Road use charges should be introduced in the uk both for motorways and for urban ...

Transportation, Public Transport

Whenever we hear today about the problems facing this country and how the government intends to solve them, arguably the three most commonly occurring points for debate on the government's agenda areeducation, thehealthsystem and transport. Transport often comes into focus when high profile incidences involving sub-standard public transport (most notably in recent times involving the railway network) are brought to light. And all this does is reinforce the reasons why many of us choose to use a car to travel in, rather than public transport. Due to the increasing need to use cars, our roads are becoming more and more congested. Now the government, in its position of trying to improve the situation, has to find a solution, which will at least ease the problem.

Congestion arises when the volume of traffic exceeds road capacity. This reduces the speed of all vehicles and so increases the average time it takes to complete a particular journey. The congestion mainly occurs at peak times where the demand for the road is at its highest. Particularly when queuing in traffic jams, more people are using the roads, which increases the (marginal) cost of time to other people. Congestion occurs due to the fact that roads are a " nonexcludable" public good, i. e. no one is excluded from using the roads (based on the assumption that everyone can afford a vehicle, can drive a vehicle, and can afford the additional costs to run a vehicle.) By its definition, when a nonexcludable public good is provided, it affects the welfare of every person in the society. A public good is one where another individual using it will have no effect on the benefits received by others using it (i. e. the marginal cost of someone else consuming it is zero) and therefore there is no competition for the service).

Figure 1; The speed flow curve

(Inverse relationship between the number of vehicles on a road and the average speed of vehicles)

There are many causes of congestion, which all lead to some economic costs and therefore affect businesses and users of the roads.

For a business the consequences of congestion are most likely to be incurred when transporting the goods and raw materials to and from factories and retail outlets. Congestion increases firms' costs, resulting in a lower comparable profit (to the value of profit without congestion) for the firm. Providing the price is inelastic these extra costs could be passed on to consumers in the form of higher market prices (whereby demand for the good is not too sensitive to a change in price). These extra costs can be incurred by either the opportunity cost of time (delays) or direct costs of extra fuel being burned travelling at lower speed.

Figure 2:

Supply and Demand during congestion for a price elastic good (Congestion costs shift the supply curve to the left, resulting in higher selling price and therefore lower quantity demanded)

Supply curve with congestion charges

Supply curve without congestion charges

Demand curve

Congestion may cause delays in delivery, which in turn may lead to various negative impacts on the business itself. For instance this may adversely effect the reputation of the business. Furthermore suppliers to the business may be delayed causing the firm to be less productive incurring unnecessary costs from staff becoming idle.

These consequences are an adverse affect on the welfare of the other motorists, (i. e. people most likely become more irritated). Since there is a direct effect here of the actions of one person on the welfare of another person or persons in a way that is not transmitted by market prices, we have the definition of an effect that is called an externality. In economics, public goods and externalities are closely related and are often associated with efficiency problems. Thus this is part of the reason why our roads are " inefficient".

Congestion also causes the road network to become an impure public good. A public good is defined as one where another individual using it will have no effect on the benefits received by others using it (i. e. the marginal cost of someone else consuming it is zero) and therefore there is no competition for the service. An impure good is one where the consumption of the commodity is to some extent rival. When congestion occurs the use of the road network becomes competitive (especially during the rush hour) and therefore the good becomes impure. This allows the public good to be given a price and so allows schemes such as congestion charging and toll roads to be introduced.

Governments across the world are introducing road charges with the goal of reducing road use and minimising the negative effects of road usage. An important decision that the government will take into consideration will be whether introducing road charges would have a negative impact upon theenvironment. In the capital the Mayor of London, Ken Livingston, is currently asking for the views of 300 groups likely to be affected by road charges to enter London. Despite a London report suggesting a 12% reduction in traffic, opposing parties believe it would cause chaos and adversely effect families and small businesses.

Transport is a derived demand as it comes from the needs of the people (whether they are travelling to work, going shopping or meeting socially) and needs of businesses (transportation of goods and industrial materials). However the increasing demand for road use over the years has added to the number of vehicles on the road, and in turn, increases the damaging effects upon the environment.

The obvious aim of introducing road charges for using motorways or entering urban areas in private vehicles are that fewer people will choose to do so, thus decreasing the harmful gas engine emissions as a result. Noise and sightpollution, along withair pollution, should also be seen as a result of reduced traffic and congestion. This would rely on the fact that roads have an elasticity that is either inelastic or elastic. The greater the elasticity (value) of these road charges would indicate higher price sensitivity in using the road in question. Establishing the elasticity will enable us to identify the

extent to which the environment will benefit from a reduction in pollution (air, gas and noise).

