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Locomotives of local growth: The short- and long-term impact of railroads in Sweden ☆

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ABSTRACT

This paper studies the impact of railroads on 150 years of urban growth in Sweden, identifying the short- and long-term effects of a first wave of railroad construction. Difference-in-differences and instrumental variable estimates show that towns that gained access experienced substantial relative increases in population, though such growth mainly reflected a relocation of economic activity. Over the twentieth century, we find little evidence of convergence in town populations, despite the railroad network expanding further to connect nearly all towns. Evidence on historical investments and present-day factors is consistent with the idea that the transitory shock of the first railroads gave rise to path dependence in the location of economic activity.

1. Introduction

Economists and policy makers have long been concerned that high trade costs may constitute a barrier to economic development. Improving transport infrastructure is thus seen as crucial to spurring growth (World Bank, 1994, 2009). Yet, credibly identifying the causal effects of such improvements remains empirically challenging because transport infrastructure is not randomly assigned across locations. Moreover, in the presence of labor market rigidities or durable investments, long-run adjustments may be slow to materialize. Historical episodes of large-scale transportation improvements provide unique opportunities to analyze such adjustments in both the short and long run.

In this paper, we exploit the rollout of the largest public infrastructure network in Swedish history—the nineteenth-century railroads—to study the impact of transport infrastructure on urban development in a poor, rural and predominately agricultural setting. In a *first wave* of railroad expansion, between 1855 and 1870, state-financed lines evolved into the backbone of the modern Swedish railroad network. An overarching ambition of state planners was to connect the capital Stockholm with the other two major port cities. Yet, due to military concerns and developmental objectives, the main trunk lines were in many instances routed through disadvantaged interior areas, connecting many smaller cities and towns.

In our main empirical analysis, we examine the short-term impact of the first wave on urban growth. Difference-in-differences estimates show that towns that gained access to the network experienced substantial relative increases in population. OLS estimates may, however, be downward biased if state planners targeted places with low potential for growth, though we find few observable differences between connected and non-connected towns prior to the construction of the network. To adress this issue we use an instrumental variable (IV) strategy that exploit low-cost

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routes between major endpoints of the network. Falsification tests show no evidence for more rapid growth along these routes prior to construction and we find no effects where a railroad was not actually built. IV estimates are indeed substantially larger than OLS estimates and are robust to a range of additional controls, in a sample balanced on propensity score, as well as using two historical network proposals as alternative instruments.[1] Additional estimates for several sets of placebo lines, that were proposed but not built and lines that were constructed after 1870, are close to zero and statistically insignificant, suggesting that our estimates reflect the causal impact of rail infrastructure on urban growth.

While our estimates imply large relative increases in population for connected towns, we also demonstrate that growth came at the cost of nearby non-connected towns: relative increases are essentially zero compared to non-connected towns more than 90 km from the network. Much of the growth that we observe therefore likely reflect a reorganization of economic activity across towns, mirroring the general concern that gains from geographically targeted policies may partially or completely be offset elsewhere through a displacement of economic activity (Gottlieb and Glaeser, 2008; Kline and Moretti, 2013; Redding and Turner, 2014).[2]

After 1870, a surge in railroad construction led to a sharp reversal of differences in connectivity. Within two decades, towns that were not assigned a rail connection in the first wave had on average more rail connections per inhabitant than towns with early access to the network. We examine whether the short-term effects persisted as the railroad network was extended to nearly all towns, asking whether the transitory shock of the first railroads permanently shifted the location of economic activity across towns.

Towns that gained access to the network during the first wave continued to grow differentially faster throughout the nineteenth century and over the twentieth century differences in town sizes largely persisted. Are such persistent differences evidence of path dependence in the location of economic activity? We distinguish between two explanations. If there is a multiplicity of steady states, even a small shock may be capable of nudging initially similar towns into very different long-term growth trajectories (David, 1985; Krugman, 1991a; Arthur, 1994).[3] Alternatively, such persistence may reflect slowly depreciating sunk investments, in which case we would expect to observe a gradual convergence in town sizes.

