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The effects of transport infrastructure changes: a general equilibrium perspective
Extended abstract
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Measures of the value of public investments are critical inputs into the policy making process. In the existing literature public investments are often valued through their effects on local equilibrium factor prices - wages and land rents - as first suggested by Rosen (1974) and Roback (1982). We extend this methodology to measure the value of public transport infrastructure, while taking into account the network character of this amenity. Furthermore, we disentangle and calculate the relative importance of various economic effects induced by transport infrastructure, including the effects on: modal split, spatial distribution of economic activities, firms' productivity.

In the spatial general equilibrium framework of this paper we explicitly model transport infrastructure as a network connecting different economic locations with various transportation modes. Consumers use the transportation network to get to their jobs; they choose hereby the transportation mode that brings them to work at lowest cost. Consumers furthermore sort themselves among home locations (in a Tiebout (1956) way) and job locations. Firms sort themselves among job locations. From these microfoundations we derive the welfare effects of transport improvements on the labor- and land market and show how to evaluate these effects via land prices. We estimate the parameters of the model from Dutch data and apply the model in practice to evaluate the benefits of a new railway connection between the two largest Dutch cities, Rotterdam and Amsterdam.

This paper contributes to a number of strands of literature. The first one consists of studies that use a general equilibrium framework to value non-traded goods through their effects on land and labor markets. Rather few papers focus on the effects of transport infrastructure. An early paper by Arnott and MacKinnon (1977) studies the long-run effects of transportation changes in a closed city. Most relevant for our research is the study by Haughwout (2002) who develops a spatial general equilibrium framework with transport infrastructure modeled as a regional amenity. In his paper the total value of the regional infrastructure yields benefits for consumers and firms located in the same region. This approach makes it possible to calculate the average effect of an extra dollar transport infrastructure investment in a specific region. However, it does not allow to calculate the effects of concrete investments in specific modes (such as a new railway line, a new highway, road pricing etc.), nor to compare the cost-effectiveness of these investments. By contrast, our methodology allows to evaluate and compare the effects of specific infrastructural improvements in various transportation modes.

Another relevant strand of literature examines empirically the property price effects of specific infrastructure investments such as new highways (Klaiber and Smith, 2010), new railway lines (Baum-Snow and Kahn, 2000, Bowes and Ihlandfeldt, 2001, Gibbons and Macchin, 2005, Ahfeldt, 2011 and the references therein). For these studies it has proven to be quite a challenge to disentangle the pure accessibility effect of a specific transport innovation from correlated other effects connected with: the modal shift, sorting of firms and households across locations, productivity increases due to agglomeration benefits, etc. Papers that tackle some of these issues, keep to the partial equilibrium approach[1]. We, on the contrary, suggest a general equilibrium framework that allows to simultaneously analyze various effects of transport infrastructure and

[1] Baum-Snow and Kahn (2000) and Ahlfeldt (2011) address the modal shift issue. Ahlfeldt furthermore develops a gravity model to measure the transport accessibility of the labor market and thus accounts to some degree for the labor market effects of the transport infrastructure.

compare their relative importance. For an investment in a specific mode on a specific connection in the transportation network our model can disentangle:
(i) the accessibility effect from commuting cost reduction, for commuters on the affected connection who use the affected transportation mode;
(ii) the option value of modal shift, for commuters using other modes on the affected connection;
(iii) the option value of job location switch to better accessible job locations, for people working elsewhere;
(iv) the option value of location switch to better accessible job locations and the resulting agglomeration benefits, for firms located elsewhere;
(v) the option value of home location switch to locations with better job accessibility, for people living elsewhere.
Effects (i)-(ii) are likely to occur in the short run, while effects (iii)-(v) occur in the medium and long run, so our model allows to disentangle and compare short and long run effects of transport innovations as well.

Finally, our paper is related to the recent and growing literature that investigates how transport infrastructure influences the distribution of economic activities across space. The land use theory developed by Alonso (1964) predicts that faster commuting times push up the demand for space in suburbs relative to central cities. In line with this theory Baum-Snow (2007, 2010) finds that highway construction accounted for an important part of decentralization of population and jobs in USA in the second part of the 20th century. Duranton and Turner (2012) develop and estimate a growth model explaining the joint evolution of highways and employment in American cities. Complimentary to this literature, we suggest a methodology that allows to calculate the welfare effects of the changes in the location of economic activities that are induced by transport infrastructure.

The main innovations of this paper are as follows. We suggest a new and improved methodology and a dataset to value the public investments in transport infrastructure. Our methodology allows to disentangle the pure accessibility effect of the transport innovation from various other effects. At the same time our approach makes it possible to evaluate and compare the effects from specific infrastructural investments in various transportation modes. We illustrate the use of the suggested methodology by evaluating the welfare effects of a new railway line between the two largest Dutch cities, Rotterdam and Amsterdam.

Our results are important for three reasons. First, transportation and infrastructure are large segments of the economy and transportation improvements often involve large public expenditures. Our methodology provides an improved basis for evaluating costs and benefits of new transportation improvements. Second, for a specific investment in infrastructure our results can give insight in the induced change in the spatial distribution of economic activities. This may provide useful guidance for policy makers charged with city planning. Finally, the transportation costs are among the fundamentals of many theoretical regional and urban models. Our paper helps to improve the understanding of how transportation costs shape the distribution of economic activities across regions.

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