Can Public Transport Investment Relieve Spatial Mismatch?  
Evidence from Recent Light Rail Extensions  

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September 20, 2014  

1 Introduction

Urban poverty is a well-documented fact for American cities.\(^1\) Within metropolitan areas, poverty rates in center cities are considerably higher than in the suburbs. The urban poverty gap is not a simple reflection of poverty of blacks and other minorities living close to central business districts (CBD) of older cities, but a pattern that holds for all races and across regions (Table 1, Glaeser et al. 2008). This gap is a fairly recent development and is often linked to the “white flight” of the 1950s and 1960s. The ubiquity of the private automobile has led to suburbanization and left neighborhoods close to the central business district deprived. In addition to the loss of residents, the urban core of many cities has experienced a relocation of downtown jobs toward the periphery with the majority of new jobs, especially high-skill jobs, being created in the suburbs (Kain 1992). Urban economists have argued that the inability of central city residents to reach job opportunities in the suburbs (reverse commuting) is a major cause of inner city poverty. This argument is well known as the spatial mismatch hypothesis (Kain 1968, Ihlanfeldt and Sjoquist 1998).

<table>
<thead>
<tr>
<th>Table 1: Urban and Suburban Poverty Rates</th>
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<tbody>
<tr>
<td><strong>Center City</strong></td>
</tr>
<tr>
<td>All</td>
</tr>
<tr>
<td>Northeast</td>
</tr>
<tr>
<td>Midwest</td>
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<tr>
<td>South</td>
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<tr>
<td>West</td>
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<tr>
<td>Blacks</td>
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<td>Non-Blacks</td>
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Source: Glaeser et al. (2008)

\(^1\)Outside metropolitan areas, there is also considerable rural poverty, but rural poverty is likely to be of a very different nature than urban poverty.
Public transportation plays a major role in this argument. The advent of the automobile and the resulting urban sprawl has made the car the sole means of transportation for most Americans. While older metropolises like New York, Boston, and Washington DC see high ridership numbers of their subway systems, in most American cities, public transportation plays almost no role as a means of commuting to work. In 2000, only 4.7% of trips to and from work were made using public buses or rail systems, while 86.6% were made by private automobiles (Glaeser & Kahn 2004). Mass transit for commuting in most American cities is largely used by low-income people who are unable to afford a car.

Research has shown the link between access to transportation and job opportunities. Blumenberg & Ong (2001) demonstrate that job opportunities for welfare recipients in Los Angeles strongly depend on residential location and cite unpredictable work arrival times and the lack of access to informal job networks as major reasons. Sanchez (2002) in his cross-sectional study of 158 metropolitan statistical areas (MSA) finds that higher public transportation provision is correlated with lower income inequality. On the theory side, Glaeser et al. (2008) demonstrate how a simple monocentric city model with two transport modes and different opportunity costs of time can generate endogenous sorting of the poor into the central city where public transport is available.

Policy recommendations from these empirical studies are ambiguous. Blumenberg & Ong (2001) conclude that although improvement of existing transit infrastructure and the creation of new fixed-route lines in inaccessible neighborhoods would significantly increase employment access, subsidizing car use for the poor would likely have larger effects. They are joined by Glaeser & Kahn (2004) who argue that automobiles do not need large additional infrastructure investments and recommend subsidizing cars to allow a car-based lifestyle for the poor. Sanchez (2002) strengthens this argument by stating that a large increase in transit supply would be needed to lessen income inequality.

