequalities of opportunity for urban travel and encouraging economic activity in urban centres. While it is true that a reduction in car use will lead to a reduction in accidents, the other arguments are more tenuous. However, a further objective which has become more prominent is the generation of revenue to finance other transport projects. This approach has been pioneered in Norway, whose toll rings, in Bergen, Oslo and Trondheim, are not schemes to charge for congestion, but means of financing new infrastructure (5).

Alternatives

6. The discussion of congestion suggests that a reduction in traffic of 15% might be needed to achieve a significant impact. The Royal Commission seeks a 25% reduction in urban car traffic. Neither of these can be achieved simply by improving public transport. Studies of fares reductions and service improvements suggest that, while patronage improves, little of it is attracted from car use (6). Even the most successful new urban rail projects have only attracted around 20% of their patronage from car use, representing perhaps 2-3% of car traffic in the corridor (7). It is clear that car users need to be directly affected, by some means of demand management, if they are to be encouraged to transfer to other forms of transport in significant numbers. In addition to congestion charging, the main methods which have been considered for reducing levels of car traffic include:

(i) parking control;
(ii) physical reallocation of road space;
(iii) regulatory controls using permits or other restrictions on car use;
(iv) other financial methods; in particular fuel taxation.

7. Parking controls are the most obvious approach, and were advocated by Buchanan in Traffic in Towns (8). Control can be by reducing parking space, regulating its use, or charging for it. The two major problems are that up to half of all parking space, in private non-residential car parks, is outside local authority control, and that through traffic, which often represents around a third of all traffic entering town centres, is unaffected (9). Even if through traffic were restricted by traffic management measures, controls would need to be provided on private non-residential parking for this approach to be successful. Attempts to introduce legislation for this purpose were abandoned in the late 1970s.

8. Occasional attempts have been made to discourage car use by reallocating road space to other users, such as buses. The intention is that car users would be both discouraged by increased congestion and encouraged by faster buses to switch to public transport. An experiment with such a scheme in Nottingham in 1975 proved unsuccessful, partly because the effects were outweighed by an increase in the cost of bus travel (10). It is possible that such a scheme could be designed to be more effective, but the remaining car traffic would have to continue to experience congestion; otherwise the disincentive to travel by car would be removed. Basically, such schemes use time, which is a real resource, as a penalty, and are thus unlikely to increase efficiency.

9. There are several examples of regulatory schemes which specify those cars which can use city centres. The two most common are the access zones of several Italian cities in which only essential users with permits are allowed to enter, and the 'odds and evens' scheme in use in Athens in which odd numbered cars are allowed in on alternate days of the week, and even numbered ones on the others. Such schemes can, in principle, achieve any pre-specified reduction in car use. However, earlier studies have concluded that the administrative costs of a fraud-proof permit system would be substantial (11) and there is no guarantee that a simple scheme such as 'odds and evens' would allocate road space to those who most needed it.

10. There is clear evidence that fuel price increases reduce car traffic, and this is the intention behind the Government's commitment to a 5% pa increase in fuel duty in real terms. However, past research has shown that the reduction is primarily in leisure journeys in the evenings and at weekends; the impact in urban centres at congested times is likely to be small (12).

11. Evidence outlined below indicates that congestion charging is capable of achieving the objectives set, at least within the inner area of a conurbation. The review above suggests the following summary of the potential of the range of measures:-

	ability to achieve		
	congestion relief	**environmental enhancement**	**revenue generation**
congestion charging	✓	✓	✓
parking control	*	*	✓
physical control	x	?	x
regulation	✓	✓	x
fuel tax	x	✓	✓

* only with legislation to control private non-residential parking.

12. It might be possible to achieve these objectives with a combination of the above measures. One concept which is currently being discussed would combine congestion charging on a cordon around a city centre with reduced parking charges, thus imposing the extra cost solely on private parkers and through traffic. A combination of fuel tax and a low level of congestion charge may also be worth pursuing, with the latter focused solely on congestion relief.

Congestion Charging Methods

13. Most early work on congestion charging, including the Singapore scheme and the Hong Kong proposals (and the Norwegian toll rings) involved point or cordon charging, with charges on vehicles when they cross cordons around the city centre or screenlines such as crossings of rivers or rail lines. More recently these have been criticised as being inflexible; as causing boundary problems, with traffic diversion around the cordon; and as being inequitable, since the short distance journeys across the boundary pay the same as long distance ones (13).

14. In response, three other approaches have developed:

- charges based on time spent travelling;
- charges based on time spent in congestion;
- charges based on distance travelled.

Time-based charging and congestion-based charging have been advocated as being related most directly to vehicles' contributions to congestion; they also avoid the boundary problems of cordon charging. The Cambridge proposal is a particular form of the latter, in which drivers would occur a pre-specified charge every time they took more than a threshold time (provisionally three minutes) to travel a half kilometre (13). The major concerns with both of these are that the charges would be unpredictable, and that they would encourage unsafe driving. Distance charging would avoid these difficulties, while still overcoming the problems with cordon charging, and is superficially the most attractive method (14).

15. The technology for these four charging methods has been reviewed fully elsewhere (15). The principal requirements are an in-vehicle unit, a payment and accounting system, a roadside to vehicle communications system, a means of detecting and classifying vehicles and a system for uniquely recording non-compliant vehicles. Cordon pricing can be implemented using a range of in-vehicle unit technologies, some of which are currently available. The other systems require in-vehicle meters, which are still being developed and for which there remain very real technical difficulties. The most serious limitation currently with all systems is

enforcement technology, which is likely to be video based, but will be limited to a practical maximum of around 85% by the obscuration of number plates by adjacent vehicles (14).

16. In our research based on Cambridge and York, we have assessed the relative impact of these four different charging mechanisms on travel conditions, taking account both of the impact of resulting charges on the total amount of travel and of the impacts of the different charging structures on the routes taken by the remaining traffic. The following table, for Cambridge, summarises the effects on speed, in the city and on the ring road, of the four systems, with charges imposed throughout the city, at three charging levels: a low charge which would reduce journeys by car by 5%, a medium charge (10%) and a high charge (15%) (3).

	Changes in Speed (%)		
Charge level	**Low**	**Medium**	**High**
(a) charge area			
cordons	8	11	22
time-based	19	28	31
congestion-based	28	34	39
distance	14	16	14
(b) outer ring road			
cordons	-2	-4	-6
time-based	-1	-3	-7
congestion-based	-1	-4	-5
distance	-2	-5	-8

17. The results suggest that speeds are improved most in the city by congestion-based charging, with time-based charging performing slightly less well, and cordon and distance charging being markedly less effective. There is clear evidence that congestion-based and time-based charging, by focusing most directly on the most congested locations, are most effective in reducing congestion. Distance charging, by contrast, appears to have an adverse effect because it encourages use of the shortest routes, which often traverse the most congested areas.

18. The poor performance of cordon charging is more surprising, but evidence elsewhere suggests that performance is critically dependent on the location of the cordons and the design of the charging structures. The latter can be quite complex, with charges which differ by direction and by time of day, and with variations also in the relative level of charges on different cordons. A recent study in Edinburgh, for example, has shown that economic benefits can be increased by 70% by adding a second cordon and operating it throughout the day (14).

19. In conclusion, it appears that the choice of charging mechanisms lies between cordon charging, which is technically feasible but requires careful detailed design to be effective, and time- or congestion-based charging, which require new technology, but are potentially more effective. Apart from the technological requirements, the main concerns with these methods are the behavioural responses to unpredictable charges, and to charges which can be avoided by driving faster. These are serious practical problems, on which further research is being proposed.

Advantages and Disadvantages

20. On the assumption that appropriate technology is available, evidence suggests that congestion charging can significantly reduce car use in the charged areas. In Singapore, simple cordon charging reduced the number of cars entering in the peak by around 45% (16) and the Hong Kong study predicted a 20% reduction in overall traffic levels (17). The Norwegian schemes have been less effective, with reductions of up to 7% (5), but it needs to be remembered that these schemes were designed to raise revenue rather than reduce traffic; indeed they are more effective the lower their impact on traffic levels. Our own work in Cambridge and York suggests that journeys by car in the city as a whole can readily be reduced by 15% by any of the charging mechanisms, and that speed increases of up to 40% can be achieved as a result (3).

21. Studies in Edinburgh suggest that cordon charging around the city centre could, when combined with other measures, reduce car traffic to the centre by 40% and increase speeds there, even after introducing widespread environmental measures, by 30% (18). This suggests that the Royal Commission's target, and the resulting environmental benefits, can potentially be achieved, in central urban areas at least, using congestion charging. Indeed, the Edinburgh study forecast a reduction in fuel consumption, and hence carbon dioxide emissions, of around 15% for the city as a whole.

22. Congestion charging would also generate significant revenue. Our studies in Cambridge suggested that around £4m could be generated per year in the morning peaks alone by a cordon charge designed to reduce car journeys by 10% (3). The Edinburgh study predicted revenue of £22m per year for a city centre cordon, and £50m per year for a two cordon system (14).

23. The advantages, in terms of reduced congestion, improved environment and revenue generation, need to be assessed against the perceived disadvantages of congestion charging. Some of these concern the performance of the technology and the related administrative and enforcement systems, and have been addressed elsewhere (15). Some, concerning the impact on the road network, have been addressed in our research reported above (3). Others related to drivers' responses to the charging mechanism, can only be resolved through field trials. The other principal concerns relate to:

- the possible invasion of privacy;
- the potential impact on the urban economy;
- equity considerations (19).

