Road Pricing in Practice – the London Congestion Charge

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Abstract

Congestion charging or more general road pricing – both terms shall be used synonymously in the following – describes the levying of fees for the use of certain road sections. One of the world's largest and most sophisticated congestion charging schemes has been introduced in Central London on February 17th 2003. Its major objective is to sustainably relieve regularly congested Central London roads of individual transport. The following treatise shall on the one hand introduce to the general economic principles of congestion charging and furthermore to important aspects of London's congestion charging system. On the other hand this treatise shall provide interim results of the effects of the congestion charge so far.

1. Introduction

Congestion as well as accidents, environmental and noise pollution are all inevitable and negative concomitants of transport. Traditional approaches in order to overcome or at least mitigate these problems were on the one hand the continuous extension and upgrading of infrastructure and on the other hand the extensive promotion of public transport. In essence, both strategies did not lead to the desired results, irrespective of the difficult further extension of infrastructure due to the political resistance of citizens and local authorities directly concerned. What is more, the alternative public transport is characterised by a stagnating or even declining modal split while the number of passengers transported increases in absolute terms.

A basic economic principle states that every user of a resource should bear the full costs incurred by using that specific resource in order to warrant an efficient resource allocation. In case the pricing mechanism is not applied for the rationing infrastructure access or not similarly applied for all modes of transport, the resulting inefficiencies and misallocation – including intermodal distortions in allocation – will inevitably lead to significant economical costs and, therefore, welfare losses. These losses can be ostensively illustrated by the example of congestion in road transport. Road infrastructure is usually, as e.g. in Germany, predominantly financed by tax revenues, which have little reference to the actual volume of traffic for budgetary reasons.

Meanwhile, technological change enabled the imposition of genuine use-related access charges – apart from the relatively primitive, incomplete as well as inaccurate toll and vignette systems. However, public acceptance of such systems is still regularly low whenever the introduction of a real congestion charging systems is politically discussed. Nevertheless, more and more cities all over the world successfully introduce road pricing systems – the Asiatic city state Singapore being the forerunner. In 1975, initially a vignette-based systems has

been introduced in Singapore, however this system has been replaced by a more sophisticated electronic charging system in 1998.[1] It is noteworthy, that Singapore's charging zone is significantly smaller than London's. Further, but technically less complex and substantially smaller, congestion charging systems are operated in three Norwegian cities (Trondheim, Bergen and Oslo), in Australia (Melbourne) and Canada (Toronto).

