Abstract: The economics of road pricing is widely considered a key option in the tackling of congestion. But it has its many sceptics who look at its forms, most prominently congestion charging, as being of questionable success. This being the case, this paper reviews the theoretical basis behind congestion charging and examines both the economic and wider rationales for its advent. Thereafter, the paper widens the concept of road pricing by examining London’s experience of its own congestion charge and evaluates it thoroughly by investigating the time savings and investment dividend garnered as well as the scheme’s yielding of behavioural change and its wide economic reach. By doing so, the paper attempts to reach a conclusion on the validity and success of congestion charging as a dominant means of road pricing.

KEYWORDS: Congestion charging, road pricing, time savings, investment dividend, externality
Introduction

By the year 2000, the average speed of trips across London was below that recorded at the beginning of the twentieth century. This was before the car was even introduced. Moreover, traffic speeds in central London had fallen dramatically by more than 20% since the 1960’s, from an average 12.7 mph in 1967 to 10 mph in 1998. Even in the larger area of inner London drivers spent almost 30% of their time stationary during peak periods in the millennium year and more than half their time travelling at speeds of less than 10 mph (Leape, 2006). To this effect, Londoners’ concerns over the levels of traffic congestion were high. Indeed, an independent survey conducted in 1999 concluded that the ‘two most important problems requiring action’ were public transport and congestion with 46% and 33% respectively. Strikingly, these were of more importance to the city’s inhabitants than law and order which came in at 20% (ibid). It was clear that urgent action was required and such action came in the form of the introduction of the Central London Congestion Charge. The congestion charge of £5 for motorists driving within a designated area1 of the city from 7am to 6pm was introduced for the sole purpose of fighting the conurbation’s chronic traffic problem. Consequently, it has set the precedent for many other cities around the world who are toying with the idea of introducing similar measures. This being the case, this paper sets out to examine the theoretical basis behind congestion charging, examining both the economic and wider rationale for its advent, and furthermore seeks to examine London’s experience and to evaluate it thoroughly.

Congestion Charging: A Theoretical Basis

On a simple level, the case for congestion charging is that traffic congestion results in inefficient use of available road space, to the detriment of the community as a whole, and occurs largely because road space use is not efficiently priced (Richards, 2006). With increases in road capacity likely to lag greatly behind increases in demand, congestion (and its often adverse effects) is likely to become more extensive unless road user charges reflect those costs. According to Gwilliam and Mackie (1975: 91) congestion ‘may be said to occur when one road user impedes the movement of another.’ As a result, the larger is the volume of traffic on a particular road, the greater the chance of impedance. Congestion charging, on the other hand, can be defined as a system of surcharging users of a particular transport network in those periods of time which possess peak demand. Its goal is to reduce vehicle overcrowding and bottlenecks. There is a well established economic rationale for congestion charging stemming as far back as the great Adam Smith. However, the case has evolved immensely since the publication of ‘The Wealth of Nations.’ Thus, this analysis gives a broad rationale for the adoption of congestion charging as an element of transport policy, encompassing not only the primary economic raison

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1 Please see Appendix 1 for map of the designated charging zone relative to Greater London as a whole
d'être but also the environmental, planning, business and financial grounds for its imposition.

**Economic Rationale**

Transport Economics, particularly vis-à-vis the road, relies heavily on essential economic principles. That is to say, it equates a transaction to an exchange. Therefore, an individual travelling in a vehicle along an otherwise empty road can travel at a speed of his or her choice so long as it pertains to the legal limit (Richards, 2006). Such an individual is incurring both benefits and costs. In the case of the former, that said individual should gain a level of utility and so too should society in general. With regard to the latter, costs are imposed, not only on the driver alone but on others. Thus, there are individual and social costs (externalities). Examples of individual costs include fuel, tax and insurance, and servicing the vehicle. In recent years, individual costs have also come to encompass congestion charges. Alternatively, social cost examples include the obvious damage to the environment. More than likely, for example, the vehicle is polluting noise and emissions. There is also the possibility of an accident occurring which may kill or maim. As such, unless it is a tolled road, it is ‘likely that the local authority or central government will have to meet such external costs’ (ibid: 9). At the present hour, it is generally agreed that social costs greatly outweigh the individual costs.

