Abstract:

Would Stockholm congestion charges have worked elsewhere?

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Introduction

Although congestion has successively become a larger and more widespread problem, the implementation of congestion charging policies has been held back by lack of public and political acceptance (Jones, 2003; Schade and Schlag, 2003). Policies are more likely to be accepted if they are expected to be effective (Bartley, 1995). We know from a number of studies (e.g. Schlag and Schade, 2000; Thorpe et al., 2000; Jones, 2003), that the public generally does not trust charges to be an effective tool for combatting congestion, and we can therefore assume that such distrust is at least part of the explanation to why congestion charging has only rarely been implemented.

When London, in 2003, and Stockholm in 2006 (trial) and 2007 (permanent system) implemented congestion charging convincing results became available, showing that at least in those cases congestion charging could, indeed, contribute to congestion reduction (Transport for London, 2003; Congestion Charge secretariat, 2006). If the experiences from London and Stockholm were transferrable this could therefore help to increase acceptance to congestion charges in other cities. To explore the transferability of the results from the Stockholm congestion charging experiences is also the main objective of this paper.

The authors of this paper have personal experiences from several occasions where we have presented the results from the Stockholm scheme, and met the reaction in line with: yes it may work in Stockholm but it would never have worked in my city, often with reference to differences between the cities with respect to public transport provision and attractiveness, or availability of by- and through- passes in the road network. Attard and Enoch (2011) also reports about similar reactions from the process of implementing charges in Valetta: "…that Valletta cannot be compared to London or Stockholm simply because it is too small".

People in other cities may have reasons to questions the effectiveness and efficiency of charges in their cities, although charges have proved to work well in both London and Stockholm? Transport system behavior is a complex function of detailed properties of land use and networks. A key question is therefore to what extent the effectiveness and efficiency of the congestion charging system in Stockholm rely on the specific features of the land use and transport systems in Stockholm? Or, in other words, is it likely that the Stockholm scheme would be equally successful in other transport systems? To explore these questions we examine the relationship between some specific features of the Stockholm transport system and the effects and efficiency of the congestion charging scheme. We do that by assessing the effects that the same scheme would have had in transport systems with different design and properties and compared to Stockholm.

Method

We apply the national transport model to forecast responses from introduction of congestion charges, keeping the current land use pattern but adding modifications in input data that change the availability of transport alternatives and the overall availability of capacity in the road system. The national transport model includes all travel modes and was able to predict the reduction in traffic flows sufficiently enough for the design and implementation processes Eliasson et al (2012).

We design six different scenarios in addition to a reference scenario (the current Stockholm system) by modifying the transport system of Stockholm, each including a baseline situation (without charging) and a charging situation (with charging). These modifications affect either the capacity of the charged links or the alternatives to use the charged links: the public transport system or the complimentary links in the road network. In all six scenarios, the same charging system is implemented, with identical charges and check point locations. The impact of the congestion charges are compared between the scenarios with respect the following output indicators:

- Baseline conditions:
  - Demand, charged system
  - Congestion (measured as relative travel time delay)
- Effects of charging:
  - Volume reduction (in the charged system)
  - Share of trips switching to public transport
  - Reduction of travel time for traveler staying on the road
  - Total benefits

To interpret the output for indicators and to introduce some useful concepts, we first analyze the corresponding changes of the traffic system in the theoretical bench-mark one-market supply- and demand model.

Results

The general hypotheses generated by the standard one-market model are confirmed with respect to initial demand and congestion level. In the scenario where the capacity over the cordon doubled, initial demand is increased and congestion is decreased. The other scenarios show that when the uncharged transport system is improved the initial demand for the charged links and the congestion levels on these decreases (and vice versa). Improvements (and deteriorations) of car alternatives have much larger effect on initial demand and congestion levels than improvements (and deteriorations) in the standard, capacity or availability of the public transport supply.

The standard one-market model suggests that increased capacity implies a larger effect on traffic volume in response to congestion charges and this is confirmed in the more complex model. The scenarios having improved or deteriorated public transport give about the same volume reduction as the reference scenario. Hence, the size of the demand effect in response to congestion charges is not very dependent on the quality of the public transport system. What stands out though is that a much larger proportion of drivers would be priced of the charged links if there were better options available for rerouting than in the reference scenario (but the effect of reduced rerouting opptions are much smaller).

Regarding the travel time reductions due to congestion charges, the hypotheses generated by the standard one-market model are confirmed. The ranking of scenarios with respect to initial congestion level is identical to the ranking of scenarios with respect to travel time benefits generated from charging for travelers staying on the road. The scenarios in which route choice alternatives are improved or deteriorated both have large consequences for the travel time reduction (in opposite directions). Aggregated travel time reductions vary with more than a factor ten between the two. Travel time reductions for the other scenarios, including modification in the public transport system, vary much less from the reference scenario because initial congestion levels vary less.

Neglecting costs of the system and other externalities than delay, the overall social benefit generated by the charging scheme can be represented by the difference between the positive effects the system has on travel times for traveler staying on the road and the negative consequences it has for those that switch to less favorable travel options (adaptation costs).

The analysis shows that the ranking of scenarios with respect to the travel time benefits for traffic staying on the road is the same as the ranking of the scenarios with respect to overall social benefit. The adaptation cost is thus similar across scenarios, largely because the differences in adaptation costs between the scenarios are relatively small. The latter is expected from the one-market model as long as the demand elasticity does not change. The adaptation cost is also highest in the scenario with the most elastic demand (where the bypass is added to the system). The adaptation cost is not very affected by the attractiveness of the public transport system, as opposed to what is usually argued.

There are three main conclusions. First, the most important feature of a traffic system implying a high social benefit is high initial congestion level. Second, the standard, capacity or availability of the public transport supply, is not crucial for archiving large demand effects from charging or small adaptation cost for travelers priced of the road. This is mainly because the cross-elasticity between car and public transport is limited and because there are many ways in which travelers may to adapt. Third, the possibility to reroute in the road network to avoid charging increases the demand effect considerably in some cases but not in all. In summary, our results confirm that there are properties of the complex multi-market interaction that is represented in our transport model that cannot be captured by the standard one-market demand-and-supply representation. Never the less, the overall picture given by the standard one-market model, concerning the type and direction of the effects, seem to be relevant also in large-scale real-world transport systems.