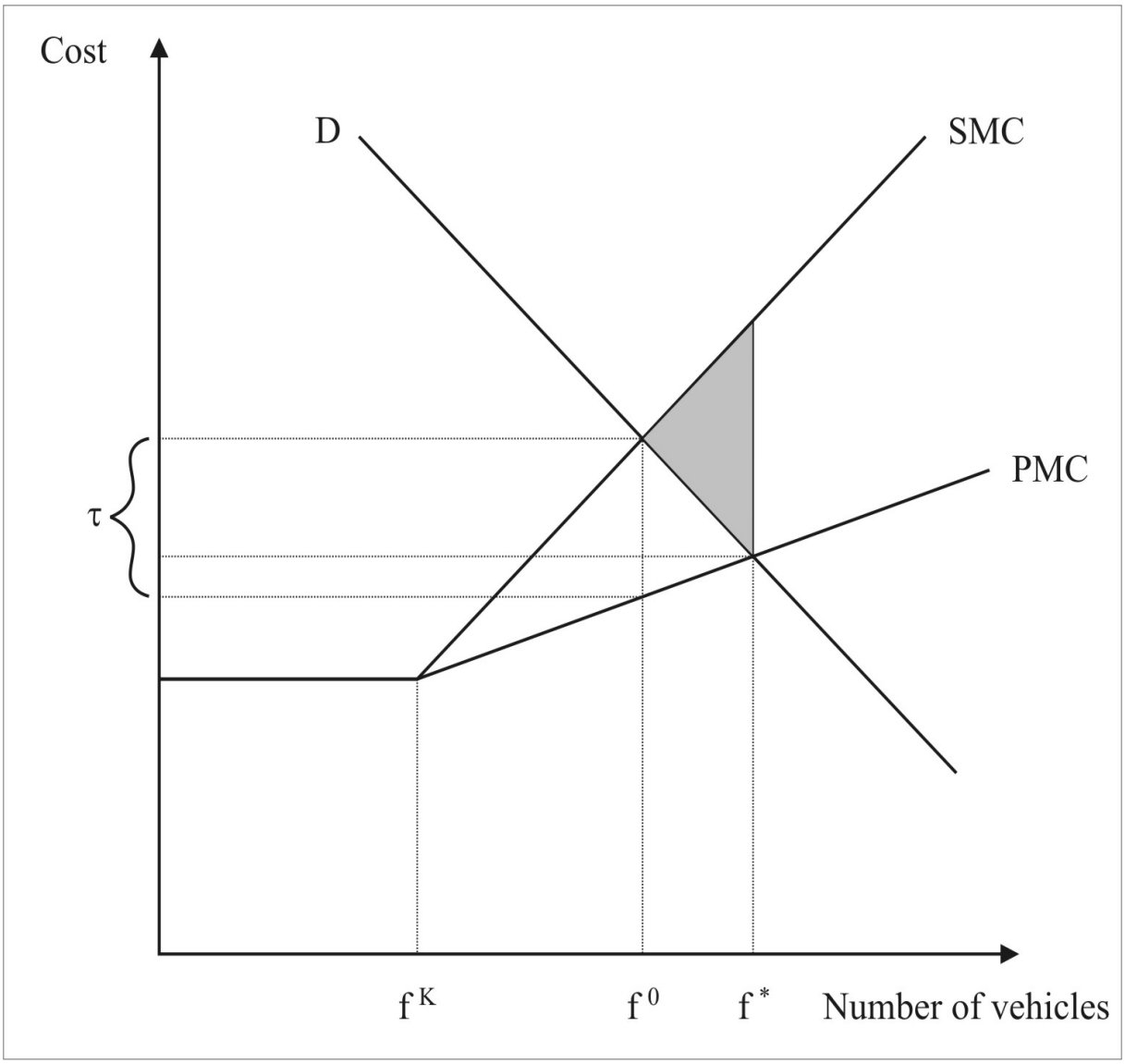
2. The Economics of Congestion Charging

Congestion charging – as well as the more commonly used term road pricing, which shall be considered a synonym in this paper[2] – describes the levying of fees for the use of certain road sections. In essence, road pricing serves as a means to assign the full costs incurred by users when using a specific resource in order to minimise the welfare alleviating misallocation of resources. Ultimately, politicians decide about the level of cost allocation – costs can in principle be fully or partially assigned to respective users. Thus, road charges may on the one hand be used as a means to finance infrastructure. Accordingly, the aim in such a case is that charges shall cover all costs incurred, i.e. all cost for maintenance and extension of infrastructure shall be covered. On the other hand road charges may serve as a means to reduce transport-related environmental damages, thus, negative externalities caused by road users shall by this means be internalised.[3] Furthermore, such charges might be levied in order to regulate or ration road use, e.g. in cases where infrastructural resources are scarce, so that congestion regularly occurs. Underlying aim in such a case is simply to equalise demand and supply. Charges aiming at regulating and/or rationing infrastructure and at assigning the actual cost of congestion to respective users are commonly known as congestion pricing. Thus, congestion pricing essentially represents a special kind of road pricing. The London Congestion Charge dealt with in this article is such a charge as the politicians responsible for its introductions essentially aimed at a sustainable reduction of congestion within Central London and to increase the average travelling speed in that area.

