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Road pricing and public transport pricing reform in Paris: Complements or substitutes?☆

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ABSTRACT

This paper explores reforms of pricing of private and public transport in Paris. Paris has used a policy of very low public transport prices and no road pricing. The Paris transport network is represented as a stylized concentric city with the choice between car, rapid rail, metro and buses as well as two income classes and different transport motives. The model is used to test what the efficiency gains are of introducing road pricing and of increasing public transit prices in the peak. Are both reforms re-enforcing each other or are they largely substitutes? We find that a zonal pricing scheme for the center of Paris combined with higher public transport fares in the peak perform best. The benefits of an overall capacity extension of public transport supply are much lower than the benefits of pricing reforms and could very well not pass the cost benefit test.

1. Introduction

The aim of this paper is to get a better understanding of the impacts of pricing reforms on the Paris transportation network. Paris has, like many metropolitan areas, implemented a policy with no road pricing and very low public transport prices. The road network within the Paris region is severely congested and the public transportation network is operating at the limit of its capacity. There exist two solutions exist to solve congestion problems: either increase the capacity of the network or adapt the pricing of the infrastructure to achieve a more efficient use. In this paper we mainly consider pricing reforms.

London and Stockholm have shown that road pricing is feasible not only technically but also politically in large metropolitan areas and that it can generate net positive welfare effects. The full impact of pricing reforms in large areas requires sophisticated and detailed modeling work. It is not within the scope of this paper to give a detailed account of all effects but rather to give a flavor of the possible consequences of different pricing reforms.

We represent the Paris transport problem as a simplified network, exploiting the concentric symmetry in Paris. Four types of households (poor/rich and working/not working) live either in the center of Paris (Paris or P), in the inner ring ("Petite Couronne" or "PC"), in the outer ring ("Grande Couronne" or "GC") or outside the Grande Couronne. Each household makes trips either inside the zone it lives in or to other zones. To make these trips, it combines different modes (car, bus, metro, RER) as a function of the generalized cost of this mode or combination of modes. The generalized cost includes all monetary costs and includes congestion and comfort elements. Production prices are taken as constant. The model is implemented using the MOLINO II model (de Palma et al., 2010) and calibrated to the 2007 equilibrium.

Among the major results, this research confirms the positive economic impact of pricing. If the strategy is to accommodate additional public transport travelers partly by expanding supply, it is important to also increase public transport fares in the peak period because a supply extension is a genuine cost to society. So, the introduction of road pricing and higher public transport fares in the peak are complements in addressing inefficiencies in the transport sector. Second, we find that, overall; the low-income earners are not necessarily worse off and this for a variety of reasons, including their more intensive bus use. Third, a simple general increase in the public transport capacity does not pass the cost benefit test in our model.

We start the paper with a brief literature review. The third section discusses the stylized model of Paris that will be used. The

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fourth section presents the reference equilibrium with unchanged pricing and capacity. The fifth section discusses the results of alternative pricing scenarios. The last section concludes with some caveats.

2. Literature review

There exists a large literature on the pricing of urban transport. We distinguish two types of complementary approaches: the tax reform literature and the more specific transport pricing literature.

Revising transport pricing can be considered as a small tax reform with efficiency and distribution effects on different types of households. More specifically, one can rely on the Guesnerie (1977) and Ahmad and Stern (1984) approach, further refined to transportation issues by Mayeres and Proost (2001), Parry and Bento (2001, 2002), Van Dender (2003) and Calthrop et al. (2010). The main idea is to start with the government budget equation. Any change in a tax, toll or subsidy needs to be compensated by an equivalent change in another tax, toll or subsidy. So, only revenue-neutral tax reforms are considered. The full welfare effect of each pair of taxes, toll or subsidy reforms is measured for each type of household and this allows studying the efficiency effects as well as the distribution effects of a tax reform. Once the different agents are informed about the effects, this can serve as input for an analysis of the political acceptability. The three main advantages of this more global tax reform approach are first that the equity effect can be measured. Second, this approach can take into account existing tax distortions outside the transport sector (say on labor or public transport) and this is an important consideration when one decides on the use of the additional tax revenues or on the way to finance the subsidy. Third, as there is a complete evaluation of the change of utility per individual, it is an important input into the political process. The main drawback of this more general approach is usually the lack of detail in the modeling of the effects inside the transport sector.

