Comments on "The London congestion charge: a tentative economic appraisal" (Prud'homme and Bocajero, 2005)

Charles Raux

Laboratoire d'Economie des Transports (CNRS)
ISH, 14 avenue Berthelot, 69363 Lyon Cedex 07, France
email : charles.raux@let.ish-lyon.cnrs.fr

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Introduction

The paper by Prud'homme and Bocajero joins what has already become a long list of papers that describe or summarize London's "congestion charging" experiment which has been in place since February 2003. However, it breaks with the previous literature most notably by using a model to evaluate the economic efficiency of the scheme. The results show that the benefits (the economic gain resulting from a reduction in congestion) are considerably exceeded by the costs of collecting the toll. Based on the apparent economic "failure" of the London congestion charging scheme, the authors draw a parallel with the Concorde to justify postponing the application of urban road user charging to the distant future. Our comments address the robustness of the results and the extent to which the conclusions are relevant to the future of urban road user charging.

The fact that the authors have published their evaluation model (which we shall refer to as the P&B model) is to their credit as, in accordance with good scientific practice, it allows anybody to check and try out variations in the data. Furthermore, the data in question are available in reports that are published on the website of Transport for London (TfL), which is the body responsible for most transport in London. All this documentation can be found on line, from pages of information targeted at the general public which describe the current situation and projects for the future (for example, the proposal to extend the charging zone) to more technical and detailed data on traffic and speeds, measurement methods, etc. Such transparency is extremely valuable for public debate and very remarkable. It has allowed us to run the P&B model on a spreadsheet implementing the equations given in the appendix to Prud'homme and Bocajero's paper.

The congestion gain is obtained by calculating the area of the trapezium B'B"CA, as shown in Prud'homme and Bocajero's Figure 2 which gives a reasonable approximation of the difference between the integral of the curve of marginal social cost and the integral of the demand curve. We obtained M€65 (per annum) which is slightly below Prud'homme and Bocajero's M€68.

Despite this minor difference between our results and those of Prud'homme and Bocajero, the most striking feature remains that the estimate of benefits from congestion reduction obtained by applying the P&B model is less than one third of that obtained by aggregating the time savings estimated by TfL (preliminary estimates given in TfL, 2003b): we have aggregated TfL's estimate of time savings for occupants of private cars and taxis, and for commercial vehicles; their estimate of benefits resulting from the increase in travel time reliability, and their estimate of increased journey times for car users who transfer to public transport. Another important consideration is that the TfL estimates apparently (see Mackie, 2005) included significant time savings which occur outside the charge zone – these are not accounted for in the P&B model.

The enormous difference in the assumed value of benefits led TfL to conclude that the operation is economically beneficial (with a net gain of M€73) while the P&B model suggests a deficit of similar magnitude. Most of the difference results from the calculation of the gains resulting from the reduction in congestion and our analysis will therefore concentrate on this point.

Sensitivity to measurements of speed

TfL estimates congestion, using a method described in their Impacts Monitoring Report (TfL, 2003a), by comparing observed speeds with a reference speed (31.6km/h) taken during free-flow conditions during the night-time and then calculating the additional minutes per kilometre. The speeds and the average congestion figure were derived from the speeds observed in surveys, weighted by the traffic volumes observed on each road. The calculations also take account of the change in the traffic structure that has occurred since the toll was introduced. Before introduction of the charging scheme, congestion was measured to be 2.3 min/km. The Impacts Monitoring Third Annual Report (TfL, 2005a) states that, after the introduction of the charge, the speed varied in a range between 18.2 km/h and 16.2 km/h (an average value of 17.14 km/h). The Report states that the average annual daily traffic flow was 1440 vkt in 2002 and 1160 vkt in 2004.

Given the range of observed speeds it legitimate to explore the sensitivity of the calculated congestion gain to assumptions about the level of post-charge congestion. If we assume that the post-charge congestion is 18.2 km/h the gain resulting from the reduction in congestion is increased by 35% (relative to that calculated for the average observed speed) whereas, if we assume it to be 16.2 km/h, it is reduced by approximately 40%. These calculations show the extreme sensitivity of the estimate of congestion reduction to variations in speeds before and after charging and highlight the extreme importance of the accuracy of speed measurements.

However, the 35% increase in estimated congestion benefit associated with a 6% change in the assumed speed after charging is not enough to explain the ratio of 1 to 3 that separates the estimations of the gains from congestion reductions in Prud'homme and Bocajero's paper and the TfL report. The other component of the economic calculation of this time saving is obviously the value of time which is employed.

Assumptions about the value of time

It should be stressed that TfL's preliminary estimation of time savings (in TfL, 2003a) included time benefits for travellers outside the charging zone while the P&B estimation method applies only to traffic volume within the charging zone. The last monitoring report (TfL, 2005a) provides no clear evidence of decreased congestion outside the charging zone in 2004 and so we will limit our analyses to changes within the charging zone. In fact we will show that, even without any congestion relief outside the charge zone, the P&B model can show time savings similar to those estimated by TfL.

The value of time used by TfL and in the P&B model is €15.6/h. Prud'homme and Bocajero point out that this is almost twice that applied in the Paris region, namely €8.8/h according to the Boiteux report (CGP, 2001), which is an average value for all modes (in 1998 Euros). However, several factors lead us to conclude that the London value of €15.6/h, far from being excessive, could be responsible for an *underestimation* of the value of the congestion savings in the charge zone.

In France the Boiteux report (CGP, 2001) recommended that values of time should be estimated on the basis of the cost of labour (average 21$€_{1998}$ in the Greater Paris Region), namely 61% of this amount for business trips (i.e. 12.8€), 55% for home-to-work trips (11.6€), 30% for other trips and with an average of 42% for trips of all types (8.8€).