Economically, the phenomenon of congestion can be described such that above a certain volume of traffic any additional vehicle travelling on a certain road or road network imposes additional costs on other users already using the respective infrastructure. Primarily, the additional cost imposed are opportunity costs resulting from the higher time expenditure necessary as any additional vehicle using a certain road or road network will decrease the average speed of vehicles already using that particular stretch of infrastructure. Consequently, congestion

occurs. However, in deciding whether and when to travel users regularly only account for their own private costs, i.e. merely their own necessary time expenditure, fuel costs, parking charges etc. The additional costs imposed upon other users of the respective infrastructure are usually completely ignored as these costs are not imposed upon him. The determination of road charges follows marginal cost considerations as these reflect additional costs, which are incurred as a result of the additional use of the existing infrastructure by a further vehicle. Table 1 belows illustrates this basic principle.

Table 1: The economically optimal road charge



Source: Teubel, U. (2001), p. 38.

The ordinate resembles the costs of infrastructure use while the abscissa shows the number of vehicles using the infrastructure. N represents a typical falling demand curve; consequently, the use of the infrastructure in question decreases with increasing costs of use. In case the number of vehicles simultaneously using the respective infrastructure at a certain point of time exceeds the optimal amount f^K reciprocate obstructions, congestion and traffic jams are the consequence. In such a case private and social costs of an additional journey diverge; thus, social marginal costs (SGK) exceed private marginal costs (PGK).

As aforementioned, if no road pricing scheme exists users will purely incorporate their own private marginal costs when making a decision about a journey; thus, excessive use of infrastructure may occur very often during certain peak times (f*). Economically, too many journey are undertaken; consequently, social welfare losses occur (the grey square illustrates these welfare losses). However, these welfare losses may be avoided if all external costs – in this case all congestion costs incurred – are fully internalised. According to the theoretical ideal case demand will then decrease to the economically optimal level (f^0). Consequently, the average travelling speed will increase. If the existence of an elastic demand curve is assumed, the introduction of a road use charge amounting to τ would be an adequate solution to the problem. Such a charge equals the additional external congestion costs incurred by an additional vehicle using the respective infrastructure.[4]

However, the identification of an optimal charge for parts of or a whole inner-city road network is in practice surely more complicated than suggested by this simple and static model. Economically optimal would be a dynamic adjustment of the charge as its optimal level varies with the actual use of the infrastructure concerned.

3. The London Congestion Charge

For several reasons the City of London outstandingly fulfils some of the crucial preconditions for the successful introduction of a congestion charging system. The capacity of the centre's road network, which has not been greatly extended since the medieval age, is for the lack of space virtually restricted. Furthermore, the extensive use of the infrastructure within the City of London leads to an unusual high susceptibility to congestion. Finally, Central London features an excellent and area-wide public transport system as an alternative.

Central London's congestion charge – supposed to be roughly equal to the average congerstion cost – since July 2005 has amounted to £8 per day (up from the original £5 charge). It is being levied between 7 and 6.30 pm on weekdays within the 21 sq km charging zone – see Table 2 in the Annex –, which is limited by the so-called Inner Ring Road linking Euston Rd., Pentonville Rd., Tower Bridge, Elephant & Castle, Vauxhall Bridge Rd., Park Lane and Maylebone Rd. The Inner Ring Road itself does not belong to the charging zone.

Please Insert Table 2 here

At the moment, a substantial enlargement of the charging zone, the so-called Western Extension, is being prepared by the Mayor of London, due to become effective in 2007.[5]

Please Insert Tables 3 and 4 here

In principle, London's charge thus represents some kind of area licence as the purchaser gains the right to enter and leave the charging zone as often as he desires within a certain time period. The congestion charge has also to be paid in case a vehicle is merely parked at an official road within the zone on a regular charging day, i.e. on all weekdays; weekends and official holidays are exempted.

In addition to the regular tariff weekly, monthly or yearly licences (being valid for 5, 20 or 252 consecutive charging days) may also be obtained at a reduced price. Furthermore, residents living within the charging zone receive a 90 % discount. Some vehicle classes are generally exempted from the congestion charge, e.g. two wheeled vehicles (motorcycles), buses and coaches (featuring more than 9 seats), taxis (if registered in London), vehicles of the fire brigades, NHS (National Health Service) other emergency services and police as well as all vehicles operated by the London boroughs. Generally exempted are furthermore vehicles driven by alternative fuels (gas and electric motors or fuel cells) as well as vehicles of breakdown services and recovery vehicles. Holders of the so-called blue badge, i.e. visually handicapped or disabled people, are also exempted from the charge. All users eligible for one of the

aforementioned exceptions are required to annually register with Transport for London (TfL), which is responsible for levying of the congestion charge, for a registration charge of £10; otherwise these users would forfeit their privileges. The same rules apply for residents of Central London.

The congestion charge may be paid in various ways – most rarely used is postal payment where users have to fill in a form, entering the charge due, and then send the form accompanied by a cheque, their credit or debit card details to TfL. Approx. 1 % of all users use postal payments, which are therefore negligible and are further made up almost entirely of payments by residents when registering for the discount. More popular are payments by credit or debit card via a call centre or a dedicated website (20 and 25 % of all users use these payment methods). Furthermore, the charge may be paid cash, by cheque or by credit or debit card in numerous retail outlets, petrol stations or post offices. This payment method is the most regularly used one – approx. 35 % of all payments are made this way. Finally, charges may also be paid at self-service machines or by mobile phone text messaging (for credit or debit card holders and in case this method of payment has been pre-arranged with TfL). Approx. 19 % use the latter method of payment, which becomes increasingly popular.[6]

More than 700 cameras have so far been installed at the borders and within the charging zone in order to completely collect number plates of vehicles entering the charging zone; their number is to increase substantially with the implementation of the proposed Western Extension. The collected data is stored in a central database and daily matched with data of those persons which have already paid the charge. In case payment arrives after 10 pm an additional charge of £2 has to be paid in order to encourage prepayment and a better planning of users' journeys. In case payment for a vehicle subject to the charge has not been received by 12 pm of the respective day the registered keeper of the vehicle in question is identified by forwarding the number plate data to the *Driver and Vehicle Licensing Agency* (*DVLA*). A fine of £80 will subsequently be imposed upon the registered keeper of the vehicle; however, this fine will be reduced to £40 in case it is settled within two weeks. If the fine will not be paid after 28 days it automatically increases to £120. TfL may even seize or decommission vehicles in case of repeated contempt.[7]

Two months after the introduction of the congestion charging system roughly 4,000 vehicle owners are fined daily whereas this figure has initially been much higher.[8] Today, this figure

decreased to approx. 3,500. However, the number of vehicle owners using forged number plates in order to elude charging increased; however, exact data is not available so far.[9] Finally, most foreign diplomats based in London's Inner City are bluntly refusing to pay the charge.[10]

4. Effects and Assessment

Even before the inauguration of the London congestion charging scheme the modal share of individual transport, usually private cars, of journeys to Central London has been fairly low. Roughly 12 % of the one million people commuting to Central London between 7 and 10 am on weekdays used their private cars. On the contrary, more than 85 % of people travelling to Central London during the same time-frame already used public transport.[11] According to TfL[12] about 60,000 journeys less to or within the charging zone have been daily recorded six months after the introduction of the charging scheme - a figure that has remained stable ever since. If all multiple trips of individual cars are taken into account this approximates 60,000 cars being no longer driven into or through the charging zone per day.[13]

More than half of this reduction is represented by car users which have transferred to public transport; this represents an increase of about two percent in overall public transport passenger levels after the introduction of the charge. A further 15 % to 25 % apply to people switching from private cars to bicycles, motorcycles or often newly established car sharing schemes. The remaining 20-30 % account for journeys that were previously undertaken through a part of the charging zone and now divert around the zone or are made less frequently.[14]

However, it is noteworthy in this respect that the overall number of journeys to or through Central London declined, especially considering journeys by London Underground (according to TfL five to ten percent less passengers were recorded). Major reasons might be several accidents which occurred on the London Underground network in 2003 as well as the declining number of tourists visiting London. Furthermore, according to TfL numerous passengers switched from underground to bus services following a comprehensive reorganisation of London's bus network accompanying the introduction of the congestion charge. Bus patronage was up by more than seven percent in the year ending March 2003.[15] It is likely that this development has been significantly supported by the higher reliability of buses since the introduction of the congestion charge.

In sum, the number of private cars entering the charging zone during charging hours has declined by approx. 30 % – TfL merely assumed a decline of 17 to max 28 % before the inauguration of the charging scheme. Instead, the number of taxis and especially bicycles and motorcycles entering the charging zone increased considerably – by 20 %, 30 % respectively 20 % - and thus significantly more than originally anticipated by TfL.[16] Journeys undertaken by bus and coach increased by 15 % as anticipated by TfL while van and lorry movements have reduced by about 10%; somewhat higher than TfL had expected. Finally, it is noteworthy that bicycle and motorcycle movements during peak times increased substantially. What is more, traffic circulating within the charging zone has declined by approx. 10-15 %.

Furthermore, since introduction of the congestion charging scheme the frequency of traffic congestion within the charging zone declined by approx. 30 %.[17] Accordingly, the average travelling speed within the zone rose by 14 % since the introduction of the charge. It is noteworthy that overall traffic in and around Central London declined even on weekends which are not subject to the congestion charge. A further proof of the successful equalisation of traffic is the fact that overall traffic increased slightly immediately after the end of the charging hours (6.30 pm), however, according to TfL currently no additional congestion exists due to this partial shifting of traffic flows.[18] Furthermore, average travelling speed within the charging zone increased from 14.3 km/h (before introduction of the London congestion charge) to 16.7 km/h in May and June 2003.

The fear that with the introduction of the congestion charge congestion might also more regularly occur on the Inner Ring Road, which limits the charging zone but is exempted from the charge, did also not materialise so far. On the contrary, congestion also decreased on the Inner Ring Road – from on average 1.9 minutes per km to 1.6 minutes per km in June and July 2003. What is more, frequency of reported personal injury accidents also decreased within the charging zone after the charging scheme had been implemented compared to the same period in 2002, however, this development approximately corresponds to the long lasting trend; thus, the influence of congestion charging cannot be exactly quantified.

Before the introduction of the scheme TfL calculated the number of vehicles subject to the congestion charge to average 150,000 daily. However, since the second week after the inauguration of the scheme the actual number of vehicles subject to the charge averages 108,000 without any noteworthy variation. Consequently, the initially aimed net-revenues of £120m

during the first year of operation and approx. £130m thereafter turned out to also be unreachable. TfL now estimates that revenues will average £68m in the first year of operation while revenues shall rise to approx. £80-100m in the medium term.

Nevertheless, the nature of the congestion charge deserves fundamental criticism as the level of the charge is independent from the type of vehicle, traffic volume, route and time of day; thus, the congestion charge is essentially a flat fee. Economically, a differentiated congestion charge makes more sense as the level of the marginal cost is directly influenced by the aforementioned characteristics. However, this gain in efficiency has to be seen alongside the disadvantage of a more in-transparent charging structure.

5. Conclusion and Agenda for Future Research

Our analysis shows that reducing traffic levels (and hence emissions which fell by roughly 15 % on average) in inner cities through road usage charges is feasible. The obvious success of the London scheme with regard to traffic suppression and diversion in the inner city area – though not in the realm of charging revenues – drew other cities' attention to congestion charging even though the system did not fulfil the high expectations in financial respects; e.g. New York City[19] now considers the introduction of a road pricing system of its own.

However, a broad agenda for future research with respect to the wider economic and social effects of road pricing exists. First, relatively few practical examples can be asserted worldwide – which might be due to the usually lacking social and political acceptance of road pricing systems, generally based on the assumption of unfairness in its distributional effects on road users. It would therefore be worthwhile to intensely study psychological and other success criteria for the introduction of a road pricing scheme. Second, the effects on the competitiveness of businesses located inside vis-à-vis their rivals outside the charging zone have been largely ignored so far; instead, simple anecdotal evidence prevails in the pertinent discussion.

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Appendix

Table 2: London Congestion Charge Map

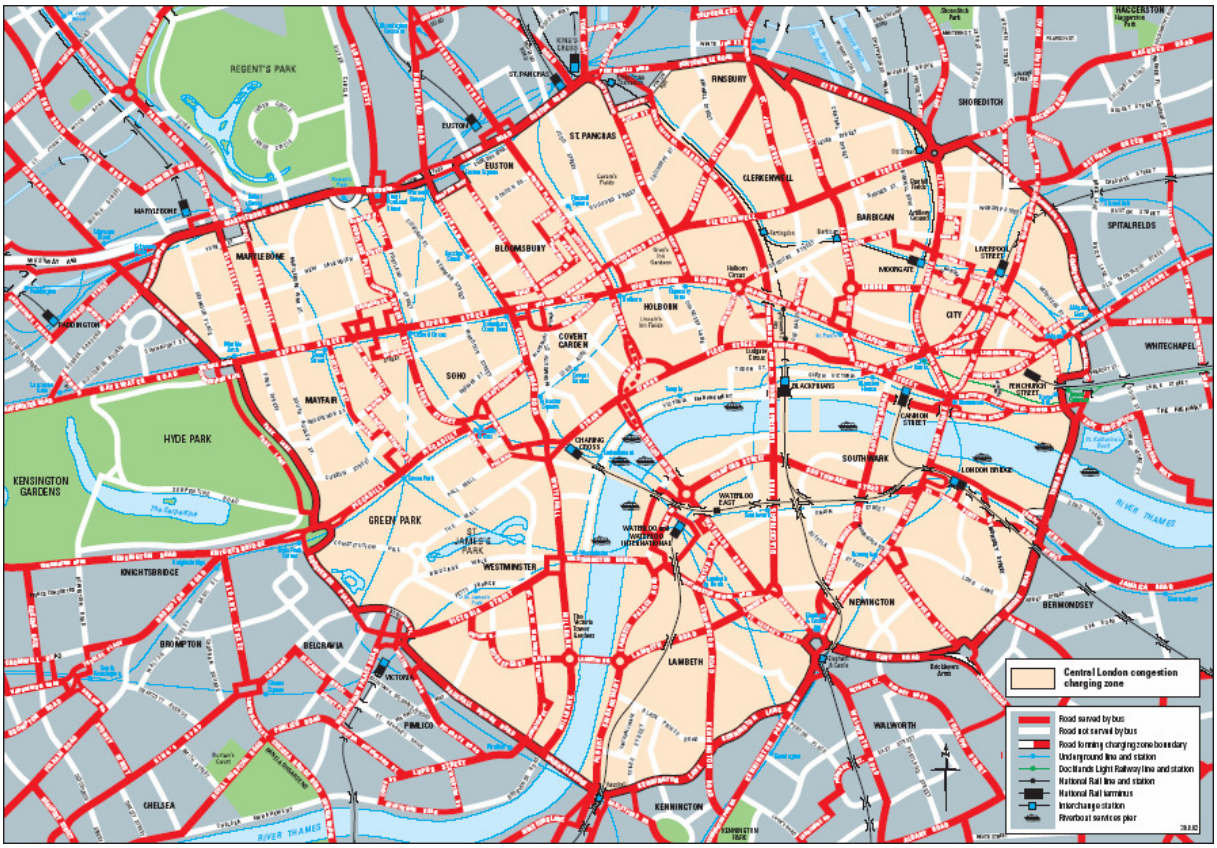

Table 3: London Congestion Charge Map – Proposed Extension (Part I)

