Estimating the agglomeration effects of public transport improvements: the case of Switzerland

Georgios Sarlas*, Raphael Fuhrer, Kay W. Axhausen
Institute for Transport Planning and Systems (IVT), Department of Civil, Environmental and Geomatic Engineering, Swiss Federal Institute of Technology, Zurich, Switzerland

*Email: georgios.sarlas@ivt.baug.ethz.ch

1 Aim-Scope

This conference contribution deals with the economic effect of public transport supply improvements to productivity, generally referred to as agglomeration economy. To the knowledge of the authors, there has not been a systematic study regarding the agglomeration economy effects in Switzerland. Driven by this, this research attempts to answer two research questions. First, to proceed to the identification and quantification of agglomeration economy effects in Switzerland, and second to enhance the understanding of how different kind of public transport improvements can affect the magnitude of agglomeration economies. The main challenge in applied studies as such, is the isolation of the transport effects from other possible sources of productivity gains (Graham and Dender 2011), as well as simultaneity in transport supply and productivity. It becomes apparent, that the successful isolation of the public transport effects from the private transport ones, constitutes one of the main issues that the current research deals with.

2 Background-Theory

"Throughout the evolution of human settlements, there is only one factor which defines their extent: the distance man wants to go or can go in the course of his daily life. The shortest of the two distances defines the extent of the real human settlement, through definition of a daily urban system" (Doxiadis 1970). Naturally, the importance of the transportation aspect comes to the surface in defining the spatial extent of human settlements, which differs from the prevailing perception of the physical structure ("the built-up area is the city") or the institutional frame ("the municipality is the city") of the human settlements. In order to overcome this limitation, the term urban agglomeration was adopted to specify the extent of human settlements around main cities that major economic activities are concentrated. As a result of this spatial concentration of economic activity, externalities arise that can lead to positive effects on productivity (Graham 2007).

Duranton and Puga (2004), in their discussion of micro-foundations of urban agglomeration economies, mention three main mechanisms that are responsible for agglomeration economy gains: sharing, matching and learning mechanisms. As Chatman and Noland (2011) argue, public transport improvements are capable of having substantial external benefits by enabling agglomeration economies in two main ways. Firstly, by increasing the accessibility between the firms and also among firms and labor force as the result of

improved transport connection and thus reduced travel cost. Secondly, such improvements can lead to densification around stops and/ or lead to the expansion of the cities, so agglomeration impacts can arise to the locations where the activities relocate to and from, with a positive and negative magnitude respectively.

Switzerland has a dense public transport network (rail, roads, rivers and lakes) which is state owned. In the 1980s, Swiss people voted for a huge rail improvement plan, including network extensions, network and stations capacity increase and new fleet. As a result, an interval timetable was established soon and many lines were operated quicker, more frequent and noticeably coordinated. Notably, the biggest change at one-go happened in 2006 when a new transalpine tunnel and a high-speed track on key locations of the network were opened. Overall, public transport has become much more attractive due to improvements in the level of service and travel time savings due to frequent headways, coordinated connections and optimized lines.

3 Methodology

Empirical data over the period of the last 25 years are used for the purposes of this study. More specifically, data per municipality on job density per industry type and employment structure, generated salaries, taxable incomes, dynamics in work places and population are available. A particular focus is given on the economic indices of the total taxable income and the generated salaries which are considered as adequate to capture changes in output and productivity.

Different formulations of panel data models are developed and tested to assess their capability of quantifying adequately the agglomeration effects, within the framework of a production function where the observed variation of the employed economic indices through the years is related to changes in the accessibility. In the same line of thought with the definition of the effective density of employment (Graham 2007), the measure of accessibility is employed. Since Hansen (1959) first formulated accessibility in mathematical terms, a variety of different approaches have evolved (see Kwan (1998)). All of these have in common, that they rely first on generalised travel costs (or approximations), second on a transport infrastructure model and third on spatial densities of so-called activity or opportunity points (e.g. inhabitants, work places). A gravity-like formulation is used:

$$A_i = \Sigma O_j * e^{\beta * C_{ij}} \quad (1)$$

With A_i as accessibility in point *i* to all *j* opportunity points O_j at generalized costs C_{ij} that are weighted by a negative exponential transformation with factor β. Apparently, factor β is crucial and might vary over time, hereupon time-corrected β estimates for Switzerland are used (Killer et al. 2013).

The employment of the accessibility approach enables to break down the generalised cost into its different components and thus highlight their specific agglomeration effect

individually. In the case of public transport, accessibility is estimated by taking into account the in-vehicle travel time, waiting time, number of transfers and average headway.

An important aspect that is taken into consideration, is the heterogeneity of the economic activity in space which has implications on the estimation of the models. In order to tackle this issue, geographically weighted regression models are estimated (an overview can be found at (Charlton and Fotheringham 2009)).

The availability of data of job densities per industries is used to investigate the densifications that have occurred and study their impact, in line with the second argument of Chatman and Noland (2011), as mentioned before. The measure of co-agglomeration by Ellison and Glaeser (1997), that has been used in a number of studies (e.g. Faggio et al. 2014), is used in order to account for the heterogeneity across industries. Furthermore, this measure allows the investigation of different aggregation levels of the industry types based on their underlying similarities and also on different sizes. It should be noted that the available data set of industries is categorised into 96 different types.

4 Results

At the present time, the research presented above is in process and more specifically in the data collection part and some initial models have already been estimated. However, the presentation of preliminary results is not yet possible since their validity is not yet fully tested. Nevertheless, we expect to show results of different models in the conference. This research is in collaboration with ecoplan AG and funded by the SBB Research Lab.

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