The standard economic diagram illustrating the basic principles of congestion pricing is originally found in the works of Walters and Vickrey and although it is overly simple, it ‘serves to illustrate the essential economic rationale’ (Button, 2010: 287). In the below diagram, a single road is taken with homogeneous traffic entering at various intervals. This is illustrated as follows:

![Diagram of Generalized and Marginal Costs](Source: Button, 1993.)
As can be seen from above, we have an average cost curve which shows the generalised costs (money and time) of consuming road space for existing traffic and we have a demand curve which represents the utility that potential road users enjoy by joining the traffic flow as long as the believe that the benefits of doing so exceed the costs. In the diagram, this leads to a traffic flow of $F_1$ (ibid). The problem, however, is that by joining the traffic stream, a vehicle slows all other vehicles by some amount. We also have the marginal cost curve. This depicts the cost borne by the driver and the cost imposed on other vehicles. Overall, if motorists take these combined costs into account, the flow would fall to $F_2$. Following on from this, we ascertain that the idea of the congestion charge is to make drivers aware of the congestion cost element by imposing a charge $C_2 - C_1$ on each road user. This is largely the additional congestion charge associated with the marginal user at the optimal traffic flow. The result of this is a welfare gain of HJI whereas the traffic flow $F_1 F_2$ would only generate benefits to road users equal to $F_1 F_2$ JJ (and at a cost of $F_1 F_2$ JH). Finally, the optimal road price is relatively easy to calculate. Taking the average cost of making a trip as $AC = (b/v)$ where a is the cost per vehicle in £2 per mile and b is the value of travel in £ per hour and the total cost of the traffic flow of q is $TA = AC q$. Thus, the additional vehicle joining the traffic flow increases the overall cost to road users by

$$MSC = \frac{dTC}{dq} = AC + \frac{dAC}{dq}$$ (ibid). Now, it takes little imagination to realise that the above case is rather simple. Indeed, the diagram and equations would not hold over a more complex network of interlocking roads and junctions. However, despite its relative simplicity, it nevertheless presents the economic rationale of congestion charging in a straightforward manner showing that if roads are to be used efficiently, there is a need for authorities to set a user charge which ensures a socially optimal flow – the congestion charge.

**Wider Rationale**

Although the original rationale for congestion charging was based solely on the above economic theory, in recent years we have witnessed a broadening of the argument. Here, there are environmental, planning, financial and business concerns to be contended to which we will now consider. In an age of global warming and increased environmental concern, it is only natural that the environment would enter this discussion. At this point, the principle of ‘polluter pays’ comes to the fore (ibid: 256). The argument goes that those who impose environmental damage should pay an ‘economic price’ for it. It is suggested that as vehicles are a key source of polluting emissions³, users should pay an emission charge, which should reflect the severity of the impact. Since some of these impacts tend to be the worst when traffic congestion

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² Pound Sterling is used here as it is the currency of the United Kingdom. The Euro or Dollar can be used as appropriate.

³ Emissions include nitrogen oxides as well as carbon dioxide on a global scale.
is at its worst, congestion related charges may be a reasonable proxy for an environmental charge. We must also consider the planning rationale. Today, as urban areas have become increasingly built up, it can be very difficult to add capacity to roads where congestion occurs because of cost and time considerations. Furthermore, just like lags exist in fiscal policy, lags too exist here (Richards, 2006). It is likely, for example, that demand has been suppressed by the congestion such that the benefits to existing users of any extra capacity may be limited because those who had previously decided to cease using the road may decide to do so again.

Next, let us deliberate business concerns. This argument centres on journey time reliability. The first US HOT lanes, on State Route 91, established ‘the principle that some users are prepared to pay for journey time reliability’ (ibid: 23). Indeed, this was a key assumption in the construction of the UK’s first tolled motorway, the M6, which provides an alternative to some 60km of heavily trafficked road where it passes through Birmingham. Vis-à-vis London in particular, evidence obtained in a study (Dix, 2002) identified uncertainties with journey time reliability as being a real cost to business. Being able to plan a journey to arrive on time at the destination with the reasonable degree of certainty can be of monumental importance, particularly with ‘just in time’ supply chains. Indeed, Livingstone quoted the frustration of London businesses with the uncertainty in travel times as one of his primary reasons for introducing congestion charges to London (City Mayors, 2002). Finally, considering financial concerns, there is a simple financial rationale based on the expectation that congestion charging can provide a new and buoyant revenue stream. This can bring in many benefits. Perhaps the most obvious of these is that it can increase the funding available for significant transport investment within the locality and this is certainly true in London.