In the second approach, one focuses on the private or urban transport sector, assuming mostly that the rest of the economy is operated efficiently, there are no other taxes and there are no income distribution issues. Lindsey (2012) reviews the many contributions to the theory of road pricing and the associated investment questions. Most analysis of transport pricing has focused on the efficiency of reforming road transport in urban areas where congestion and air pollution are most acute. Before Singapore, London, Stockholm and Milan demonstrated the feasibility of road pricing, most urban areas relied on a policy of low prices for public transit to relieve car congestion. Public transport capacity was extended in many cities and heavily subsidized in order to attract car drivers. Parry and Small (2009) examine the optimal second best public transport fares for large metropolitan areas (London, Washington DC, Los Angeles). They find that subsidies that cover up to 90% of the operating cost are justified when road pricing cannot be introduced and if the low public transport prices attract many car users. For the peak period, the main justification for the additional subsidy lies in the substitution of congested car trips. For the off-peak period, the justification lies mainly in the scale economies (available seats in existing buses or rail). Proost and Van Dender (2008) find similar results for Brussels.

A crucial assumption in the justification of the subsidies in the peak period is that car use is priced below the marginal social cost. Once road pricing corrects the use of peak car transport, public transport pricing can also implement marginal social cost pricing. There is no unanimity in the literature on whether this implies higher or lower transport prices. Kraus (2012) reviews the literature on how to move from second best pricing of public transit to first best pricing. He distinguishes between papers that jointly optimize pricing and frequency of service and papers that only reform public transport pricing. Kraus uses a bottleneck model for cars and transit to compare first and second best optimum fares and frequencies. The main result is that the introduction of road pricing that corrects for the environmental externality and the queuing externality on the road implies higher public transport prices and smaller frequencies for public transport than in the second best optimum without road pricing.

There have been several studies on road pricing in Paris. Marin (2003) has studied alternative pricing schemes for a possible private road network consisting of a certain number of ring roads and access roads. The analysis is based on simulation to assess the impact of new infrastructure (an automated highway) on traffic flows by year 2020. The author finds that urban form becomes more compact (activity relocation around dense areas) and this leads to a reduction in average travel distances. Bureau and Glachant (2008) considered different types of tolling systems combined with different ways of using the revenues. They were mainly interested in the distributional impact. They find that road pricing is regressive (without revenue distribution, it decreases the welfare for poor and rich but its impact, measured as percentage of the revenue, on the poor is higher). If absolute values are considered, the impact for the low-income group is better. The authors use a simple econometric model and authors recognize this also as the major weakness of their approach. Compared to Bureau and Glachant (2008), we focus less on the distributional impact, but we also include the pricing, congestion and costs of public transport supply. De Palma and Lindsey (2006) used the dynamic METROPOLIS model to study the optimal pricing of the morning peak. This analysis uses the bottleneck model where users choose their departure times as well as an elaborate network model. This allows them to analyze the effects of different tolling strategies and perform a more realistic simulation of the reaction of traffic flows. The authors consider three types of tolls: time independent toll on selected links, time varying cordon toll and network-wide toll proportional to travel time. The main finding is that, on the basis of welfare impact, this last pricing scheme dominates the other two. Compared to de Palma and Lindsey (2006), who focus primarily on the road network, we consider a less detailed road network but pay more attention to the public transport network. Finally, there are the papers of Prud'homme et al. (2012) who studied the congestion in the Paris subway and Prud'homme et al. (2011) who studied the costs and benefits of replacing a bus line by a tramway in 2006. For the tramway, one had to reduce the capacity of one of the parallels to the ringroad. A survey on a population of 1000 users revealed that the main modal switch was between metro and bus to tramway and not from car to public transport. As one reduced the capacity of the ringroad, road congestion got worse so that the main benefits were a reduction of crowding in public transport. Overall, the tramway project produced negative net benefits. Compared to the latter two studies, we use a more macroscopic approach and also focus on the pricing of road transport.

3. The simulation model

For the simulation of the different pricing policies we use the MOLINO model (de Palma et al., 2010). MOLINO is research software that can be used to evaluate the effects of a pricing or investment policy for an arbitrary transport network. The locations of residents and firms, schools and shops (the Origins and Destinations "OD" of the network) are, however, kept fixed.

The network is defined by several ODs which are connected by a set of links. Each link has a certain capacity and has an associated speed-flow relation that is a function of the ratio of the number of