Metros, agglomeration and firm productivity. Evidence from London

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Keywords: transportation, mass transit, displacement, urban economics, firm productivity, project appraisal

Global population living in cities is projected to grow by 2.5 billion in the next 30 years, and 90% of this comes from Africa and Asia (United Nations Department of Economic and Social Affairs (2018)). These cities need high capacity public transportation to keep up with rapidly increasing transport demand. At the same time, cities in the developed world are upgrading their transport services to reap the benefits of increased access to economic opportunities. Cities both in the developing and the developed world are investing in metro projects, and 40% of all metro infrastructure in the world was built since the year 2000 (UITP (2015)). The 21st century may be the century of metros, but economic justification for these multi-billion dollar investments is still lacking. Studies mostly evaluate highways or railways, so there is minimal evidence about the returns of inner city transport projects (for a review see (Melo et al., 2013)). This research fills this gap by using state of the art causal methods to estimate the wider economic impacts of a metro investment in London.

This paper contributes to multiple fields of economics. It contributes to the field of urban economics as we find evidence to displacement effects (Redding and Turner, 2015) within a city, which was found previously only around intercity investments (Baum-Snow, 2007, Chandra and Thompson, 2000). Moreover, we find that urban rail clusters economic activity more than suburban rail (Mayer and Trevien, 2017), intercity rail (Ahlfeldt and Feddersen, 2018) or highways (Chandra and Thompson, 2000). It contributes to the field of transport economics, as we find evidence that mean firm productivity increases similarly to labour productivity due to an intracity transport investment (Venables, 2007). It also contributes to the field of project appraisal, as we develop a new methodology which incorporates the displacement impact of the project; moreover, our local business unit level calculations are more precise than the current methodology which uses changes in employment on the regional level (Graham and Gibbons, 2017).

This study estimates the 1999 Jubilee Line Extension's (JLE) impact on firm productivity and the local economy as a whole, using a business unit level panel dataset for Greater London. The subset of the Annual Respondents Database X (Office for National Statistics, 2017) covers around 350,000 business units in all sectors of the economy, only very small businesses (mostly sole traders) are not covered. This highly disaggregate, full-address level database enables sophisticated panel and instrumental variables methodologies. This research 1) estimates the impact of a metro line on firm productivity, and 2) analyses its overall impact on the local economy, with a special interest in dynamic agglomeration effects.

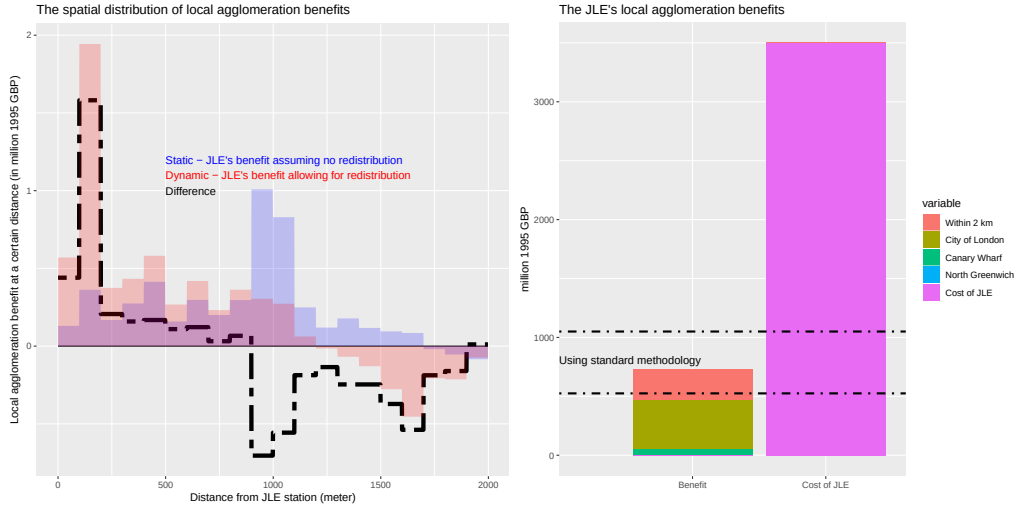
This paper is a continuation of Pogonyi et al. (Pogonyi et al., 2018). They find that the Jubilee Line Extension had a significant impact on the spatial distribution of employment and business units; however, the net impact is not significantly different from zero. Economic activity became more clustered around the stations and sectoral mix shifted towards high-value-added industries. These findings suggest that the JLE induced agglomeration effects and increased productivity; however, they do not study firm productivity and thus cannot evaluate the agglomeration benefits of the transportation scheme. This paper tests their results by using a different, local business unit-level dataset. We first estimate total factor productivity for every business unit in London, then estimate the JLE's impact on firm productivity to evaluate the overall spatial impact of the scheme. Building on these results we develop a new methodology for project appraisal, which provides accurate local agglomeration benefit calculations on the business unit level and incorporates the displacement impact of the transport project.

We find that the Jubilee Line Extension (JLE) in London had a significant and positive impact on firm productivity and the local economy. The spatial scope of the impact disappears around 2 km away from the JLE stations, with aggregate value added increasing by 2.3-3.5% within 2 km. The impact is the strongest close to the stations: within walking distance (750 meters) the causal impact is 15%, and it gradually decreases with distance. Between 1250 and 2000 meters the impact is negative, showing evidence for the displacement of economic activity. The impact on aggregate value added can be separated to the impact on the number of local units and their mean productivity. We find a very similar pattern to Pogonyi et al. (2018) for the spatial impact on the number of local units: a significant and positive impact within 750 meters of the scheme, and a significant negative between 750 and 2000 meters. Mean productivity is significantly positive within 1250 meters and insignificant further away. This shows that the reason behind displacement is the decreasing number of local units and not decreasing mean productivity.

Our findings suggest that the JLE's impact can be categorised to three areas: *Treated* is the area between 0 and 750 meters to the stations where aggregate and mean productivity and the number of local units increased. *Transition* is

the area between 750 and 1250 meters where mean productivity increased, but the number of local units decreased. Also, *untreated* is the area where both aggregate productivity and the number of local units decreased, and change in mean productivity is not significantly different from zero. Redding and Turner (2015) explain that the construction of transport infrastructure could displace economic activity from neighbouring locations to those immediately adjacent to the transport infrastructure. Our results provide the first empirical proofs of a transport project causing displacement in the local economy within a city.

Figure 1: Graphical representation of the spatial distribution of agglomeration benefits and overall local benefits



The overall direct dynamic impact on the local economy is significantly positive, £4.4 million per year (in real 1995 GBP). This paper emphasises the importance of dynamic economic benefit calculations: disregarding the spatial redistribution of business units overvalues benefits by 10%; however, the most critical shortcoming is that current calculations disregard the displacement effect. In addition to causal benefit estimations, we provide less robust estimates for key business districts in London to estimate the overall impact of the JLE on the local economy. This increases benefits to £12.2 million per year which totals local economic benefits to £732 million assuming a sixty-year payback period (£1.06 billion in 2019 prices). This is 21% of construction costs which is close to usual wider economic benefit calculations, even though we used an entirely different methodology than previous studies using regional labour productivity. This shows that our methodology is not just more precise in estimating the within-city impacts of the investment, but its results are also reliable for project appraisal.

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