**The London Congestion Charge and its Predicted Effects**

The London congestion charge is now 4 a £10 daily fee to drive into central London between 7am and 6pm. The charging zone covers the area known as ‘Central London’ and encompasses the financial centre, Parliament and government offices, the major tourist sites, and the main centres of business, law and entertainment. This zone is bounded by the Inner Ring Road and covers an area of around 8 square miles. Although quite small, covering little more than one percent of Greater London, it nevertheless includes the main areas of worst congestion. 5 Many studies were undertaken before its introduction to determine what effects the system would have. Leape (2006) reported that complex and extensive modelling was carried out to estimate the extent to which charges would deter drivers from making their journeys. For example, survey results were used to carefully model household demand, by type of household and type of trip, for the fee or ‘area license.’ This was in turn fed into

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4 The fee stood at £5 in 2003. It increased to £8 in 2007 and to £10 in 2011.

5 For a fuller explanation of how the congestion charge works, please see Appendix 2.
separate models so that Transport for London (TfL) could predict the effects of congestion charging on traffic levels, congestion levels and revenues. Pollution, faster journey time, effects on public transport and the costs of running the scheme were also widely studied (Blow et al, 2003). The organisation’s predicted effects of the congestion charge on traffic levels, speed and congestion are illustrated in Figure A below.

**Figure A: Transport for London’s Forecast Effects of Congestion Charge**

<table>
<thead>
<tr>
<th>Area</th>
<th>Traffic Volume</th>
<th>Congestion</th>
<th>Average Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charging Zone</td>
<td>10 – 15% Decrease</td>
<td>20 – 30% Decrease</td>
<td>10 – 15% Increase</td>
</tr>
</tbody>
</table>

*Source: Blow et al, 2003*

In total, TfL argued that there would be a ‘reduction in traffic circulating within the zone…of between ten and fifteen percent’ (Blow et al, 2003: 9). Additionally, there was a predicted corresponding diminution in congestion of between fifteen and twenty percent and an increase in average speed of between eight and ten percent. All of these, it was ordained, would lead to greater efficiency in ‘higher value trips’ (ibid). Finally, reports concluded that the congestion charging scheme would bring about a multitude of other benefits such as the revenues garnered as well as behavioural change and wider economic impacts which are less tangible.

**Evaluation of the Congestion Charge**

This evaluation will concentrate on four main areas. It begins with how the above predicted effects compare to the actual effects observed and the time savings garnered as a result. It follows on with a discussion of behavioural change, the creation of an investment dividend and the bringing about of wider economic benefits. Although not a perfect system by any stretch, the London congestion charge has been appreciably successful.

**Figure B: Comparison of Predicted Effects with Observed Effects in the Charging Zone**

<table>
<thead>
<tr>
<th>Effect</th>
<th>Traffic Volume</th>
<th>Congestion</th>
<th>Average Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted</td>
<td>10 – 15% Decrease</td>
<td>15 – 20% Decrease</td>
<td>8 – 12% Increase</td>
</tr>
<tr>
<td>Observed 2003</td>
<td>18% Decrease</td>
<td>30% Decrease</td>
<td>10% Decrease</td>
</tr>
<tr>
<td>Observed 2005</td>
<td>20% Decrease</td>
<td>22% Decrease</td>
<td>6% Decrease</td>
</tr>
</tbody>
</table>
Focusing our attentions on time savings, it can be seen that congestion charging has garnered real benefits. As can be seen from the above table, the charge has been rendered successful to varying degrees. Looking at traffic volume, we see that the traffic pattern has decreased immensely since the charge came in. Overall, for example, traffic entering the central zone in 2007 was 21% lower than was the case before charging. This is, perhaps, the best immediately measurable result of congestion charging according to the Impacts Monitoring Report (Transport for London, 2008).\(^6\) 

Vis-à-vis speed, it is the case that the introduction of congestion charging substantially increased speed ‘almost overnight,’ bringing average speed back to 1980’s levels (Transport for London, 2007: 47). Since then, however, speed has progressively fallen. For example, while in 2003 the average speed increased from 14km to 17km, this had reduced to 16km by 2005 and 15km by 2007. Still, it is worth noting that had charging not been introduced at all, speeds would now be as low as 11.5km (ibid).\(^7\) 

