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Looming Stations: Valuing Transport Innovations in Historical Context‡

Abstract: We investigate the impact of transport innovations on the productivity of urban locations in 1890 – 1936 Berlin, Germany. We find an increase in land value of up to 2.5% per 100 m decline in distance to urban railway station.

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I Introduction

Some of the economically most essential technological advances since the industrial revolution comprise transport innovations that brought economic agents closer together. The reduction of transport cost amplified agglomeration economies and economic growth along new major transport lines and, hence, sustainably reshaped the economic geography of regions and cities. On an urban scale, increased location productivity, which mirrors in land value, may arise, e.g. from lower input prices due to reduced transport cost, increased communication and human capital spillovers between firms. Reduced labor market frictions or improved worker efficiency due to reduced commuting effort (Gibbons and Machin, 2005) may further contribute to an increase in economic wealth. Rapid transit networks constituted by metrorail and suburban or commuter railway lines represent the backbone of urban mass transportation in many modern metropolitan areas, particularly in Europe. The impact of rail transit on property prices has attracted much scholarly attention (Bowes and Ihlanfeldt, 2001; Gatzlaff and Smith, 1993; Gibbons and Machin, 2005; Mcmillen and Mcdonald, 2004).

We follow an empirical approach that shares the basic ideas with Gibbons and Machin (2005) and reveals the marginal value of reduced distance to the next urban railway station by application of a time-difference estimation strategy. Our analysis however, differs in at least three important aspects. In contrast to Gibbons and Machin (2005) we use archival land values similar to McMillen (1996). There is no need for an adjustment for housing characteristics. Also, the sample is strictly restricted to commercial areas according to zoning regulations instead of using residential property data. Most importantly, our analysis investigates the impact of new stations during the peak time of industrialization, when the inauguration of the rapid transit network represented a major shock on intra-urban transport costs, accessibility, and hence, location attractiveness and productivity.

From 1890 to 1910, 871 of 1,473 considered commercial areas experienced a decline in distance to station, while from 1910 to 1936 679 of 1,678 locations were affected. Distance only increased at very few locations where stations were disconnected or slightly moved along the network. For a detailed description of the data set see Ahlfeldt and Wendland (2008).

II Empirical Strategy

The starting point of our empirical analysis is a simple monocentric city model (Alonso, 1964), which can be estimated using the well-established log-linear specification. Our standard setup assumes the value of urban land (*LV*) to be an exponential function of distance to the city center (*distCBD*).[2] We extend the basic monocentric model by distance to the nearest railway station (*distST*) and allow for unobserved location effects (*f*).

$$\log(LV_{it}) = \alpha_t + \beta_t \; distCBD_t + \gamma_t \; distST_{it} + f_i + \varepsilon_{ti} \qquad (1)$$

Assuming that the marginal benefit of having a railway station close by remained unchanged over time ($\gamma = \gamma_t = \gamma_{t-1}$), we obtain the following time-difference form:

$$\begin{aligned} \log(LV_{it}) - \log(LV_{it-1}) = {} & (\alpha_t - \alpha_{t-1}) + (\beta_t - \beta_{t-1}) \; distCBD_i \\ & + \gamma \; (distST_{it} - distST_{it-1}) + (\varepsilon_{ti} - \varepsilon_{ti-1}) \end{aligned} \qquad (2)$$

Existing evidence suggests a flattening of the land gradient over time, owing to changes in the production and transportation technology (Ahlfeldt and Wendland, 2008; Atack and Margo, 1998; Margo, 1996; Mcmillen, 1996; Smith, 2003). Our specification therefore allows the gradient to vary over time. Periods *t-1* and *t* refer either to 1890-1936, 1890-1910 or 1910-1936. It can be shown that our first difference estimate satisfies quasi experimental conditions. Considering a control group (*C*) of locations that remain unaffected by transport innovations, parameter γ provides a difference-in-difference estimate distinguishing between time as well as control and treatment (*T*) locations.

