The impact of urban public transportation evidence from the Paris region[☆]

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ABSTRACT

We use the natural experiment provided by the opening and progressive extension of the Regional Express Rail (RER) between 1970 and 2000 in the Paris metropolitan region, and in particular the departure from the original plans due to budget constraints and technical considerations, to identify the causal impact of urban rail transport on firm location, employment and population growth. We apply a difference-in-differences method to a particular subsample, selected to minimize the endogeneity that is routinely found in the evaluation of the effects of transport infrastructure. We find that the RER opening caused a 8.8% rise in employment in the municipalities connected to the network between 1975 and 1990. While we find no effect on overall population growth, our results suggest that the arrival of the RER may have increased competition for land, since high-skilled households were more likely to locate in the vicinity of a RER station.

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1. Introduction

In both Europe and North America, a number of ongoing projects have demonstrated policy-makers' belief in the efficiency of public spending on rail transport. We can mention here the "Crossrail"[1] project in London, the "Grand Paris Express"[2] in France, and the plan for high-speed rail in California.[3] Spending on inland transport infrastructure is far from negligible, at 0.7% of GDP in North America, 0.8% in Western Europe and 0.9% in France (OECD, 2011), underlining the importance of assessing the return to those costly investments. Our paper supplies quantitative evidence regarding the way in which urban rail transit can shape urban development. To do so, we use the natural experiment

offered by the improvement of the Paris commuter rail system from the 1970s to the end of the 1990s.

Between 1968 and 2006, the Parisian metropolitan area spread, with population rising from 9.2 million to 11.5 million (INSEE, Census). This growth was accompanied by the improvement of the commuter rail system and the commissioning of the so-called Regional Express Rail (RER hereafter). While this policy mainly improved the existing network, it also entailed the construction of new stations and lines. The improvement of the suburban rail system into a fast high-capacity network offers an interesting experiment to estimate the causal impact of public mass transit on the location of firms, employment and population across metropolitan areas. We estimate the effect of a one-minute reduction in travel time by public transport on various indicators at the municipality level.[4] We take a difference-in-differences approach using a continuous treatment variable on a particular subsample that is selected to address potential endogeneity bias. We find that local employment grows by 8.8% in municipalities that were connected to the RER network in the 1975–1990 period, with a similar order of magnitudes for firm location. However, we find no robust impact on population growth.

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[1] http://www.crossrail.co.uk/.
[2] http://www.societedugrandparis.fr/english-version.
[3] http://www.hsr.ca.gov/.

[4] We will use the terms municipality and city interchangeably, referring to the administrative units that are our units of observation (there are over 1300 municipalities in the Paris region).

The existing evidence suggests that transport plays a key role in the economics of cities. The standard monocentric city model predicts that lower transport costs should increase the share of the population living in the suburbs. In this model (see Duranton and Puga, 2015 for a recent survey of both traditional and modern versions of this model), lower transport costs also increase city size by reducing congestion costs. There is empirical support for this prediction. Baum-Snow (2007) considers the effect of highways on the shape of US cities, and shows that roads explain one third of the observed population movement from city centers to the suburbs. Similar results have been found in Spain (García-López et al., 2013). Duranton and Turner (2012) highlight the positive impact of highways on city growth: a 10% rise in the stock of highways causes 1.5% higher local employment in the US. However, in line with theoretical models of economic geography (Martin and Rogers, 1995), Faber (2014) confirms that better transport access may in some cases reduce economic activity. He shows that highways reduced GDP growth in non-targeted peripheral counties in China. The empirical analysis of firm location choice tends to find a positive link with transport infrastructure. Coughlin and Segev (2000) show that highways foster foreign-owned manufacturing plant location in US counties; Holl (2004a); 2004b) finds similar results in Portugal and Spain. Strauss-Kahn and Vives (2009) show that proximity to an airport is a significant predictor of headquarters relocation in the United States. More generally, transport infrastructure is positively associated with city productivity: Fernald (1999) shows that highway construction in the US increased the productivity of vehicle-intensive industries at the metropolitan level. Our contribution to this literature is to consider how firm location, employment and overall population react to investment in commuter rail, which is an important type of transport infrastructure that has been only little-studied to date.