Regarding congestion, there were average reductions of 30% against the representative 2002 baseline. This was at the top end of TfL’s predictions. The average reduction for 2005 was 22%, lower than the first two years but still within the establishment’s original expectation range. 2006 and 2007, however, ‘saw an accelerating loss of the original congestion benefits’ according to Transport for London (2008: 55). Average congestion in 2006 was just 8% below pre charging levels while the absolute level of congestion during 2007 was effectively identical to the representative value to conditions before the scheme’s implementation.\(^8\) In other words, journey times in the zone were comparable to journey times prior to charging. This is in spite of the consistent reduction in the volume of traffic (ibid).\(^9\) 

TfL combats this deterioration in decongestion by pointing to London’s ‘gradual background congestion trend’ as well as numerous street works and developments. It also points out how worse congestion would be in the absence of the charge not having been introduced (Transport for London, 2012). Taken as a whole, it can be ascertained from the above that there have been real time savings which have brought about real productivity benefits to the London economy. The Eddington Report estimated these to be £183.9 in 2006 (Department for Transport, 2006). While we

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\(^6\) For an illustration of traffic volume since the charge’s inception, please see Appendix 3. PG 42 6TH IMPMON

\(^7\) For an illustration of speed, please see Appendix 4.

\(^8\) For an illustration of congestion, please see Appendix 5.

\(^9\) All things being equal, a reduction in traffic of 10% in central London will lead to a journey time improvement of 10% and the equivalent reduction in congestion would be about 20%. However, all other things have not been equal and TfL reports that such things as increased road and street works, the role of traffic signals and major developments, for example in Knightsbridge, have all contributed to deteriorating congestion.
must be cautious when looking at this (since such savings only represent a portion of the total accruing benefits) and while congestion and average speeds have deteriorated with time, traffic volume has been stable and London is in a better position with the charge than it would be without. For such reasons, Prud’homme and Bocarejo (2005: 2) commented that ‘the congestion charge is generally seen as a great success.’

Turning our attentions to behavioural change, we see that the introduction of the congestion charge has indeed brought this about successfully. In theory, road pricing is supposed to incentivise smarter transport and land use choices. It therefore endeavours to discourage the use of the car and encourage less expensive travel modes like buses and trains. Seemingly, London is only one of a few cities in the world which has experienced the advent of such behavioural change and this has been due, in part, to the congestion charge according to Tochtermann of Centre For Cities (2008). To this effect, the city has witnessed a transformation in the composition of traffic entering the central zone between 2002 and the present. For example, the amount of bicycles being used in the zone has increased monumentally by 66% (ibid) while Leape (2006) reports that the amount of buses and taxis has augmented staggeringly (38% and 31% respectively). Furthermore, Centre For Cities (2008: 6) speculates that the decrease in cars will ‘inevitably lead to a more tightly built city over time whereby more amenities are located within walking distance.’ Also, the large increase in demand for other suitable transport modes besides the car is likely to lead to an enhancing of public transport as well as increased provision of cycling and pedestrian infrastructure. This is of the utmost importance because it has been cited as a significant factor in the location decisions of companies as well as the highly skilled. It is such a factor that has radically boosted London’s economy (ibid) and by stimulating such important behavioural changes, the success of the London charge can be seen.

Let us now consider the investment dividend with which congestion charging garners. The charging scheme has generated a significant amount of revenue since its inception in 2003. TfL's annual report for 2010/2011 shows that revenues from the congestion charge were £287 million over the financial year, representing 8% of the organisation’s annual revenues. However, it must be noted that nearly half of this was spent on the cost of running the toll system, at £130.1 million, and this has been the case consistently since the charge came into operation (Transport for London, 2011). Once other charges were deducted, the congestion charge brought in an annual operating net income of £148m (ibid). While this income seems minimal in comparison to TfL’s total revenue from bus and tube fares of £3,015m (or 82.3% of revenue before costs) it must nonetheless be pointed out that it is more than 21% of London’s annual bus subsidy of £700 million (London Assembly Transport Committee, 2010) and that by law, all surpluses raised must be reinvested in the capital’s transport system. This reinvestment in public transport alternatives provides a vital link between people at all levels of the labour market to jobs and economic opportunities. For example, 560 extra bus services came directly from this revenue
thereby facilitating an extra 29,000 additional bus passengers between 2002 and 2006 (Campaign for Better Transport, 2012). Considering such factors, it is undeniably clear that the London charge is a success story.