Nevertheless, the US has seen a rebound of public transport and many cities have built modern light rail systems, including car-based cities like Phoenix (2008), Charlotte (2007), Houston (2004), and Dallas (1996). A stated purpose of many of these recent transit projects is to connect suburban job growth areas that were previously only accessible by car. Besides an environmental concern about reducing the emissions of greenhouse gases from car trips, these investments are also targeted to allow low-income households to commute to work. Given that subsidizing cars is difficult to carry out politically, the provision of fast public transport might be a second-best tool to alleviate spatial mismatch and to increase job accessibility of the poor.
Despite the vast literature on the spatial mismatch hypothesis, economic research on the effect of the recent light rail extensions on job accessibility of the poor is lacking. Most studies on the economic effects of light rail systems have focused on property values and have documented that house prices increase with better access to transit stations (e.g. Pan 2013, Pagliara and Papa 2011). Notable exceptions are Glaeser et al. (2008), Fan et al. (2012), and Liu (2014). Fan et al. (2012) study the effect of the construction of the Hiawatha light rail line in Minneapolis/St. Paul and calculate the number of jobs reachable by a 30-minute public transport commute before and after construction. They find that the new line increases access to both low-wage and high-wage jobs. Liu (2014) documents a similar positive effect on job accessibility along new light rail lines in Phoenix which is more pronounced for lower income groups. Both these studies use an accessibility measure that is simply based on survey-based job listings and theoretical travel times, but the question whether the new transport possibilities are actually taken up by the poor is outside their focus. Glaeser et al. (2008) use variation in the extent of rail transit provision and show that increased proximity to transit lines is associated with higher poverty rates at the census tract. However, they do not investigate which mechanism could cause this result. It might be very much the case that improvements in rail infrastructure increase job opportunities of the poor and that people with low income move to these areas to benefit from the closeness to public transport, thus causing the positive correlation between poverty and transit access.

This study proposes a research plan that can fill a gap in the empirical literature on the effect of public transport improvements on the job accessibility of the poor by using census data supported by individual-level geocoded panel data of the Panel of Social Income Dynamics (PSID) dataset to study the effect of light rail access in the city of Dallas. The PSID dataset allows geographical identification of the subjects to their census tract and provides a multitude of potential outcome variables to measure the impact of light rail access on job accessibility, such as employment status, income, and commuting times. It also allows me to study the potentially heterogeneous effects for different groups such as women or racial minorities. Using panel data will help to abstract from city-specific factors and can give clearer insight on the social return on the large transport investments American cities have made. The creation of light rail networks in many metropolitan areas over the last two decades provides an ideal framework to study the impact of mass transit because contrary to the expansion of bus lines, the construction of light rails provides a large change in the whole public transport infrastructure.
2 Background Dallas Light Rail

I choose the Dallas-Fort Worth metropolitan area for the analysis of the impact of light rail access for several reasons. First of all, due to its large size with around 7 million residents, the metropolitan area provides a mass of data. The vast Dallas-Fort Worth metroplex is highly fragmented into different municipalities and no less than 13 counties. Figure 1 shows the built-up area with its many suburbs and edge cities as well as the light rail stations. Secondly, the dual core structure of the MSA provides helpful counterfactuals. Since the light rail system was implemented to connect only Dallas and its surrounding suburbs, Fort Worth serves as an ideal control group which helps to abstract from metropolitan-level idiosyncratic shocks. In addition, the light rail was built in several steps with different lines at different times providing useful variation. Lastly, Dallas is pretty much void of any natural features. It is therefore close to the “featureless plane” of many models in economic geography.

Figure 1: Dallas-Fort Worth Metropolitan Area and Light Rail Stations

The Dallas Area Rapid Transit (DART) system opened its first two light rail branches in 1996 and was subsequently expanded to four lines. The light rail system is built in radial lines towards Downtown Dallas where all lines connect and it does not feature tangential routes between the four branches. To encourage commuters to switch to the light rail, suburban stations feature a large amount of parking spaces for transfer riders. The initial layout of the
system consisted of two routes connecting the southern suburbs with the central business district which were later extended to reach the northern suburbs. In 2009 and 2012, two more lines opened which connected the suburbs in the west and the east. Many stations, especially in the more central areas, are shared by more than one line and all the routes use the same downtown corridor, offering multiple transfer opportunities.