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[2] We build on the 1936 CBD identified by Ahlfeldt and Wendland (2008). Accordingly, the CBD is located between Pariser Platz and the intersection of boulevards Friedrichstrasse and Unter den Linden.

$$(\log(LV_{it})-\log(LV_{it-1}))^{T}-(\log(LV_{it})-\log(LV_{it-1}))^{C}=\gamma\ (distST_{it}-distST_{it-1}) \qquad (3)$$

III Results

Results corresponding to equation (2) are presented in column (1) of Table (1) for the long difference 1890 – 1936. The positive coefficient on *distCBD* indicates the typical process of decentralization in industrializing cities, which reflects in a flattening land gradient. Accordingly, the marginal cost of locating farther away from the CBD is reduced by almost 40 percentage points. At the same time, the negative coefficient on *distST* points to a marginal increase in land value by approximately 22.3% per km reduction in distance to station.

[Table 1 about here]

In order to capture land value decentralization more flexibly, we use binomial and trinomial forms of distance to the CBD (columns 2 and 3) as well as mutually exclusive 1 km distance rings (column 5 and 6). Anecdotal evidence (Leyden, 1933) highlights the emergence of a strong subcenter along the boulevards Kurfürstendamm and Tauentzienstrasse at the beginning of the 20th century. Indeed, the respective dummy coefficient (*KU*) indicates a relative increase in land value of more than 50% (column 4 and 6) with the relative 1 km impact area estimated by Ahlfeldt and Wendland (2008). The key coefficient of interest on *distST* is estimated consistently in all specifications.

[Table 2 about here]

Tables 2 and Table 3 repeat Table 1 estimations for 1890-1910 and 1910-1936 respectively. Our estimates suggest that the increased land value following transport innovations observed for the whole study period is almost entirely attributable to an adjustment during the first period. While the coefficient estimates on *distST* are similar in Table 1 and 2, Table 3 reveals no significant impact of distance to station. Results also indicate that the emergence of the Kurfürstendamm area as a strong subcenter took place after 1910, as the respective coefficient is insignificant for 1890-1910.

[Table 3 about here]

IV Discussion

Building on the work of Gibbons and Machin (2005), we provide the first archival evidence for the value of transport innovations during European industrialization.[3] Our results reflect the willingness of landlords to bid higher prices for commercial properties due to infrastructural improvements. The estimated effect is a net effect of travel time savings to and from the respective locations and environmental changes arising, e.g. from increased noise. Our estimated impact for a 100 m decrease in distance to railway station of 2.0% to 2.5% is relatively large compared to the findings of Gibbons and Machin (2005), whose estimates range from 0.15% to 0.55% per 100 m reduction. Several explanations may account for this difference. First, the impact on commercial land is probably larger compared to residential properties investigated by Gibbons and Machin, since the marginal cost of locating farther away from customers, employees and business partners together potentially exceed residents' opportunity cost of commuting.[4] At the same time, commercial land value may be less sensitive to the depreciating impact of environmental factors such as noise. A lower impact of station proximity on residential relative to commercial land value has recently been shown for the present-day Berlin (Ahlfeldt and Maennig, 2008). Other explanations refer to the historical context of our analysis. The marginal value of having a station close by critically depends on the transport mode employed for moving to and from stations. Thus, a decrease in marginal cost over time is expected from an increasing availability of cars, buses and bikes. Also, we would expect much uncertainty in the market as our study covers the pioneering period of rapid transit innovations. While our time-differences span enough time to account for anticipation effects (Mcmillen and Mcdonald, 2004), uncertainty might have led to a considerable overestimation of the expected impact of new stations' real estate price effects during the first period from

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[3] LeRoy and Sonstelie (1983) develop a theoretical model that predicts where high-income residents locate depending on the affordability of high-speed intra-city transport. They also provide interesting evidence for U.S. cities in support of their model.

[4] The market potential concept states that firms value access to customers and employees (Crafts, 2005; Harris, 1954) while localized production externalities explain why firms attract each other (Fujita and Ogawa, 1982; Lucas, 2001).

1890 to 1910.[5] Amplified by the troubled environment of World War One and the Great Depression, the following disillusion may have led to an exaggerated downward adjustment of expectations.

[5] Anecdotal evidence points to much speculation in the market for real estate, in particular with respect to new rapid transit lines (Ribbe, 1987).

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