From a report by Button (1993) the 'trip type' significantly affects the price elasticity. For instance travelling to urban areas for shopping purposes has a high elasticity, so if road charges become applicable it is likely that fewer people will decide to make the journey using private vehicles. From an environmental perspective fewer cars entering these urban areas will reduce congestion and vehicle pollution levels. When looking into the decrease of CO emissions for particular areas, such as Hereford as shown above, this illustrates the dramatic reduction in air pollution levels when a charge is applied. This does however depend on price elasticity of demand for the road. This is in comparison to the minimum elasticity for urban commuting (travelling to work) which is much lower. Any road charges imposed on these people will have a minimal effect, as it is more essential for them to travel into the urban area.

An additional advantage of road charges is the extra revenue that would be generated through payment of those people who continue to use the particular (charged) road. This has seen positive results in Norway where the funds collected are being used to support the successful public transport areas of Oslo and Trondheim.

The biggest environmental concern that road charges are associated with, specifically with motorways, is the likelihood that car drivers would take alternate routes (not charged) such as country roads. These roads that were

previously quiet would then be subjected to noise and gas emissions as well as congestion problems. This is an example of the substitution effect as both the main roads and the rural roads could satisfy the needs of the public. The introduction of payment for using the main roads would result in an increase in the quantity demanded of the substitute, that is the rural roads where no charges are being imposed.

How elasticity effects the demand for motorways with/without alternative routes

(Motorways without alternative routes) (Motorways with alternative routes)

From an environmental perspective road charges should be introduced for the vehicles entering the urban areas. This is because there is significant evidence that motor vehicle usage will drop significantly (as shown in the Button 1993 table).

The additional revenue raised can be used to fund the much-needed public transport services. Therefore those who will no longer use their own private vehicles will potentially benefit from an improved transport service. Evidence showed that those who continue to travel into the urban areas using private vehicles are also more satisfied if themoneythey are charged goes into improving public transport (as shown in the MORI diagram).

For motorways the decision from an environmental perspective is split between those motorways that have alternative routes and those that do not. On those motorways with possible alternative routes the disadvantages

(such as the possible movement of traffic as opposed to reduction) outweighs the potential benefit of the additional revenue. Where alternative routes are unavailable road charges are appropriate as the disadvantages stated above and in the report are much less of a problem. Revenue generated from these charges can then help urban areas with the possible improvement of public transport (like the Norwegian example).

If roads were a " typical" competitive commodity, supply and demand would determine its price and an organization or business would own it. However there isn't a market for roads, and (in places where there are no toll systems in place) people can use the roads for free (i. e. its price is treated as if it was zero). Added to the fact that no one actually owns the roads (the government only has a requirement to maintain them), we have a demand for the usage of the roads by the public, but afailureof a market to emerge. Therefore there is no mechanism to ensure that the resource of roads is used efficiently. Therefore if someone owned the roads and could charge a price for their use, a market would emerge leading to an efficient use of the commodity, because the price reflects the value for alternative uses.

Thus through the understanding of how a road is economically defined and the fact that at the moment, it is economically " inefficient", a measure has to be taken. Therefore we will now explain using the defining economic principles why road use charges should be introduced for motorways and for urban areas.

Arguably, though, the notion of congestion charges is more readily available to be implemented than road tolls, but the economic principles that should guide the design of this policy towards taxing and charging road users also applies to road tolls.

The aim of the policy is to find an equilibrium position, where the marginal cost of using the resource is equal to the marginal cost of providing the resource.

Figure 4:

The equilibrium position and the effect of road charges

The graph is labelled with " level of traffic" on the x-axis and " generalised cost of driving" (this means that the generalised costs are time and money spent on making the journey) on the y-axis. The first line drawn in was the demand curve (D), which is also the marginal benefit (MB) curve, (which is a straight line). The easiest way to describe it's negative gradient is as the number of people using the road increases, the marginal driver will have a lower benefit from the road than the previous one. There are two costs curves to be added to the diagram.

The private marginal costs (PMC) are the direct costs to the driver. The PMC curve is also the supply curve (S). It is an upward sloping curve because with low traffic densities, the only cost to the driver is petrol. However as levels of traffic increase, congestion increases, and thus the driver incurs time costs as well. The social marginal costs (SMC) has the same base as the PMC (i. e.

petrol costs) but as traffic increases, not only does it represent the time cost to that one particular driver, there is also the time costs that each driver imposes on every other driver.

