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Not invented here: Transferability of congestion charges effects

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ABSTRACT

The purpose of this paper is to explore to what extent the effects of congestion charges rely on specific features of a city and its transport system. We use Stockholm, and its current congestion charging scheme, as a case study by making various modifications in the transport system influencing the availability and attractiveness of public transport, bypasses and bottleneck capacities. We use a transport model to forecast the effects of the Stockholm charges given each transport system modification. Our main conclusion is that although the social benefit of a given charging system is considerably and non-linearly dependent on initial congestion levels, traffic effects and adaptations costs are surprisingly stable across transport system modifications. Specifically, the level of public transport provision has only small effects on baseline congestion, and therefore on the total benefit of the charges. Contrary to expectation, the charges' effect on traffic volumes remains virtually unchanged regardless of the changes in public transport supply. All results are compared to and consistent with the one-market standard model. We interpret our results with respect to common arguments against the transferability of experiences from cities having introduced congestion charges.

1. Introduction

Although congestion charging has been considered to be an efficient remedy to congestion problems for decades (Vickrey, 1973), implementation has been held back by lack of public and political support (Jones, 2003; Schade and Schlag, 2003). Several authors have noted that a main reason for this skepticism is the belief that they will not "work" (Bartley, 1995; Börjesson et al., 2012; Eliasson and Jonsson, 2011; Eliasson, 2008; Jones, 2003; Schlag and Schade, 2000). In the words of Jones (2003): "The public not only dislikes charges, it thinks it will not be effective".

Indeed, the authors of this paper can verify this. Having presented the experiences from Stockholm and other cities with congestion pricing to audiences from all over the world, we can testify that a common response is "*congestion pricing may be effective in Stockholm/London/Singapore/… – but it doesn't suit our city*, *because [we don't have a ring road]/[our public transport system is not good enough]/[traffic would just change routes]/[we simply need more road capacity]/…*" or other similar arguments. Attard and Enoch (2011) report similar reactions for Valetta, Malta: "… Valletta cannot be compared to London or Stockholm simply because it is too small".

The Stockholm congestion charging system, consisting of a time-varying toll at the bottlenecks on the arterials to the inner city, turned out to reduce congestion efficiently. Traffic across the cordon was reduced by about 21%, and the effects have remained stable since it was first introduced in 2006 (Börjesson et al., 2012). As a result, travel times have decreased dramatically, especially on the arterials but also in the inner city (Eliasson, 2008). London experienced similar effects (Leape, 2006; Santos and Shaffer, 2004). If the experiences from London and Stockholm are found to be transferrable between transport systems, this may help to increase the general support in other cities and to meet arguments such as those exemplified above. The main objective of this paper is to explore the transferability of the traffic effects of the Stockholm congestion charges.

Understanding the transferability of the effects of congestion pricing is essential, because acceptance tend to increase if the charges are expected to have substantial traffic effects (Eliasson, 2008; Börjesson et al. 2012; Bartley, 1995), while the public generally does not trust charges to be an effective tool for combating congestion. Such distrust is therefore at least part of the explanation to why congestion charging has only rarely been implemented.

We examine whether the effects experienced in Stockholm hinge upon particular features of the city, investigating to what extent the effectiveness and efficiency of the Stockholm charges rely on specific features of the Stockholm transport system. We focus on the most common arguments used to question the

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transferability of the Stockholm experiences, such as *we do not have such an efficient and extensive public transport system as Stockholm* or *if we had better public transport we would not need congestion pricing*; *we do not have a bypass like Stockholm has* or *if we had more bypasses we would not need congestion pricing*; *if we had more road capacity, we would not need congestion pricing*. The present study is designed to specifically explore these arguments and to what extent they can be rejected or supported.

To this end, we use a transport model to forecast the effects of the Stockholm charges given transport system scenarios. The scenarios are constructed by making various modifications of the road and public transport systems, such as those indicated above: availability and attractiveness of public transport, bypasses and bottleneck capacities. The transport model we use was able to predict the traffic reduction when the charges were first introduced (Eliasson et al., 2013), which suggests that the model will also be able to predict what would happen assuming these various modifications on the transport system.

We find that traffic reductions and adaptation strategies to a large extent are transferable between different transport systems, but that travel time reductions, and therefore welfare benefits, depend considerably and non-linearly on initial congestion levels. However, even if these results do suggest a high transferability of congestion charging, design variables such as charge levels, time differentiation, checkpoint locations, exemptions etc., must be based on local characteristics (Eliasson, 2010). Dolowitz and Marsh (2000) point out that inappropriate policy transfer (with insufficient attention being paid to differences between policy contexts) is a strong risk factor in policy transfer.