24. The potential for invasion of privacy was a major consideration with the proposals for Hong Kong, in which a central computer would have monitored all vehicle movements, and sent drivers an itemised bill on a monthly basis (20). Developments in technology since then have meant that this is no longer necessary; the accounting procedures can be kept anonymous, while enabling drivers to check their accounts (15). The only drivers who need to be uniquely identified are those thought to be violating the system.

25. The potential impact on the economy is a more serious issue, because it is extremely difficult to predict, or to isolate from the other influences on the urban economy. One study attempted to assess the impact of area licensing on the Singapore economy, ten years after its introduction, but found it impossible to isolate an effect. In practice, it seems likely, as argued in Edinburgh, that congestion charging will have positive effects by improving the environment

and access by public transport, but that these will be offset by the increased cost of car use and, potentially, by the image which congestion charging presents. The overall impact will then depend crucially on how the policy is presented, and with which other policy measures it is combined The existence of competing uncharged (or out of town) centres will also have an important influence on the impact, particularly for retail activities.

26. The equity arguments are also complex. It is clear that car users as a whole will suffer, although it is possible that for some the reduction in congestion will more than offset the costs of the charge. Commercial vehicles, if charged, will be similarly affected. Conversely bus users are likely to benefit, since they will experience reduced congestion and incur little or no charge. The main equity arguments, however, concern different income groups. High income travellers are more likely to travel by car, or train if available. They are more likely to have higher values of time, and hence to benefit from reduced congestion. Low income travellers are more likely to travel by bus, and hence benefit, but those who currently use cars will be the most affected, since they will have less ability to pay the charge. The net impact of these effects is difficult to assess. A study funded by the Economic and Social Research Council which we recently completed investigated the impact of cordon charging in London on travellers living in households in three different income groups, with and without cars. It found that low income non car owning households, who represented 18% of all households, would typically experience only 5-7% of any disbenefits, while low income car owning households (also 18%) would experience around 16% of all disbenefits. However, these results were sensitive to the design of the cordon; one version increased disbenefits to low income households substantially (21). Even in these circumstances congestion charging is likely to be more progressive than most other financial transport policies.

27. These concerns over equity and the urban economy, and an underlying resistance to measures which involve additional costs, make congestion charging one of the least popular policy options. Surveys in London (22) and nationally (23) found that only 43% and 30% of respondents, respectively, considered congestion charging an acceptable solution to urban transport problems. A more recent national attitude survey recorded only 18% in favour (24).

Additional Policy Measures

28. The performance and acceptability of congestion charging could potentially be enhanced by combining it with other measures designed to

- increase the impact of the charges;
- overcome any adverse effects of the charges;
- reallocate the road space freed by charging;
- increase public acceptability.

The role of the revenue generated by charging in funding these additional measures is particularly important.

29. A range of measures is potentially available. Enhancements to public transport are the most likely to encourage a greater reduction in car use, but in the long term changes in development patterns, as advocated by the Department of the Environment may also help (25). Improvements to public transport may also be the most appropriate way of redressing the urban economy and equity issues discussed above. In addition some improvements in orbital road capacity may be necessary to overcome localised congestion problems outside the charged area. Traffic calming measures, cycle and pedestrian facilities and bus (and

commercial vehicle) priority lanes are all ways in which road space can be reallocated. They will reduce the improvements gained in general traffic speeds, but should improve conditions for priority users and for the environment and safety. A mix of these measures is likely to contribute to public acceptability, but more direct ways of reallocating revenue through reductions in taxes may also contribute.

30. Several of the integrated transport studies have investigated the impact of these packages of measures in some detail. The Edinburgh study is a useful example. It showed that it would be possible to use congestion charging revenue to finance two new light rail lines and a road scheme, together with a 10% fares reduction, at no net financial cost to the local authority. The reduction in car traffic would permit closure of a quarter of the city centre's road capacity, to achieve environmental improvements. Despite this, speeds would still rise by 20% in the centre and 6% elsewhere, thus improving conditions for road users generally (26).

31. Attitudinal research has demonstrated that such packages significantly increase the public acceptability of congestion charging. The London survey quoted above found that the percentage of respondents willing to accept congestion charging rose from 43% when considered on its own to 62% when the revenue was allocated to improving London's public transport (22). In the nationwide survey, acceptance rose from 30% alone to 57% when the revenue was to be used to improve public transport, conditions for pedestrians and cyclists, and road safety (23).