Historical evidence from the late-nineteenth century is consistent with railroads increasing the pace of industrialization, promoting scale economies in manufacturing and a relative shift away from artisanal production. However, neither an industrial advantage in the early twentieth century nor a range of historically sunk investments in schools, electricity works, communications infrastructure or railroads explain the present-day variation in town size that we attribute to the population shock induced by the early railroads. Furthermore, comparing towns with an early rail connection to similarly large towns today—in terms of, for example, roads, railroads and housing prices—we find little to suggest that towns that gained access in the first wave persist due to slowly depreciating factors. Our results thus seem most consistent with the idea that the transitory advantage of an early rail connection permanently shifted the location of economic activity.

Our paper speaks to two strands in the literature. We contribute to a growing body of work that examines the causal impact of the railroad on historical development (Atack et al., 2010; Keller and Shiue, 2008; Donaldson, 2015; Donaldson and Hornbeck, 2015; Hornung, 2015), as well as recent efforts to disentangle the impact of transport infrastructure on regional trade (Michaels, 2008), urban form (Baum-Snow, 2007; Baum-Snow et al., 2012) and urban growth (Duranton and Turner, 2012; Storeygard, 2013). Similar to much of this literature, our results suggest that transport infrastructure can have substantial causal short-term effects on urban development, though we also document that such growth partly reflect a displacement of economic activity. More novel, our results show that such short-run effects can affect local development paths over a century of substantial economic modernization, during which Sweden transformed from one of the poorest countries in Europe to one of the richest in the world. In that sense, our results appear in a historical context very different from Jedwab and Moradi (2015) and Jedwab et al. (2015) documenting that African cities formed along the Colonial railroads and that cities persist at these locations today. We instead show how the staggered rollout of a major transportation network can lead to persistent differences, despite such a network eventually connecting all locations. Importantly, this allows us to distinguish between historically sunk investments in rail infrastructure and path dependence as competing explanations for persistent differences in urban populations.

Our evidence of path dependence in the location of economic activity contributes to an emerging empirical literature on urban development and the existence of multiple spatial equilibria. Bleakley and Lin (2012), for example, document the formation and persistence of US cities at portage sites, despite this natural advantage being made economically irrelevant more than a century ago.[4] In contrast, we examine a man-made and reproducible advantage with more obvious policy implications. In that sense, our paper is related to Kline and Moretti (2014) that examine the long-run impact of a major US regional policy intervention under the Tennessee Valley Authority and Redding et al. (2011) that examine a shift between multiple equilibria in the location of Germany's main air hub following post-war division. Evidence of path dependence stands in constrast to the finding that economic activity is uniquely tied down by fundamentals even in the face of extreme shocks (Davis and Weinstein, 2002, 2008).[5] A potential explanation for why we observe path dependence emphasizes initial conditions: Swedish towns were small and the population was largely rural in the nineteenth century, ensuring that a shock of comparably small magnitude was able to permanently shift economic activity between locations. Our results thus have implications for debates about the potential impact of investments in major transportation networks in modern developing countries that are less urbanized.

The remainder of this paper is structured as follows. In the next section we provide a historical background, document the initial divergence and subsequent sharp reversal in rail connectivity for towns in the first wave relative to other towns over the last 150 years. Section 3 details our empirical strategies, with estimates of the impact of the first wave on short- and long-term patterns of

[1] Both Baum-Snow (2007) and Duranton and Turner (2012) find that IV estimates of the impact of highways in US cities are larger than OLS estimates, suggesting that the political allocation process assigned road infrastructure to slowly growing places.

[2] However, during the period under study a large reallocation of people from rural to urban areas took place, with the urban population more than tripling, meaning that the railroad could have contributed to urbanization in the aggregate. Though our estimates do not allow us to make inference about the railroads' nationwide effects, evidence on reorganization lends qualitative support to work that downplays the railroads' historical impact on aggregate growth (Fogel, 1964).

[3] A related literature discusses the feasability of "big push" policies (Rosenstein-Rodan, 1943; Murphy et al., 1989; Kline and Moretti, 2014).

[4] A related literature examines intra-city persistence; Brooks and Lutz (2014), for example, examine the persistent impact of Los Angeles' streetcars and Ahlfeldt et al. (2015) use the division and reunification of Berlin to study the role of market access in determining urban form.

[5] Also, see Brakman et al. (2004), Bosker et al. (2007) and Miguel and Roland (2011). As pointed out by Redding et al. (2011), historically sunk investments in infrastructure networks, around which reconstruction efforts could be coordinated, is one potential explanation for the fact that even extreme shocks do not seem to shift urban economies between steady states.

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