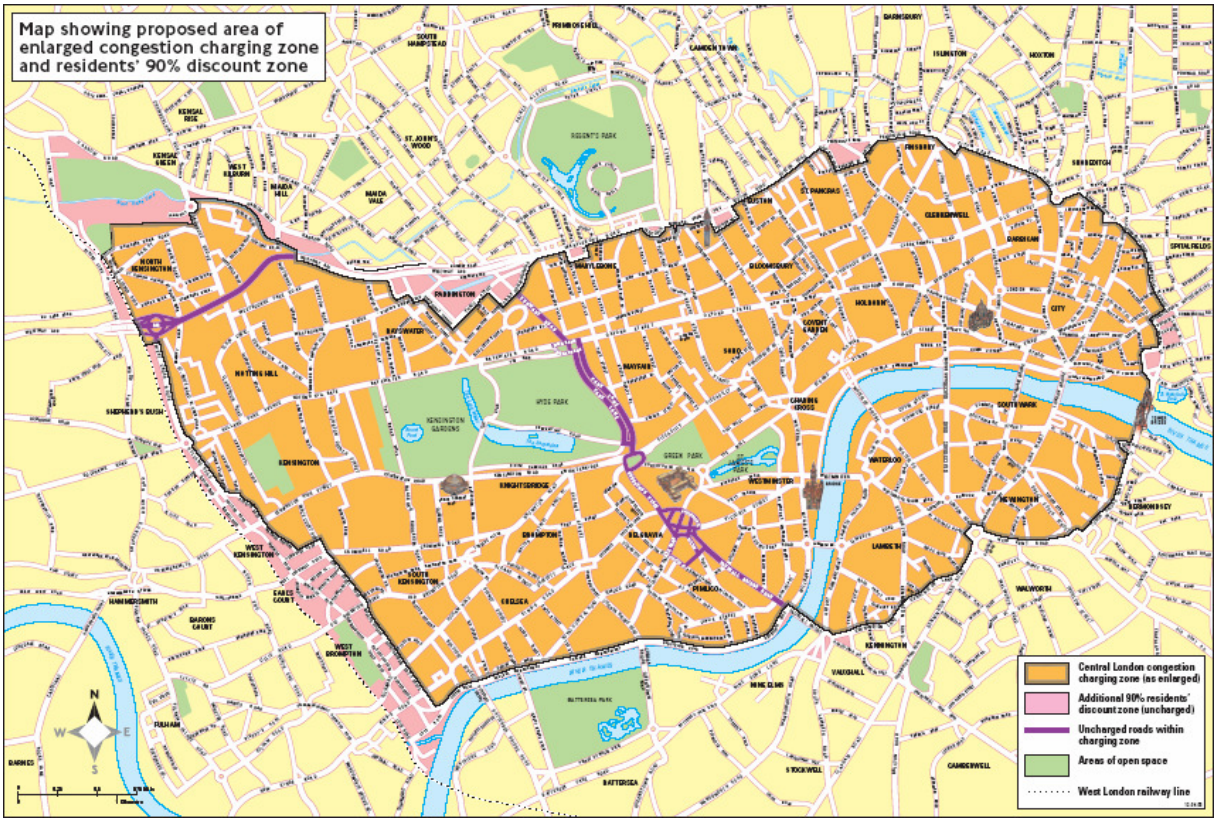

Table 4: London Congestion Charge Map – Proposed Extension (Part II)

[1] See e.g. Keong (2002) and Banister (2003), p. 252.

[2] Strictly speaking road pricing is the more general and congestion charging the more specific term. See section 2 for a more detailed differentiation of the two concepts

[3] See Teubel (2001), p. 28.

[4] See Teubel (2001), p. 38 or Blow/Leicester/Smith (2003), p. 2.

[5] For details see Transport for London (2006a).

[6] See Transport for London (2003), 6.7.

[7] See The Central London Congestion Charging Scheme – The Consolidated Scheme Order, Article 14.

[8] See Litman, T. (2006).

[9] See Esterhazy (2004).

[10] See Schulz (2006), p. 47

[11] See Litman (2006), p. 5.

[12] See Transport for London (2006b).

[13] Ibd, p. 21.

[14] See Transport for London (2003 and 2006b).

[15] See Transport for London (2003 and 2006b).

[16] See Borger (2003) and for the expected effects of the congestion charging scheme also Banister (2003), p. 260.

[17] Traffic congestion is measured in terms of the minutes of delay per kilometre experienced, compared to the travel rate for a journey in uncongested conditions. Transport for London expected a 20-30% reduction in congestion inside the charging zone during charging hours, against typical traffic delays of 2.3 minutes/km, estimated to be representative of conditions before charging was introduced.

[18] See Transport for London (2003), 3.57.

[19] See Wells (2003).