A recent paper on tolls on two Californian freeways (Brownstone and Small, 2005) gives observed values of time in a range of between 50 and 90% of the average labour cost (i.e. an average time value of $20-40 an hour).

As has been stated by Mackie (2005) "the British value for employer's business travel is €31.2/h" and a high proportion of trips in Central London are of this type (40% of car kilometres and 50% of taxi travel are on employers' business). As we have no data on the socioeconomic characteristics of those persons who *continue* to use their cars in the charging zone (if any such data exists) we can only make reasonable hypotheses about this: as the toll operates from Monday to Friday during the day, the proportion of business travel and home-to-work trips is probably higher than that of other trip purposes. Furthermore, this population of motorists is probably made up of persons with much higher than average incomes.

Another factor which encourages higher estimates of congestion reduction gains concerns the increase in reliability that results from the reduction in traffic jams: according to TfL (2004), the proportion of time that drivers spend stopped or in traffic jams has decreased by one third.

The standard behavioural hypothesis is that transport users, whether they use their car or public transport, attempt to minimize their generalized cost of travel by combining the cost of travel time with the cost of late or early arrival. De Palma and Fontan have measured these values for home-to-work trips in the Paris Region (MADDIF survey, 2000), and arrived at €12.96/h for travel time (which is roughly consistent with that given in the Boiteux report), €8.61/h for early arrival and €30.22/h for late arrival, i.e. more than twice the value of travel time. Brownstone and Small (2005) have estimated, in the case of Californian toll motorways, that the value of the reliability of journey time is in the range of 95 to 140% of the median value of time. They conclude that two-thirds of the value of the service provided by a toll motorway in relation to a toll-free motorway is due to journey time and one third to reliability.

We can introduce this improved reliability factor indirectly to the P&B model by increasing the value of travel time. It follows from the foregoing considerations concerning the value of time and the value of reliability that it is not unreasonable to consider average values of time that are considerably higher than those used by TfL and by Prud'homme and Bocajero, in a range of between €20-40. We have tested a range of values of time and find that, as expected, congestion reduction benefits increase in proportion to the increase in the value of time. They begin to match scheme costs when the value of time reaches €27 (at this point they are 124% higher than Prud'homme and Bocajero's initial calculation) and, with a value of time of €35, the congestion reduction benefit triples and so reaches the TfL estimate.

Assumptions about costs of toll collection

The London congestion charging scheme uses a system of cameras with number plate recognition. This results in high running costs and has prompted consideration of alternative technologies for possible future implementation (TfL, 2005b). Other technical solutions have been adopted elsewhere in the world and have been operational for a number of years. Several employ vehicle-borne electronic equipment in subscribers' vehicles but allow for "manual" charging of non-equipped vehicles.

Although the objectives of the charging schemes differ (most being designed to maximise revenue rather than, as in London, to influence demand), and although this influences the technical requirements, we think that it is worth exploring the implications that adoption of a cheaper technology might have for the estimation of net benefits of the London scheme. We have tested the consequences of implementing a charging system, similar to Oslo's and, using reasonable assumptions, conclude that positive net benefits can be expected even for tolls which are very much lower than those currently applied in London (see table 1).

Table 1: Simulation of the different levels of toll with a more rustic technology

	Current toll	Simulated	Simulated	Simulated	Simulated	Simulated
Toll (€ / vkt) [1]	0.56	0.10	0.20	0.30	0.40	0.50
Traffic (1000 vkt) [2]	1160	1352	1312	1271	1229	1186
Reduction / before charging	-17%	-3%	-6%	-9%	-12%	-15%
In thousand Euros per day:						
Congestion reduction	257	63	118	166	207	240
Total benefits	**401**[3]	**63**	**118**	**166**	**207**	**240**
Fixed collection costs[4]		20	20	20	20	20
Variable collection costs[4]		14	26	38	49	59
Total collection costs	689	34	46	58	69	79
Bus subsidies	18	18	18	18	18	18
Total costs	**707**	**65**	**90**	**114**	**136**	**157**
Net daily benefit	**-306**	**-2**	**28**	**52**	**70**	**83**
Net annual benefit	-78 080	-541	7 061	13 186	17 901	21 268
Yield of toll	650	135	262	381	492	593

Notes:

1 Calculated by dividing revenue by traffic (it would be necessary to know the distances covered by vehicles in order to transform these toll values into daily toll fees).

2 Behavioural response estimated using the P&B model

3 Including the increase in bus speed (k€124) and environmental benefits (k€20).

4 The costs are based on that of the Oslo system (CERTU et al, 2002) which handles twice the number of vehicles per day as does the London system, adopting Prud'homme and Bocajero's assumption of a 5% opportunity rate of return on capital costs and a 10% annual depreciation rate.

Conclusion

We have shown the high sensitivity of results to measured speeds before and after charging, thus highlighting the importance of the accuracy of speed measurements in any economic assessment of the gains that can be anticipated from congestion charging.

We have argued that, it is reasonable to apply significantly higher values of time for motorists using the charging zone than are normally used in the UK, let alone in Paris, and that adoption of such values would allow the London Scheme to show a positive benefit in the P&B model. We note that more accurate estimates of the values of time, and of the value of reliability, are required.

We accept that the high cost method of collecting revenues currently being used in London is detracting from the net economic benefits of the London scheme but have established that, using a technology with costs similar to that being used in Oslo, positive net benefits could be achieved even at very much lower levels of toll.

We conclude that it would be wrong to use the results of Prud'homme and Bocajero to justify indefinite postponement of the implementation of congestion charging in other conurbations.

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