As is to be expected, at the moment, drivers act according to their PMC curve and the level of traffic on the road increases to the point (Xo), where the PMC is equal to the MB. Thus as the economic theory states, we are at a level of traffic above the social optimum, because the social optimum occurs when the SMC is equal to the MB. This is shown at the point X*, which is the social optimum and the optimal level of traffic. To get the level of traffic reduced from Xo to X*, we have to impose an extra charge or tax " P" (= P*-Po). This is referred to as the Pigouvian tax amount. This amount (P) forces the road user to take into account the costs of the externality that they are generating, and thus induces them to operate at the efficient level.

Since this " tax" is a congestion charge, it should only be imposed where congestion arises, and the level of charge should be directly related to the amount of congestion. Therefore the inner cities (i. e. urban areas) and motorways, having high levels of traffic, should have higher charges than areas with low levels of traffic.

Traffic imposes a cost on society over and above the PMC. To achieve the socially optimal solution, these costs should be passed on to the driver. In doing this, only those drivers who were willing to pay society for the externalities they cause would use the road network. Thus levels of traffic

would fall to the optimal output level, reducing congestion and pollution in the desired areas of urban areas and the motorways.

It could be argued that if drivers were charged for the delays and road congestion they impose on one another, some of them would arrange to travel at different times, by different means e. g. rail and bus, or arrange to use different routes where road use charges can be avoided completely. There are various technological methods of charging for road uses.

The simplest method is buying a license to enter a zone at certain times. The license, like a tax disc, would be prominently displayed with traffic wardens policing the system. However this would mean that only people parked in these zones would get checked; it would not include people just driving through them. To do this, traffic wardens would somehow have to physically stop cars and charge them for entrance into the area. To set this up in the UK would be very difficult with our complicated network of motorways, urban and rural roads and actually stopping cars would cause more congestion rather than reducing it.

Another method that uses the newtechnologyof electronic tolls/beacons, no longer requires motorists to halt at tollbooths. As motorists drive past these tollbooths, the toll registers the electronic number plate and sends a signal to a recording computer. This is a very direct way to charge the amount specific to the road and to the time of day with the amount due being deducted from their bank account. However, this would infringe on privacy rights, as it would enable people to derive individuals' locations. Hence the

use of smartcards would be more preferable like the method used in Hong Kong. The driver inserts a prepaid card, like a telephone card, into the electronic number plate and payments are debited from it when a tollbooth is passed. Only in a case where the card runs out of credit do the central computer monitors start charging directly for road use.

The installation of electronic technology would have the drawbacks of being time consuming and very costly. Not only is there the construction of tollbooths, the installation of smartcards on every single car, but maintenance as well. A type of security system would also be needed to prevent free riders1, for example they could remove the smartcard or tamper with it. A method of overcoming this would be the use of cameras on each booth to capture an image of the license plate if a smart card was not detected.

The most technical method, and therefore probably the most expensive, would be satellite car tracking technology. This uses existing Global Positioning System (GPS) satellites to track vehicles via electronic black boxes fixed to the dashboard of all vehicles. The problems associated with using satellites are similar to that of the above; that is the infringement on privacy rights and costs of setup and maintenance. However one possibility with this method is that it can also be used in conjunction with locating stolen cars.

From a technical point of view smartcards seem to be the most sensible option. Although it would be more costly than just buying licenses, this

method would lead to less congestion, as there is no stopping to enter the areas being charged. It is less expensive than using satellites and would not infringe on privacy rights. However there are difficulties and limitations with implementing any of these road use charging methods; the general public will have to be educated in the use of them, which will be quite complicated due to different regions and the specific times of the day having varying charges.

The aim of this report was to analyse the argument that as elsewhere in the world, road charges should be introduced in the UK, both for motorways and for urban areas. On addressing the argument the environmental and the consequential factors of congestion needed to be considered. On considering the environmental factors the conclusion is that the reduction in pollution levels would only occur if the road charges reduced private road use and increased the use for public transport (i. e. there were no alternative routes that people had switched to avoid the charges).

However a reduction in congestion on motorways and urban areas could certainly improve a firm's economic profit as the investigation into consequences of congestion revealed. Having decided the obvious need for charges with the economic principles supporting this, whether the application of schemes is technically possible became important. For this factor the smartcard road-charging scheme emerged as the best option. On bringing all these points together road charges are both necessary and feasible for UK motorways and urban areas. Except by environmental

perspectives where additionally there have to be few alternative routes, thus preventing people congesting other roads and avoid payment.