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IS SECOND BEST GOOD ENOUGH? LONDON'S EXPERIMENT WITH URBAN ROAD PRICING

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1. OPTIMISING URBAN ROAD TRANSPORT.

The advertising brochure for the Australian Institute of Traffic Planning and Management (AITPM) 2003 National Conference held recently in Sydney included among its aims "… a more *sustainable* approach to transporting people and goods." In "Setting the Scene" the brochure went on to ask "What will it take to get people to *decrease* car use …?" (my italics).

The assumption that "sustainable urban transport" necessarily involves "reducing car use" is accepted almost as an axiom among many, if not most, transport planners and engineers.

Transport economists, on the other hand, ought to regard such simple unidirectional prescriptions with suspicion. By all means, reduce "unnecessary car use", if we can agree on the difference between necessary and unnecessary use (no simple task), but to insist on a policy of reducing car use as an unqualified aim is poor planning policy.

To economists, the object should always be to optimise an activity, taking into account all costs, including not just marketed commercial costs but non-marketed social and environmental costs.

Optimising urban road transport may mean encouraging greater car use if the net social benefits (marginal social benefits less marginal social costs) are positive. For example, access to a job may mean increased use of the car by a previously unemployed youth.

The issue of sustainability, interpreted here as the Brundtland Commission's "development that meets the needs of the present without compromising the ability of future generations to meet their own needs", means that urban transport policy should be judged less by the volume of transport than by how it is managed.

The key to achieving sustainability is to live within the income flows generated by the total capital stock, so that future generations have at least the same opportunity to meet their own income needs as has today's generation. This principle means that a higher volume of transport is justified if it leads to an increase in the combined stock of natural, manufactured and human capital. We do our children no good by denying them the benefits of a greater capital stock that would enable them to increase their collective welfare. Nor do we necessarily benefit the natural environment, which will depend increasingly on the ability of affluent and concerned societies to protect it.

Part of the misguided but frequently stated axiomatic goal to reduce car travel as an end in itself stems from the false assumption that public transport can provide a realistic substitute for personal motorised travel and that therefore the only way to reduce the considerable costs of motorised transport in the form of resource use (especially petroleum products as fuel), pollution (particularly the emissions of greenhouse gases), road trauma (principally from accidents and the fear of accidents), and congestion, is to reduce overall car "dependence".

This paper argues that this approach is misguided, that car use world-wide will increase considerably into the future, particularly in developing countries, that public transport is becoming less and less a viable substitute for car travel due to changing employment patterns, changing land use patterns and more complex daily activity patterns, and that the most efficient, equitable and environmentally friendly way to tackle the rising costs of urban motorised transport is to "civilise" car use by adopting economic pricing policies.

In this regard, London's recently established road pricing scheme, in the form of a fixed entry fee for vehicles entering the central area, although widely regarded as a step in the right direction, is essentially a crude second best substitute for the first best solution of marginal social cost pricing.

Reasons for the growth of motor vehicle ownership and use are presented, together with principles for understanding urban travel behaviour and the policies needed to civilise urban motor vehicle use. London's experiment with road pricing will then be evaluated in terms both of theoretical principles and empirical results.

2. THE GROWTH OF THE WORLD'S MOTOR VEHICLE FLEET AND USE.

According to the World Resources Institute (WRI, 2003), the total motor vehicle fleet of cars, trucks and buses grew from 70 million in 1950 to 630 million in 1994 and will probably rise to well over 1 billion by 2025. Growth rates are potentially very high among the rapidly developing countries of Asia, such as China and India, where motor vehicle ownership rates of 8 and 7 per 1,000 persons are very low compared with the 1994 rates of 519 and 750 per 1,000 persons in Japan and the USA respectively. The Office of Transportation Technologies (OTT, 7/8/2000) claims that China's current rate of vehicle ownership is similar to that reached by the USA in 1912, illustrating the huge growth potential of the world's most populous nation. OTT also estimates that the 1998 rate of vehicle ownership in the USA had reached 783 per 1,000 persons.

The WRI (WRI, 2003) estimates that China's motor vehicle fleet has been growing at an annual rate of 13% for the last 30 years, doubling nearly every 5 years, while India's fleet has been expanding at more than 7% over the same period. Other developing countries, particularly those actively pursuing the growth benefits of the open trading and investment policies of globalisation, are experiencing similar vehicle growth patterns.

Vehicle use patterns show similar growth trends to vehicle ownership. The OTT claims that vehicle miles of travel (VMT) of highway vehicles in the USA was 2.5 times higher in 2001 than in 1970 and that VMT had grown at an average annual rate of 3% over the same period (OTT, 28/7/2003).

In Australia, urban passenger car travel more than doubled, from 66 to 137 billion passenger-km, between 1971 and 1993 (BTCE, 1996, p. 340). Despite a concerted effort to encourage public transport patronage through financial subsidisation of operating costs and a political campaign to denigrate car travel as socially irresponsible and environmentally damaging, car travel actually increased its share of the total urban passenger task during this period from 82% to 87%.

In Western Europe, where public transport is most widely promoted and car travel most widely condemned, private motor travel almost doubled, from 1,556 to 3,071 billion passenger-km, between 1970 and 1990 (European Environment Agency, 1995, pp. 441-2).

Offsetting the rise of motor vehicle travel, the OTT (OTT, 26/8/2002) claimed that the amount of energy consumed by all highway vehicles declined from 3.3 quads per trillion dollars of GDP in 1970 to 2.3 quads per trillion dollars of GDP in 2000 (in 1996 dollar equivalents). Light highway vehicles (cars, pickups, SUVs and vans less than 10,000 lbs gross vehicle weight rating) declined from 2.8 quads to 1.7 quads in the same period, reflecting significant improvements in engine efficiency.

The growth of vehicle miles of travel (VMT) in the USA, and no doubt in all countries, shows a remarkably close relationship to the growth of national GDP (OTT, 14/5/2001). Graphs of the relationship show that growth trends of the two variables are hardly distinguishable from each other, including during periods of economic slowdown.

In countries of the European Conference of Ministers of Transport (ECMT) levels of car ownership increased at an average 3.4% per annum between 1970 and 1990, compared with GDP growth of 2.6% per annum over the same period (European Environment Agency, 1995, p. 442).

Clearly, the potential for continuing rapid growth in vehicle ownership and use in developed countries, notwithstanding a continuing slowdown in population growth rates and the inevitable asymptotic approach to saturation levels, and in developing countries, where population is still expanding and ownership and use rates have the potential for long term exponential growth, suggests that the costs of motor vehicle use can not be avoided by minor mode shifts from cars to public transport.

Dealing with the rising costs of urban personal motorised transport requires both an understanding of the reasons why car travel is so popular compared with public transport travel and the development of effective policies that confront the costs of car travel directly rather than indirectly.

3. REASONS FOR THE GROWTH OF VEHICLE OWNERSHIP AND USE.

The growth in motor vehicle ownership and use can be seen as part of a broader set of cultural transitions which have been evolving in European countries since the beginning of the industrial revolution and which, in a much shortened time frame, are being worked through in similar fashion in developing countries.

A demographic transition towards declining birth rates and increased longevity have combined to produce an increasingly educated, affluent, independent and active aged persons component of the population.

Employment patterns are undergoing a transition from primary and secondary occupations to tertiary (unskilled and semi-skilled) and, in particular, quaternary (professionally skilled) service occupations.

Working practices are also in transition, from the rigid, regular, routine and repetitive work practices of the industrial era to the more flexible, irregular, multi-locational and temporally variable work practices of the emerging post-industrial workforce. Jobs in the post-industrial economy are increasingly urban, part-time, contractual and customer-focussed, requiring knowledge and interpersonal communication skills.

A major factor in the rise of the post-industrial service economy has been the employment of women, particularly mothers of dependent children. Participation rates for women are approaching those of men. In some European countries women are expected to outnumber men in the workforce within a few years (Core, 1994, p. 5).

Rising car and truck ownership and use is causing another major transition, the transformation of land use from a star-shaped radial structure focussed on the central business district to a low density multi-nuclear areal spread.

Trucks have allowed manufacturing, in particular, and more recently retailing and office employment to relocate away from crowded central city locations to more spacious sites in the suburbs and peripheries of urban areas, while still retaining important transport links to railway terminals and sea and air ports.

Increasing car ownership has enabled people, for the first time in history, to choose home sites largely free from the constraints of having to live either near to where they work or close to public transport routes. Cars have opened up previously inaccessible but highly desired residential sites on hill slopes with views and aspects, in quiet bushland settings, in areas close to beaches and waterways, and on cheaper land at the urban fringe.

Despite the significant and highly visible trend to inner city living taking advantage of the renovation of old redundant industrial sites by those with low space requirements and high demand for access to urban services (predominantly young adults and retirees cashing in their lump sum superannuation payments), the dominant urban trend continues to be low density areal spread (Forster, 1999, p. 133).

These changing patterns of population, employment and land use combine to generate activity patterns which are becoming increasingly diverse, both spatially and temporally.

Activity patterns in the industrial era were dominated by early morning and late afternoon tidal flows of journeys to and from work along corridors of public transport routes. These flows were highly concentrated in time and space. In the emerging post-industrial city flexible working hours and greater proportions of non-work travel produce more random and dispersed patterns.

Activity patterns increasingly consist of complex chains of highly interdependent links. A working mother may take her children to school on the way to work, use her lunch break to travel to conduct personal business, and stop on her way home to shop or visit friends. Workers in service industries may make several trips during the working day to contact clients for face-to-face business activities. Retired people may travel to play games of golf, visit friends or engage in social activities. Whereas leisure in the Industrial age was of secondary importance, a recuperation from the drudgery of repetitive work, leisure in the post-industrial city is becoming more experiential and of primary importance.

For all the above reasons, personal motorised transport with its go-anywhere anytime characteristics is becoming increasingly superior to the rigid fixed-route and fixed-timetable modes of public transport in serving post-industrial activity patterns.

Hagerstrand reminds us that the increasingly complex activity chains of modern urban living need to be accommodated within the "capability" (biological), "coupling" (social) and "authority" (legal) constraints of people's limited time-space realms (Hagerstrand, 1970, pp. 11-12).

Data from the USA (OTT, 30/7/2001) indicates that in regard to commuting, private motorists (1995 figures) enjoyed shorter average commute times (20.1 minutes compared to 42.0 minutes), shorter commute lengths (18.9 km compared to 20.6 km) and faster commute speeds (56.6 km per hour compared to 30.9 km per hour) in comparison with commuters using public transport.

By enabling greatly expanded time-space prisms, personal motorised transport gives people more available choices and potentially richer lives.

4. THE COSTS OF MOTOR VEHICLE USE.

The enormous personal benefits that motor vehicle use brings comes at a high cost, not only in the private cost to individuals but in terms of the environmental and social externality costs to third parties.

In broad terms these externality costs can be grouped under three headings; congestion, road trauma and pollution.

Congestion, in economic analysis, is an example of market failure caused by the absence of property rights. Motorists in a congested traffic stream pay the average private costs of time delays and inefficient vehicle operation. What they don't pay are the marginal externality costs of delays and inefficiencies they impose on other motorists; nor are they themselves compensated by the extra costs they suffer due to the actions of other motorists.

Roads are open access facilities. Provided motorists have a road-worthy vehicle, a driver's licence and fuel in the tank, they can generally crowd onto the road system and travel wherever and whenever they like. Consider if we applied the same procedure to allow entry to a concert hall or basketball stadium faced with a popular demand that exceeded its limited capacity. People paying to enter the hall (or stadium) would be free to sit or stand wherever they could find space. We might witness a new phenomenon, "concert rage", as people jostled each other for favoured positions. Entry would continue until, at the margin, the private costs of crowding exceed the expected benefits of witnessing the concert or basketball match.

Of course we don't do this; the limited capacity of the hall or stadium is rationed by selling tickets to give each spectator exclusive property rights to a particular seat. Order is assured and chaos kept in check.

Our failure to apply the same principle to rationing scarce road space during periods when demand exceeds capacity causes inefficient congestion. The cost of road congestion in the United States has been estimated to be approximately $43 billion a year in motorist time and wasted fuel, and an additional $100 billion from air and water pollution, accidents, and delayed freight movements (Zimmerman, 1997). In Australia the Industry Commission estimated the costs of congestion in Melbourne, of vehicle operating and travel time costs alone, at $AUD2 billion a year (Industry Commission, 1994, p. 220) . If extrapolated to the rest of Australia and if other externality costs caused by congestion were included, this could amount to a national cost of about $AUD10 billion ($US 5 billion) per year.

Road trauma, resulting from accidents and the fear of accidents, occurs because the control of vehicles relies on the skill and concentration of drivers. Vehicle manufacturers have taken for granted the assumption that drivers are fully responsible for the operation of vehicles, and have designed vehicles to be as safe as optimally possible, given other design and price constraints. Roll bars, bumper bars, air bags and other features are built into vehicles to protect occupants in the unlikely event that they will be involved in potentially fatal accidents. The extra weight of safety features results in vehicles being heavier than they would otherwise be, and necessitates more powerful engines to operate them.

Pollution, from greenhouse gases and other noxious emissions, is an example of market failure caused by not incorporating these costs into the private costs of motoring. Environmental costs include the emissions of sulphur and nitrogen oxides, compounds of heavy metals, and greenhouse gases. Although the full environmental costs of these emissions are not fully known, the proportion of greenhouse gas emissions attributable to transport industries in developed countries is generally estimated to be in the order of 12% of total greenhouse gas emissions (BTCE, 1996, p. xxix).

5. REDUCING THE COSTS OF MOTOR VEHICLE USE: THE LOGISTICAL APPROACH

The traditional logistical approach to urban travel has attempted to deal with the costs of congestion, road trauma and pollution by either supply side engineering improvements or demand side command and control management.

When congestion was first recognised as a problem, in the post Second World War period, the supply side approach was to build more roads in order to cater for the increased traffic. In terms of the concert hall analogy, this approach is equivalent to building more or bigger concert halls to cater for the increased demand. Unfortunately, this approach leads to excess capacity during off-peak periods and fails to take into account the opportunity cost of the resources needed to expand the road system. Civilian protests at the rate of road building in urban areas, particularly urban freeway developments, led to this approach being effectively abandoned during the 1960s.

Problems of road trauma and pollution were dealt with in similar ways; building bigger, heavier cars to protect occupants in the event of an accident and developing cleaner, more efficient engines to reduce fuel consumption and pollution. This approach has also tended to fail because of the basic incompatibility of the two approaches. Heavier vehicles, although they may be safer to the occupants (but not necessarily to other road users), require more powerful engines; smaller, more efficient vehicles may increase the likelihood of severe damage to the occupants in the event of an accident.

The alternative command and control approach has been to reduce vehicle use by demand side management. To again use the concert hall analogy, this approach amounts to trying to persuade people not to attend concerts or to undertake alternative activities. In regard to urban transport, this meant trying to persuade travellers to walk or use public transport. Unfortunately, this approach has been largely unsuccessful, due to the failure of the logistical paradigm to recognise that public transport services and personal motorised transport are essentially two different goods serving different markets.

Public transport systems were developed in the late nineteenth century at a time when personal transport was limited to animal power. The types of public transport developed during this period were ideally suited to the travel demands of a predominantly male industrial workforce engaged in concentrated daily work travel between new residential suburbs and the factories and offices of the central city.

Public transport was, and remains, dependent on the need to accommodate large numbers of passengers per vehicle. To repay the high fixed costs of capital infrastructure, operating expenses, and administration overheads, vehicles and service levels need to be designed to achieve economies of scale. This can only be done by having multi-passenger vehicles, fixed routes, and published timetables.