Finally, we evaluate by looking at the economic reach of the congestion charge. As traffic levels have been reduced, the economic reach of London has notably widened (Centre for Cities, 2008). After all, it is now much faster to travel on de-clogged roads and ameliorated public transport. This has resulted in a higher number of people being able to reach their desired destination in a more efficient and effective manner. In turn, this has aided in increasing the capital’s effective density and furthermore to that effect, the city’s economy has been boosted over and above the monetary benefits of time savings (ibid). This can be seen in four fundamental ways. To begin with, it has given London companies more fluid access to a larger pool of labour and secondly, such firms can source from a greater network of suppliers. Additionally, individuals have found it easier to find employment and more information has been exchanged which has habitually led to greater amounts of research and development as well as innovation (ibid). Such wider economic benefits from improved access to the city centre have been estimated to be worth £59.6 million to London in 2006 (Department for Transport, 2006). However, it must be taken into account that such wider economic benefits have simply not occurred over night and that they are long term in nature. Added to this, one must make clear that they represent a small proportion of total user benefits and these must be weighted up against the costs of congestion charging to those relevant businesses and residents (Centre For Cities, 2008).

Nevertheless, with London’s economy considerably widened, one can observe the outright success of the London system.

Conclusion

Historically, attempts at introducing congestion charging in the UK have encountered fierce political resistance. The Rebecca Riots in rural Wales, for example, centred on farmers who took to the streets to dismantle tool booths. More recently in 2000, truckers blocked major roads and refineries in protest at rising fuel prices. As such, many saw any attempt to introduce congestion charging in London as foolish. But, all in all, its introduction has proved both a practical and popular success. This paper has sought to examine the theory behind congestion charging and evaluate London’s experience. As we have seen, congestion charging serves to internalise the social cost of congestion so that roads can be used more effectively and people experience increased welfare due to time savings. In undertaking this analysis, it is pertinent to say that congestion charging works not just as a theoretical economic model but also in reality. Although not perfect, we have seen this because it has helped London immensely. After all, congestion has eased and more people have opted for other forms of transport. Moreover, the benefits accrued in terms of time savings, revenue, behavioural change and wider economic gains have been of paramount importance to this city. One can only wonder why London is only one of the few global cities to
have implemented such a measure. As Ken Livingstone put it: ‘the sky did not fall on London’s head’ (Evening Standard, 2004).
Appendix 1.

**Figure C**: Designated Charging Zone relative to Greater London

Appendix 2.

**How London’s Congestion Charge Works**

The congestion charge is a £10 daily fee to drive into central London. Payment can be made in advance or on the day of travel. The charging zone covers the area known as ‘Central London’ and encompasses the financial centre (the ‘City of London’), Parliament and government offices, the major tourist sites, and the main centres of business, law and entertainment. This zone is bounded by the Inner Ring Road and covers an area of around 8 square miles. Although quite small, covering little more than one percent of Greater London, it nevertheless includes the main areas of worst
congestion. Effectively, the charge is an ‘area license’ in that the fee allows the motorist the right to drive into and out of the zone as many times as desired throughout the day, with charges applicable between 7 am and 6 pm on weekdays. Drivers entering the zone have their vehicle number plate read by cameras using a system called ‘Automatic Number Plate Recognition’ technology or ANPR. This number is then stored in a database that is compared at midnight each night against that of a database comprising all those who have paid the charge for that particular day. If it is found that eligible vehicles (private motorists and commercial heavy and light goods vehicles) have entered the zone without paying, they will find themselves subject to a hefty fine of £120.

Appendix 3.

**Figure D.** Traffic volume entering the central London charging zone by time of day. Annualised weekdays for 2002 (pre-charging) and 2003 to 2007 (post charging).

Appendix 4

**Figure E.** Long term trend in traffic speeds in the central London charging zone.


Appendix 5.

**Figure F.** Congestion in the London charging Zone during charging hours.

Bibliography of Consulted Works


Department for Transport, 2006. The Eddington Transport Study. London:


