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Are users better-off with new transit lines?

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ABSTRACT

This paper studies the entry of a new competitor in a public transport network. Competitors for existing rail can be long distance buses but also the vanpool services. These new lines decrease the ridership of the existing lines and increase waiting time for its passengers. A stylized network model is used to study this potential *vicious cycle*. We derive sufficient conditions for this negative effect to increase overall public transport costs. The new line is only beneficial when there are relatively many users that want to use the new direct line or when the unit cost reduction is sufficiently large. Our result raises concerns with respect to the decentralized management of transit systems.

1. Introduction

Over the last 20 years, several countries have deregulated and liberalized the entry of new public transport suppliers. In the EU, there is free entry for the international rail routes. In some countries there is also free entry for domestic rail lines (cf. Nash, 2015). In public transport one can organize competition for the market by an auction process or competition in the market by allowing competitors to add a competing service for the same customers. We are discussing here the addition of a new line that competes for part of the existing customers. Setting up a new public transport line is easier for non-urban bus services. Following the UK example (1980), there was a deregulation of bus services in Sweden (1997), Norway (2003) and more recently Germany (2013) as well as France (2015).[1] Typically, bus companies open a new direct line between two cities that were previously connected by an indirect or expensive rail service. The new line did attract some passengers from the existing public transport network but it is not clear whether travel costs for all passengers of public transport decreased.

Engineers and economists have studied situations where adding a new road link may decrease social welfare.[2] This may only occur in the presence of unpriced congestion (or at least if congestion is not priced at the first best). As we will see, this may also occur in the public transport context considered here. In this case the externality is the waiting time externality. We will study here the potentially negative consequences of changing the network (by adding a new service) or changing market

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[1] For a review of the bus regulation in Europe see Van de Velde (2015). de Palma et al. (2011) survey competition and regulation of transportation activities for different modes.

[2] This is sometime referred to as the Braess paradox, in the context of private transportation (cf. Steinberg and Zangwill, 1983).

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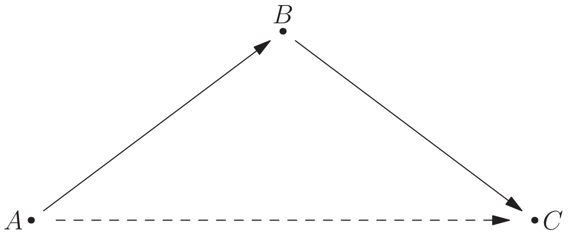

Fig. 1. The existing transit system AB, BC and the new entry AC – this setting is referred to as $\mathcal{T}$.

organization (with the divestiture of two operators) in a public transport system. Often, when some new infrastructure is built, there are winners and losers (those may be compensated). We will use the term "destructive change" to refer to this extreme case where, after the change (of infrastructure or in organization) losses outweigh the gains (social welfare decreases). In this case, losers cannot be compensated.

Our paper can be relevant to understand the impact of new services such as public transport on demand (e.g. Google-Transit or Bridj). These new services can potentially deteriorate the quality of the existing public transport network by inducing lower frequencies. The reverse problem may also arise when public transport network has become too dense. In this case, eliminating some links may decrease the total system cost.

We focus on the simplest setup of public transport links. Take any two public transport links that are connected (AB, BC) where part of the passengers also travel from A to C (see Fig. 1 for illustration). We will show that adding a direct service from A to C can increase or decrease the total travel costs when the direct service is not managed by the same operator as the two connected lines. The two main effects are the negative impact derived from less passengers on an existing line as well as the effect of competition for part of the passengers on the operation costs of the existing and new line. The positive externality associated with a more frequent bus or rail service when the number of passengers increases is attributed to Mohring (1972). One of Mohring's best known finding is that minimizing the sum of travel costs and bus operating costs, in a regime with frequent service, implies that the optimal frequency of service increases with the square root of the number of passengers.[3] As waiting time is a component of the travel costs, an increase in the number of passengers will in general decrease waiting costs and travel costs: there is a positive externality associated with an increase of the density of passengers on a line. The second component is the competition regime in the public transport market. If the new line is managed by an independent operator, this may decrease unit operation costs of the incumbent and newcomer because both aim partly at the same market. If the line would be organized by the same operator, we can expect very different results. The operator would take into account the loss of passengers on the existing line and there would be no competitive pressure on the unit operating costs.

The issue we signal is more widespread than it appears at first sight. Pickrell (1990) found for the public transport networks of Buffalo, Miami and Sacramento that overall ridership decreased as rail transit service was introduced. Trips were probably diverted to the road network. In Europe, where public transport has a larger market share, the issue is common when a High Speed Rail (HSR) line is built next to an existing rail line. HSR lines are often operated by a different operator (Thalys, Eurostar) than the local rail lines. Jiang and Zhang (2016) show that the development of HSR lines can have important impacts on airlines activities. Ivaldi and Vibes (2008) studied the entry of new competitors on the intercity passenger market. They showed that entry could be beneficial for passengers. The frequency of service was however kept constant. Entry of a competitor is easier for existing bus lines. The evidence in the UK after deregulation is that it produced cost reductions but that one ended up with a monopoly supplier with lower costs but higher prices (cf. Savage, 1993; Van de Velde, 2015). The German deregulated long distance bus market has been studied by Augustin et al. (2014). A new bus entrant cannot offer stops at less than 50 km in order to protect existing local public transport services. Despite this restriction, there is effective competition in the bus market but also intermodal competition with rail. They show how the bus operators opened more than 100 new bus lines. The new bus lines supply competing routes for rail, on average, at half the price of rail but 50% slower than rail. According to Deutsche Bahn (DB), one third of the new passengers come from rail. Aarhaug and Fearnley (2016) conclude that in Norway competition is essentially intermodal. In this paper we also touch upon political economy aspects by showing that a relative small number of voters using the new line helps to block inefficient entry.

The paper is organized as follows: Section 2 presents the setting of the network, Section 3 shows under what condition the destructive change problem may occur and the extension to the case of synchronized services is discussed in Section 4. Section 5 presents illustrations. Section 6 concludes with caveats. Proofs are relegated to the Appendix.

2. The setting

The paper considers a public transport network without congestion where a fixed number of passengers want to go from A to B, from B to C and from A to C via B. We show under what conditions the addition of a new direct line AC, which avoids

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[3] Mohring's model has also endogenous number of passengers so that the optimal adaptation of frequencies to the number of users becomes a vicious cycle (cf. Bar-Yosef et al., 2013).