Public transport is further disadvantaged in that crucial decisions affecting travel behaviour, such as the types and number of vehicles, the levels of service and fare structures, and the choice of routes and frequencies, are beyond the direct control of passengers. Instead, these decisions are in the hands of the authorities who manage and operate the systems. This type of "top-down" decision making is increasingly out of step with the shift in modern societies to individualism and "bottom-up" management.

The necessary requirements for mass transit efficiency, of having large numbers of passengers with broadly similar activity patterns, going from similar origins to similar destinations at approximately the same time, are now found only in large cities and only for certain types of travel, such as the journeys to and from work of central city commuters or the travel needs of an increasing number of transit-dependent tourists and foreigners. For other types of activities the market for public transport is steadily decreasing due to the inability of these systems to service low density, time- and space-dispersed travel demands, where collecting enough passengers to achieve economies of scale is difficult because of the combination of long distances from home to bus, tram, and train stations and long waiting times for vehicles to arrive.

Personal transport systems, on the other hand, are on-demand, go-anywhere, any-time forms of transport. Unlike public transport systems which require passengers to travel on prescribed routes and to present themselves at designated stops at times when vehicles are scheduled to arrive, personal transport systems are relatively ubiquitous in time and space and are available generally when people want to use them. Hence they are ideally suited for serving the increasingly time- and space-dispersed travel demands of post-industrial urban activity patterns.

6. REDUCING THE COSTS OF MOTOR VEHICLE USE: THE ECONOMIC APPROACH

The economic approach is now starting to receive serious attention as the most effective and efficient way of dealing with the considerable costs of urban traffic. This is due to three main reasons. First, from a paradigm point of view, the economic approach has only recently emerged, having long been overshadowed by the logistical engineering approaches described above. Second, from a political point of view, economic policies which require motorists to pay for the full costs of travel are now more in tune with public opinion, and third, from a practical perspective, the technologies needed to achieve economic solutions are becoming available and financially feasible.

The technical barriers to economic policies have now been removed. The logistical approach is in decline, not only because increasing the supply of road space has become increasingly expensive, but because demand side management measures underestimate the enormous benefits of personal motorised transport and overestimate the value of public transport services.

The fear that pricing policies are likely to be politically unacceptable overlooks the benefits that motorists and the general public gain from reducing the costs of urban travel. To many motorists the prospects of a congestion-free trip is worth paying for, knowing they could reliably expect to reach their destination on time and with a minimum of hassle. Of course, motorists have reason to be wary that the introduction of prices could lead to them being taxed for services they don't receive, but that caution applies to all systems of charges. Provided prices are based on real costs and are transparently applied so that the benefits can be properly evaluated, prices for internalising externality costs are no different from prices in other sectors of the economy. Rationing scarce road space by means of congestion charges is no different from rationing scarce parking space by paying parking fees.

Furthermore, it is possible to make the introduction of charges politically attractive by revenue neutral policies which compensate owners by giving them equivalent reductions in other transport related charges, such as cheaper vehicle registration fees. In this way, motorists would benefit from the removal of externality costs without, in overall household budget terms, having to pay more to do so.

The third reason for the previous lack of adoption of economic measures to urban transport, namely, the lack of appropriate technology, has been solved in recent years by the development of cheap, reliable and effective electronic information systems (Hills and Blythe, 1990).

The economic approach to dealing with the externality costs of urban transport depends on being able to identify and target individual motorists responsible for causing the costs. This can now be achieved by using instruments on the vehicle capable of interacting electronically with instruments both on the road and on other vehicles.

Communication between vehicle and road, and between vehicle and vehicle, can be achieved by electronic signals transmitted and received either via cables located under or by the side of the road, or via overhead satellites. Payment for charges can be deducted from a pre-paid "smart" card attached to the vehicle, or from a standard credit card, or they can be paid later by means of a monthly invoice.

In practice, proposed electronic road pricing (ERP) systems tend to strike a compromise between achieving a high level of economic efficiency (by adopting prices which closely correspond to marginal social costs) and achieving a high level of administrative simplicity in application and enforcement.

For example, entry toll systems are relatively easy to install and cheap to administer but may be relatively inefficient in terms of controlling congestion. Highly flexible congestion pricing systems, on the other hand, may achieve economic efficiency but at the expense of driver confusion and difficulties of enforcement. Further advances in electronic technology, and increasing public acceptance of flexible cost-based pricing policies, are certain to ensure a closer confluence in future between efficiency and effectiveness in ERP systems.

A growing body of literature now exists both in regard to the theory of electronic road pricing and in regard to the practical considerations of different types of systems and their respective advantages and disadvantages.
The impending introduction of electronic road pricing (ERP) to control congestion will deliver enormous gains in economic efficiency and environmental improvements. Together with the transmission of other forms of in-vehicle electronic information for the benefit of the driver and passengers, the introduction of ERP is likely to revolutionise the way future motorists use urban roads (Hills and Blythe, 1990; Wherrett, 1991).

The development of "smart" cars interacting with "smart" roads and with other "smart" vehicles in the traffic stream offers the prospect of "civilising" motor vehicle use, thereby leading to the prospect of truly sustainable personal motorised transport.

ERP is capable not only of controlling congestion to socially optimum levels, but has the same capability to prevent collisions either between vehicles or between vehicles and adjacent stationary objects. With electronic guidance systems, the avoidance of accidents will no longer depend on driver skill and mental concentration. Safe road travel will save a whole range of costs associated with accident prevention, including the policing and enforcement of road rules, and the medical costs incurred in dealing with accident victims.

Electronic guidance systems to control vehicle movements will enable cars to be packed closer together on roads and to travel faster, thereby considerably increasing the density of vehicles on roads and reducing the need, as total road travel increases, for proportionately more road space.

The reduction of accidents and road trauma opens the way to the development of ultra lightweight vehicles. Cars will no longer need weight and heavy construction to help protect occupants in the event of an accident. Instead, vehicles can be constructed from lightweight, but highly strong and recyclable plastic panels, and, through nanotechnology, may even be capable of changing body shape and colour to suit the daily moods of the owner. Cars will be cheaper and have longer life spans.

Lightweight vehicles can be powered by lightweight, highly efficient engines based on solar cells or electric batteries. Polluting, greenhouse gas emitting petrol engines will be phased out to be replaced by environmentally benign engines still powerful enough to move several passengers and their luggage. According to one recent study, the introduction of efficient road user charges would represent the most effective 'no regrets' measure that could be adopted to reduce Australia's transport greenhouse gas emissions (BTCE, 1196, p. 308). The introduction of ERP, the study claims, would lead to an overall saving in road operating costs of about $AUD120 billion over the period from 1996 to 2015, and reduce Australia's greenhouse gas emissions during the same period by more than 90 million tonnes.

Electronic systems have the capability to provide a vast range of other on-board vehicle services, such as information relating to travel characteristics (such as appropriate route choice, available parking spaces at destination, and ways of avoiding potential bottlenecks), vehicle safety and security systems to prevent theft and mis-use, and a range of non-travel related information for the entertainment of passengers (such as television, news bulletins, and other telecommunications services).

Electronic guidance systems can also enable people who are mobility impaired (such as the aged, the frail, and people with disabilities) to enjoy the same degree of motorised time-space freedom that other members of society take for granted.

7. LONDON'S CONGESTION CHARGING SCHEME.

On February 17, 2003, the Mayor of London, "Red Ken" Livingstone, announced the introduction of a so-called Congestion Charging scheme for central London. The scheme is based on a fixed entry fee of 5 British pounds to enter the restricted area between the hours of 7.00 am to 6.30 pm Monday to Friday, excluding public holidays. Certain businesses and other groups considered to provide valuable public services are eligible for exemptions or discounts.

The defined central area is roughly bound by Park Lane and Edgware Road to the west, Marylebone Road and Euston Road to the north, City Road and Tower Bridge to the east and a southern boundary extending south of the Thames. Motorists entering the restricted area have several options by which to pay the charge. A network of more than 200 strategically placed cameras record the number plates of all vehicles entering the area which are matched electronically with the database of vehicles having paid the congestion charge that day. Severe financial penalties for motorists attempting to avoid the charges help to ensure high rates of compliance.