The urban poverty structure of the Dallas-Fort Worth metropolitan area is clearly visible from Figure 2. High-poverty areas are centered around the CBDs of both Dallas and Fort Worth and to a lesser extent around the edge cities such as Burleson and Denton. A regression approach confirms the strong clustering of the poor around the city center. I regress census tract poverty rates in 2000 on the distance to the nearest CBD and find a clear negative relationship (Table 2). The results indicate that poverty rates decline by approximately 0.28% (Dallas) and 0.21% (Forth Worth) percentage points for each mile further away from
Table 2: Regression Results

<table>
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<tr>
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<th>(1)</th>
<th>(2)</th>
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<tbody>
<tr>
<td>Distance to CBD</td>
<td>-0.210***</td>
<td>-0.281***</td>
</tr>
<tr>
<td></td>
<td>(-5.20)</td>
<td>(-8.86)</td>
</tr>
<tr>
<td>Constant</td>
<td>12.51***</td>
<td>14.29***</td>
</tr>
<tr>
<td></td>
<td>(16.04)</td>
<td>(22.71)</td>
</tr>
<tr>
<td>N</td>
<td>373</td>
<td>678</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.07</td>
<td>0.10</td>
</tr>
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</table>

$t$ statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

the city center. While Dallas exhibits slightly higher central city poverty and shows a steeper decline as distance increases, the poverty structure of both cities is very similar and has the same patterns that were documented for many American cities (Glaeser and Kahn 2004).

The racial make-up of Dallas is diverse and the city features large groups of ethnic minorities of blacks (25% of the population) and hispanics (42.4%) who live especially in the southern suburbs. In contrast, most employment growth has been observed in the richer northern suburbs which are predominantly white (Kain 1992). This made many urban researchers believe that Dallas experiences a high level of spatial mismatch (Stoll 2005).

3 Methodology

The decennial censuses of 1990, 2000, and 2010 provide a variety of data at the census-tract level that can be used to measure the effect of the light rail on neighborhoods. I plan to regress census-tract poverty level changes on changes of the distance to the nearest light rail station. I measure distance with an indicator variable that is equal to one if there is a light rail station within a one mile radius around the census tract’s centroid. I interact this variable with the length of operation of the particular stop. The ten-year intervals of the censuses and the gradual expansion of the light rail network provide variation to estimate how long it takes for poverty levels to react once access to the light rail is available. The regression equation is given by
\[ \text{Poverty}_{it} = \alpha + \beta_1 \text{LightRailPresence}_{it} + \beta_2 \text{LightRailPresence}_{it} \times \text{MonthsInOperation}_{it} + \beta_3 \text{CBD dist}_{it} + \gamma \text{controls}_{it} + \epsilon_{it} \]

where \( \text{Poverty}_{it} \) is the poverty rate of census tract \( i \) in period \( t \) where \( t \in (1990, 2000, 2010) \). I control for census tract characteristics such as racial makeup and distance to the central business district. In another specification, I plan to interact the effect of light rail presence with the CBD distance. If urban poverty is indeed caused by the lack of public transportation to reverse commute, then the effect should be higher in neighborhoods closer to the center. In yet another approach to construct counterfactuals, I can match Dallas census tracts to census tracts of neighboring Fort Worth according to characteristics such as racial composition, distance to downtown, and pre-existing job density.

This specification is prone to many endogeneity issues. At first, the routes of the light rail and the timing of their opening are clearly not randomly assigned, but resulted from a long process of transportation planning. This will create a problem for the estimation if neighborhoods that were assumed to benefit especially well from light rail access were explicitly targeted to receive access. Since most of the DART system runs on pre-existing rail tracks, the exact routing of the light rail is to a large degree predetermined. However, the endogenous choice of which existing rail tracks were to be converted into light rail and the exact location of the stations along the tracks might still be a concern. Secondly, migration between census tracts can bias the estimates if poor people who would benefit from light rail access move to connected neighborhoods to profit from this access, thus initially driving up the poverty rate of census tracts close to light rail stations.

**Alternative Approach: Individual-Level Data (PSID)** The PSID provides geocoded individual-level data that can, after obtaining approval, be tracked to the census-tract and census-block level. This data can solve some of the endogeneity issues as it is possible to track people and their locations over time to check for endogenous sorting. The dataset also allows a more thorough analysis of the effect on different groups, such as single-parent households and ethnic minorities. The major drawback of this dataset is the small sample size. Even in a large metropolis like the Dallas-Fort Worth MSA, there might be just a handful of observations limiting the ability to estimate the effect of the light rail.
4 References