The existing evaluations of public transport have highlighted that their effects on cities differ from those of other means of transport. First, commuter-rail systems help to reduce air pollution in cities. Chen and Whalley (2012) show that the opening of the metro system in Taipei reduced the measured concentration of carbon monoxide by 5 to 15% . Second, rail affects the location of people and jobs in cities differently from other means of transport. Using lights at night data for the 632 largest cities in the world, Gonzalez-Navarro and Turner (2016) show that subway extensions cause cities to spread, but with no impact on population growth. In Baum-Snow and Kahn (2000), commuter-rail investment caused a slight increase in the local value of properties in five major American cities and encouraged switching from driving to public transport. Burchfield et al. (2006) also show that cities where public transportation was embedded in the initial urban development plan sprawl less than cities that were built for cars, due to the higher commuting costs. Glaeser et al. (2008) emphasize an ambiguous effect of public transportation on urban spatial inequality. On the one hand, the mobility of the poor is higher in American cities with good public transport, as car-based mobility is too expensive; on the other hand, these cities are more segmented, with lower-income residents being "stuck" close to rail stations while the richer live in neighborhoods that are only accessible by car. Our results are in line with the conclusions in Brueckner et al. (1999) that European and American cities are different: for Paris, we find suggestive evidence of gentrification around train stations in the inner ring of the Parisian suburbs. Last, considering the effects in a major European city is a relevant question, as urban mass transit plays a much larger role in commuting there than in North America. For example, only 5.3% of American workers use public transport to commute[5] (McKenzie and Rapino, 2011),

while 13.3% of French workers (François, 2010) and 22.6% of Japanese commuters do so[6] (Japan Census, 2010). The use of cars is prevalent in the US (90.0%), less prominent in France (72.3%) and even rarer in Japan (46.9%).

In this paper, we investigate the impact of public transport on firm-location choice in the suburbs of a large metropolitan area. When considering whether to locate in the city centre or suburbs, firms face a trade-off (Fujita and Ogawa, 1982). While land is cheaper in the suburbs, agglomeration spillovers will tend to be lower, as other firms will be more distant. Commuting costs also matter, as firms should compensate workers for longer commutes. It can be argued that moving to the suburbs will reduce commuting costs, as the population is less concentrated in city centers than are firms. However, Duranton and Puga (2015) underline "wasteful" commuting patterns, in that workers do not necessarily commute to the closest workplace. This comes about due to preferences for specific amenities, the location choice of two-earner couples or the costs of a move when changing job.

Public transport will likely modify this trade-off, and we present evidence of this. First, the average commuting distance of workers rises in RER municipalities, confirming a fall in commuting costs allowing firms to locate further from the residences of workers. Second, manufacturing firms do not locate more frequently in the vicinity of a RER station than other firms. This is not in line with the US results for highways in Duranton and Puga (2015), and probably reflects that highway proximity reduces the transport costs of goods, while passenger rail does not.

Transport infrastructure is not randomly located, producing endogeneity problems in the evaluation of its impact. A naive evaluation, comparing connected to unconnected areas, will certainly yield biased results, with the sign of the bias depending mostly on policymakers' objectives. The latter may be to connect either dynamic or deprived areas, depending on the public-policy goal at the time of decision. The literature proposes a number of identification strategies to address this issue, based on natural experiments or clever instruments. Duranton and Turner (2012) evaluate the effect of the development of the highway network in the United States on the local evolution of employment. They use an instrumental-variable strategy, based on the 1947 plan of the Interstate highway system, partially reflecting military objectives and the late Nineteenth Century railroad network, to address the endogeneity of current highway location. Michaels (2008) also uses the 1947 plan as an exogenous source of road variation to evaluate the impact on interstate trade. Donaldson (2017) shows that railway extensions in India reduced interregional trade costs and increased both income and trade. To do so, he uses the natural experiment provided by 40,000 km of planned lines that were never built for arguably exogenous reasons. Banerjee et al. (2012) find a moderate positive effect of transport access on income growth in China. Their identification strategy relies on railroad lines that were built in China to connect European concessions on the coast to inland historical cities in the 19th Century. They argue that the areas crossed, which were located in between these two types of cities, were "quasi-randomly" linked to the railway network and can be compared to similar but unconnected areas. Chandra and Thompson (2000) is an early paper using the same identification strategy for the impact of highways in the United States, looking at rural counties that were accidentally treated because of their spatial location inbetween major cities.

We provide two identification strategies to address endogeneity. The first is inspired by the approach in Banerjee et al. (2012) and Chandra and Thompson (2000). The RER network was

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[5] Not including those who work at home.

[6] This number refers to workers and students aged over 15; public transport includes company or school buses; two answers can be given in the census - in this case respondents are split equally between the two modes.