After 3 months of operation the monitoring watchdog organisation Transport for London (TfL, 2003) reported the following preliminary effects:

(a) approximately 110,000 people per day were paying the charge
(b) charging is delivering more than the expected reduction in congestion with traffic levels within the charging zone reduced by some 16%
(c) car journeys to and from the charging zone are quicker and more reliable
(d) many ex car users have transferred to public transport
(e) diverted traffic is being successfully accommodated beyond the restricted area
(f) the technical monitoring and payment systems are operating effectively, and,
(g) public information continues to show support for the scheme.

8. IS SECOND BEST GOOD ENOUGH? ECONOMIC OBJECTIONS TO THE LONDON EXPERIMENT.

A survey of 73 cities and urban areas in 15 European countries reported a 72% interest in London's experiment with congestion charging with a view to possible implementation in their own jurisdictions (OTT, 23/6/2003). Given this interest, it is important to assess the shortcomings of the London scheme in comparison with the first best approach of marginal social cost pricing.

First, the fixed entry charge, although administratively convenient, does not accord with marginal levels of congestion. The fee remains the same irrespective of the level of congestion within the restricted area or the length of time spent in the area and roads traversed.

Secondly, as with all fixed entry fees, the charge may eventually and perversely increase the total amount of motorised travel in the area. There is the danger that as the scheme becomes entrenched, motorists may accept the fee less as a deterrent and more as an integral component of travel cost. Hence, the marginal effect of the charge may gradually reduce to zero. It is important to note that paying an entry fee, while it may restrict total demand, does not remove the open access nature of the scarce resource of road space.

Furthermore, given the once-only daily payment of the fee, motorists may be encouraged to spend more travel time within the area (notwithstanding that travel is an intermediate good, a means to an end rather than an end in itself), inspired by the irrational intention of "getting their money's worth" by reducing the average cost of travel per km.

A third consideration is the spill-over effect to traffic volumes and patterns outside the central area. Given that travel beyond the restricted area is still unrestricted, land uses and road travel patterns will eventually adjust to the new situation of an artifically created island of higher level travel cost in the central area. Ideally, the price of travel should reflect not only the private costs faced by the motorist but the social and environmental marginal costs caused by their actions. These prices should be continuous and variable according to changing circumstances relating to time and place. The induced land use and travel effects of London's congestion charging system will unfold over time but may well be detrimental to the overall efficiency of the total urban system.

9. CONCLUSION.

The full effects of London's experiment with a fixed entry congestion charge are too early to assess and may take years to fully unfold.

However, given the interest by other cities and urban areas in adopting similar schemes, it is important to recognise the inherent weaknesses of the system and to argue for a first best solution based on marginal social cost pricing rather than a crude second best entry fee system, radical though it may seem.

A proper marginal social cost pricing scheme consisting of "smart" vehicles electronically interacting with other "smart" vehicles and with "smart" roads has the potential to rapidly set in chain a number of management practices that will have the effect of "civilising" motor vehicle use in urban areas.

The infinitely adjustable ability of varying travel prices to reflect full marginal social costs to optimise congestion can also be used to prevent road accidents by electronically taking away the responsibility of manipulating the vehicle from the quirkiness of human control.

Removing the threat of road accidents not only saves the costs of road trauma but permits road vehicles to be much lighter in construction by removing the necessity of transporting superfluous safety equipment.

Light weight vehicles, in turn, allow for the replacement of powerful internal combustion engines by low cost environmentally benign engines powered by renewable energy sources.

In short, first best marginal social cost pricing solutions using the latest sophisticated electronic equipment have the potential to set in train a number of flow-on practices to civilise motor vehicle use, achieving the win-win-win outcomes of economic efficiency, social equity and environmental responsibility.

London's second best entry fee system may represent an unfortunate diversion in achieving that goal. Time will tell.

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