32. All of these allocations of revenue are potentially justified, and it will be important to allow the authority introducing the scheme the freedom to allocate revenue in the most appropriate way. This might well include other means of making the measure more publicly acceptable. One simple but appealing solution is the so-called 'rule of three' in which revenue is share between improvements to public transport, to the environment and for road users (27).

Requirements for a Trial Scheme

33. Virtually all the analysis of congestion charging has been predictive, given the lack of practical experience other than in Singapore. Those predictions are inevitably open to error and uncertainty, and there are particular doubts surrounding the impacts on drivers' responses to charges and the longer term impacts on the urban economy. These uncertainties can only be resolved by experimentation, and any experimental scheme must be accompanied by a detailed monitoring programme, to ensure that the impacts are carefully measured, and by a readiness to modify the scheme to overcome any unexpected adverse side-effects. Both of these requirements were successfully met in Singapore, where the World Bank conducted a major monitoring programme, and the authorities took steps to overcome localised congestion on the boundary route and at the end of the control period (16).

34. The site for a trial scheme therefore needs to be one in which the effects of congestion charging can be readily isolated. This argues strongly for a site outside London, whose transport networks are too complex. It will also need to be small enough for any abortive costs from an unsuccessful trial to be acceptable, but yet sufficiently congested for the measure to be justified. Recent speed surveys suggest that cities such as Bristol, Derby, Leicester, Norwich, Nottingham, Sheffield or Southampton might be appropriate in this regard (28).

35. It will of course be important to find a city whose local authority is willing to take the political risk of introducing a trial scheme, and this will not be easy. That local authority will need to be free to take the necessary steps to increase the public acceptability of the measure. Ability to retain the revenue and to use it in the most appropriate ways will be essential. In particular, it will be preferable to test a package of measures, of which congestion charging forms part, and to use the revenue to finance other elements, rather than simply testing congestion charging on its own. Unfortunately deregulation of bus services makes it difficult for local authorities to ensure that revenue used to enhance bus services is applied in the most effective way.

36. With a short term trial, it will clearly be impossible to use the revenue to finance capital projects. If it is clear that capital projects, such as guided bus or light rail routes, are an important element of the overall package, the government should seek ways of underwriting this investment so that the potential for financing infrastructure improvements can be clearly demonstrated. The opportunity should also be taken to make use of EU finance to support any trial scheme.

37. Of all the potential side effects of congestion charging, that on the urban economy will be the most difficult to assess, particularly since the effects are likely only to emerge in the long term. It will be sensible to reduce these effects to a minimum in any trial scheme, by choosing a free standing city reasonably remote from competing centres. Admittedly this will mean that the results will be less transferable, but the balance of impacts on public transport access, environmental improvements, costs of car use and image will be better understood, enabling more reasoned assessments of impacts elsewhere.

38. It is difficult to assess the most appropriate charging mechanism and technology for a trial scheme. In current circumstances it is probably preferable to use cordon charging but, as noted above, the location of cordons and the relative levels of charge by direction, location and time of day would need to be carefully designed. The opportunity to test time-based or congestion-based charging should not be overlooked, given their potential to generate greater benefits. However, it would be essential to resolve any adverse effects on driver behaviour first. A cordon charge could be implemented, as in Singapore, with a low technology prepaid licence. This would involve low capital cost, but would raise problems both of enforcement and of the lost time in purchasing licences. If the technology for motorway charging has been introduced, it would be preferable to make use of the fact that many vehicles will already be equipped with in-vehicle units which could also be used for the trial. However, it will be important in designing any motorway charging system to ensure that the technology specified is capable of facilitating the full range of appropriate congestion charging mechanisms.

Conclusion

39. Evidence suggests that congestion charging is uniquely able to achieve significant reductions in congestion, major improvements in the environment and, substantial revenue generation. Time-based and congestion-based charging are likely to achieve the greatest benefits, but only if potentially unsafe driving behaviour can be avoided. The only suitable alternative is cordon charging, and this needs to be carefully designed to achieve optimal benefits. The most serious concerns with any form of congestion charging are with impacts on the urban economy, equity and underlying public acceptability. All of these can be addressed in part by developing a package of measures, of which congestion charging forms part, and in which the revenue generated is used to finance the other elements of the package.

40. A trial scheme is needed to confirm that the benefits predicted from congestion charging can be realised. Such a trial needs to be carefully monitored, and operated flexibly so that problems can be resolved if and when they arise. The trial should be in a free standing but congested provincial city, and should be of a package of measures, rather than of congestion charging alone. Crucially, the local authority should have the freedom to use the revenue in the most appropriate way, and government should be prepared to underwrite any infrastructure projects to be financed from the revenue. The trial could employ time-based, congestion-based or cordon charging, but in any case should take advantage of the technology being developed for motorway charging.

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