Policy transfer and policy diffusion have become an increasingly more important part of policy formation both in general (Dolowitz and Marsh, 2000) and for transport policy in particular (Marsden and Stead, 2011; Timms, 2011). For the specific case of congestion charging policies, there is evidence of an increasing interest to learn from the lessons of others, and investigate the transferability of policies (Attard and Enoch, 2011; Marsden and Stead, 2011; Richardson and Bae, 2008).

Assuming that policy transfer and diffusion are real and plays a role, the successful implementation of congestion charging in London and Stockholm would be expected to wither the distrust in the effectiveness of this policy measure. And congestion charging would have been expected to be implemented in many other cities with congestion problems. And indeed, the implementation of congestion charging has increased in later years, and the London and Stockholm experiences seem to have played a role for other cities considering congestion charges (Marsden et al., 2010; Attard and Enoch, 2011). But a number of cities have still declined concrete congestion charging proposals at different stages of decision making, for example Edinburgh, Manchester, Helsinki and Copenhagen. In all those cases lack of public acceptance has been a key factor for why the proposals failed. Hence, it seems that many people in cities around Europe still are not convinced that congestion charging would be an efficient way to combat congestion.

The paper is outlined as follows. In Section 2 we describe the Stockholm congestion charging system and the main effects on the transport system. In Section 3 we describe how and motivate why the present transport system are modified in the scenarios. Section 4 uses the static one-link model to develop hypothesis on how the most relevant baseline conditions and effects of the charges will differ between scenarios. Section 5 describes the transport model and how output indicators are computed from the model output. Section 6 reports the results and Section 7 concludes.

2. The Stockholm congestion charges

The Stockholm congestion charging system consists of a toll cordon, with charging points located at or near the main bottlenecks on the arterials leading into the inner city. The City of Stockholm has around 0.8 million inhabitants, and is the central part of the Stockholm county, with a total of 2 million inhabitants. Out of the almost 300,000 inhabitants within the toll cordon, approximately 60,000 commute to workplaces outside of the zone. The area within the cordon has close to 23,000 workplaces, employing approximately 318,000 persons, of which more than two-thirds are commuting from outside the zone. Before the introduction of the charges the volumes across the cordon was a little less than 500,000 vehicles per day.

Stockholm has an extensive public transport system, including the Metro, commuting trains, trams and buses running to and from the inner city. The share of public transport trips to and from the inner city reaches 75% during peak hours, and the Metro takes 57% of these. Central Stockholm is built on several islands connected by bridges, which means that traveling distances are relatively long and road congestion spreading out from the bottlenecks around the inner city is high.

The cost[1] of passing the cordon in any direction on weekdays is €2 during peak hours (7:30–8:30, 16:00–17:30), €1.5 during the shoulders of the peaks (30 min before and after peak period) and €1 during the rest of the period 6.30–18.30.[2] The charge is levied in both directions. The Essinge bypass (E4/E20) is the only free-of-charge passage between the north and south part of the county. It is also the most important bottleneck in the system that remains uncharged. It was heavily congested before the charges were introduced and the charges did not affect the level of congestion to any great extent (Börjesson et al., 2012). However, politicians have regarded it as essential for public acceptance that there is a non-charged connection between the southern and northern parts of the county.

When the charges were introduced in 2006, traffic across the cordon decreased over 20% (average over the charged period), meaning that traffic was down to levels not seen since the 1970's, reducing queuing times by 30–50%. On some links and routes, the effects were even larger. Despite this, circumferential traffic (including the Essinge bypass) did not increase. Around half of the diverted car drivers changed to public transport. Still, crowding did not increase appreciably since this only increased public transport volumes by a few per cent (in rush hours, PT volumes are almost three times larger than car volumes across the cordon).

The traffic effects were relatively close to the forecast effects from the national transport model Sampers (see Section 5), in the sense that effects were predicted well enough to allow planners to draw correct conclusions regarding the design and preparations for the scheme (Eliasson et al., 2013). Still, the predicted response to the charges was so large that several experts considered the forecasts unrealistic. As it turned out, however, the model gave much more accurate predictions than experts′ judgments, in addition to providing more detail and consistency. The skepticism towards the predictions was understandable: the introduction of

[1] We have converted SEK to Euro using a conversion rate of 10 SEK/€.

[2] Recent model simulations suggest that increasing the charge in rush hours would improve social surplus. In other words, the current charge seems to be below the marginal external cost, considering the macroscopic relation between traffic flow across the cordon and congestion in and around the inner city. The optimal rush hour charge (yielding maximal social surplus) seems to be in the range 3–4€. These results are uncertain because of the difficulties to integrate demand models with the dynamic traffic assignment models needed to capture congestion accurately, but they were part of the motivation of politicians to decide to increase rush-hour charges in 2016.